United States Environmental Protection Agency | Office of Water Washington, DC 20460 | September 2015

EPA

Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category: EPA's Response to Public Comments

Part 5 of 10

7. Industry Operations

Commenter Name: Cari Boyce
Commenter Affiliation: Duke Energy
Document Control Number: EPA-HQ-OW-2009-0819-4305-A3
Comment Excerpt Number: 63
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

EPA assumed that the Roxboro Generating Station could reduce the FGD flow rate from 1,000 gpm to 375 gpm by operating the FGD scrubber at 30,000 ppm chloride, as opposed to the maximum chloride design limit of 12,000 ppm. Roxboro FGD scrubbers are made of Stebbin's tile and alloy 2205. EPA assumed Roxboro could increase their chloride limit based on an outdated published chloride limit of 30,000 ppm for alloy 2205. In the early 2000's, the industry believed alloy 2205 could be resistant up to 20,000 or 30,000 ppm chlorides; in practice, however, alloy 2205 has not been able to withstand these elevated chloride levels. The industry has witnessed severe corrosion on alloy 2205 at chloride levels above 10,000 ppm[15]. Duke Energy, therefore, operates most of their scrubbers at levels below 10,000 ppm.

---

[15] Corrosion in Wet Flue Gas Desulfurization (FGD) Systems: Technical Root Cause Analysis of Internal Corrosion on Wet FGD
Alloy Absorbers, EPRI, April 30, 2012

Comment Response:

EPA has revised the maximum operating chloride concentration for Duke Energy's Roxboro Generating Station to 10,000 ppm for compliance cost estimates associated with the ELGs. As a result, EPA's calculation for flow minimization achievable at the Roxboro Generating Station associated with the final ELGs is based on this revised maximum operating chloride concentration. See the *Incremental Costs and Pollutant Removals for the Final Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category* Report (DCN SE05831/SE05832 for plant-specific compliance cost estimates and pollutant loadings estimated for the final ELG.

Commenter Name: Cari Boyce
Commenter Affiliation: Duke Energy
Document Control Number: EPA-HQ-OW-2009-0819-4305-A3
Comment Excerpt Number: 77

External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Duke Energy contends that EPA used the incorrect flow rate for Roxboro and Mayo Generating Stations. For Roxboro, EPA used a flow rate of 19.25 MGD, which was listed in the water balance diagram. EPA's analysis, however, did not account for the use of cooling tower blowdown and condenser cooling water within this flow rate. The analysis should have used the bottom ash sluice water flow rates reported for each generating unit in Table C-19 from the ICR, which are shown below:

Table 2-10. Roxboro Bottom Ash Transport Water Flow Rate

Steam Electric Generating Unit	Bottom Ash Transport Water Flow Rate (GPD)
SE Unit-1	408,000
SE Unit-2	306,000
SE Unit-3	630,000
SE Unit-4	900,000
Total	2,244,000

By utilizing the correct flow rate and the EPA reported average effluent concentration from bottom ash impoundments, the analysis would have shown a pollutant removal of approximately 20,075,873 lbs/yr (16,858 TWPE), as compared to the reported pollutant removal of 97,500,000 lbs/yr (143,000 TWPE) for Roxboro under Regulatory Options 4a, 4 and 5. This is equates to a reduction of over 88% TWPE for this facility.

For the Mayo Steam Plant, a flow rate of 2,649,863 gallons per day was used for the pollutant removal analysis. This, however, is the flow rate reported for fly ash sluice water in Pond 1 Block Flow Diagram in response to questions D3-1. The correct flow rate for bottom ash sluice water was listed in the Pond 1 Block Flow Diagram, which is 1.8 MGD. By utilizing the correct flow rate and the EPA reported average effluent concentration from bottom ash impoundments, the analysis would have shown a pollutant removal of approximately 7,157,174 lbs/yr (6,010 TWPE), as compared to the reported pollutant removal of 13,400,000 lbs/yr (19,600 TWPE) for Mayo under Regulatory Options 4a, 4 and 5. This is equates to a reduction of over 69% TWPE for this facility.

Comment Response:

EPA identified that the five generating units operating at the Roxboro and Mayo Generating Stations converted their wet fly ash and bottom ash sluicing systems to dry fly ash and bottom ash handling systems (see DCN SE05069). Therefore, EPA did not estimate pollutant loadings or compliance costs associated with these generating units because they are already in compliance.

Commenter Name: Lisa C. Messinger
Commenter Affiliation: Vectren Corporation
Document Control Number: EPA-HQ-OW-2009-0819-4317-A1
Comment Excerpt Number: 11
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

The format of the questions within Section C of the 2010 ICR did not allow for facilities that recycle water through ponds to properly characterize and differentiate between discharge into a pond and discharge from the facility. Specifically question C3-5 states "Is any of the wet bottom ash sluice water immediately recycled (e.g. without trcatment such as a pond) back to the plant process?" Because of the qualifier "without treatment such as a pond", the answer had to be "no", and therefore we were precluded from answering the follow-up comment section that asks th e respondent to describe how the bottom ash sluice is reused. Howevcr, the operational reality is that sluice water, by design, goes to a pond. Question A2- 10 of the ICR asked about the percent contribution of each waste stream to th e outfall yet doesn 't appear to correlate the answers between the two sections.

In the financial analysis described in the Incremental Costs Document, EPA chose to use the bottom ash sluice water flow rate in the calculations of cost per TWPE removed, which is incorrect. Ignoring the fact that some facilities recycle and reuse the ash pond water within other plant syst ems leads to a gross overstatement of the actual amount of pollutants leaving the facility. For our A.B. Brown plant the ash pond water is continually recirculated and used as the sluice water so the flow rate is only representative of the influent to the pond, and not the effluent leaving the plant. Further, because the water is recirculated, the flow rate does not equate to a new cumulative volume of water added to the pond or discharged to the Ohio River so it is incorrect to use the flow rate in the pollutant loading calculations.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4379-A1, Excerpt Number 134 for more information on EPA's calculation of ash transport water discharge flow rates.

For the final rule, EPA reevaluated data from the 2009 Steam Electric Survey and used the influent flow into the ash pond from Part D Section 3.2 and the flow discharge information provided in Part A Section 5 (Water Balance Diagram) to determine the fly ash and bottom ash normalized flow discharged to surface water and recycled back into the system. Therefore, based on EPA's reevaluation of the 2009 Steam Electric Survey responses and Vectren's comments, EPA revised the bottom ash sluice flow rate to account for the transport water recycled back to the system. For the final rule analysis, EPA included costs for a full bottom ash handling conversion for the A.B. Brown plant. See the *Incremental Costs and Pollutant Removals for the Final Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category* Report (DCN SE05831/SE05832 for additional discussion.

Commenter Name: Lisa C. Messinger
Commenter Affiliation: Vectren Corporation
Document Control Number: EPA-HQ-OW-2009-0819-4317-A1
Comment Excerpt Number: 14
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

In addition, Section C o f the 2010 ICR repeated the same line of questioning as described above in the Bottom Ash comments. Question C2-4 states "Is any of the wet fly ash sluice water immediately recycled (e.g. without treatment such as a pond) back to the plant process?" Again, because of the qualifier "without treatment such as a pond ", the answer had to be "no" since the water goes to the pond for settling. We did provide a response to the follow up question stating the water is reused for sluicing, but it is unclear if this information was considered in the pollutant loading calculations since the prompt after the "No" answer says to Skip to Question C2-5. Also, just as we described for the bottom ash, the flow rate is only an indication of the flow **INTO** the pond, and not discharge from the pond.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4317-A1, Excerpt Number 11.

Commenter Name: Lisa C. Messinger
Commenter Affiliation: Vectren Corporation
Document Control Number: EPA-HQ-OW-2009-0819-4317-A1
Comment Excerpt Number: 15
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Under the preferred options, which require the dry handling fly ash in all facilities, we could be forced to construct a landfill that may operate only10 weeks per year to handle de minimis amounts of ash which can not be recycled due to kiln outages, conveyor maintenance, or river transportation issues. The newly installed chemical precipitation tank system may become obsolete if no amount of fly ash transport water can leave the site, even if it goes through a treatment system.

For our facilities which already have dry handling systems installed, the move to 100% dry handling would be excessively costly for the small incremental increase in pollutant removal. In the "Plant -Specific Costs and Pollutant Removals estimates by Wastestream and Regulatory Option" (DCN SE03995.A2) EPA inaccurately assumed that since the facility already has a dry fly ash system installed, "there are no estimated compliance costs for this plant associated with fly ash transport water." The system at A.B. Brown has a conveyor system that leads to an off site temporary barge storage silo, for direct loading onto a barge. Currently there is no ability to off-load dry fly ash at the plant or even into a truck at the off-site facility. The only back-up option for the dry fly ash is to wet sluice to the pond. The costs associated with building a new landfill or making operational changes to the design of the current dry fly ash system were not considered by EPA in our Plant Specific Costs estimates. Also, due to the timing of the 2010 ICR information request, the dry fly ash system had only operated 1 full month, so the listed O&M costs of $0 is completely inaccurate to use as the on-going O&M costs associated with the dry fly ash system. In addition, it is not realistic or operationally ideal to operate a landfill for only a few weeks per year. If forced to build a landfill due to our loss of the ability to use a wet sluice for back-up, one outcome may be to abandon the recycling and operate the landfill full time. That is obviously not preferred nor is it the most beneficial option for the environment, but under the circumstances may be more operationally practical than operating a landfill for intermittent, short term intervals.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4317-A1, Excerpt Number 11.

Based on the information received in the public comments, EPA revised the cost estimate for the A.B. Brown plant. For the final rule, EPA estimated the costs for the plant to install backup silo and pugmill capacity and disposal costs for the A.B. Brown plant for the amount of fly ash currently handled by the wet ash handling system. These disposal costs account for transporting the ash to disposal in a landfill. Additionally, EPA estimated the pollutant loadings/removals associated with the amount of fly ash transport water that is currently discharged at the plant.

Commenter Name: Tom DeLawrence
Commenter Affiliation: PowerSouth Energy Cooperative
Document Control Number: EPA-HQ-OW-2009-0819-4460-A1
Comment Excerpt Number: 56
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

PowerSouth performed an engineering evaluation of potential dry bottom ash handling options. Dry bottom ash hoppers were determined to be an infeasible option due to lack of space and boiler configuration; therefore, all potential bottom ash handling technologies evaluated were remotely located away from the bottom of the boiler. PowerSouth has preliminarily estimated in 2012 dollars that the cost to install one of the remote dry bottom ash handling technologies at the Lowman Plant ranges from $24 to $31 million, with an annual increase in operational and maintenance costs of more than $0.25 million.

Comment Response:

Based on the information received in public comments, EPA estimated compliance costs for this plant to install a remote MDS bottom ash handling system to meet the zero discharge requirement for the ELG. EPA determined that the final rule is technologically available and economically achievable. See Preamble Section VIII.

EPA's has estimated the costs for the ELG under several scenarios: (1) taking into account the effects of the Clean Power Plan and the CCR rule, in addition to site-specific conditions at plants and the operating company's plants for retirements/conversions; (2) taking into account the CCR rule (but not the CPP), as well as the site-specific conditions at plants and the operating company's plants for retirements/conversions; and (3) taking into account the site-specific conditions at plants and the operating company's plants for retirements/conversions, but assuming that the CCR rule and the CPP will not affect the plant in any way. The paragraph above describes how EPA estimated costs for the plant under Scenario 3. For Scenario 2 (as well as Scenario 1), EPA's modeling conducted for the CCR rule projects that the plant will convert to a dry ash handling system prior to the plant having to take steps to implement the ELG. Thus, for Scenarios 1 and 2, this plant is estimated to incur no ELG compliance costs for ash handling.

Commenter Name: Bruce W. Ramme
Commenter Affiliation: We Energies
Document Control Number: EPA-HQ-OW-2009-0819-4475-A1
Comment Excerpt Number: 18
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

EPA should correct We Energies plant-specific compliance cost and pollutant removal estimates. Various inaccuracies and inconsistencies were found when reviewing We Energies specific input data and compliance cost and pollutant removal estimates. This information was provided to us via separate correspondence on August 7, 2013. Specifically, FGD wastewater pollutant removals were overestimated for Oak Creek Power Plant and Pleasant Prairie Power Plant. Inconsistent methodologies were used to estimate plant-specific removals of bottom ash transport water at Presque Isle Power Plant and Valley Power Plant. Bottom ash transport water pollutant removals were overestimated for Pleasant Prairie Power Plant. Landfill leachate flow rates were inaccurate. EPA should correct the plant-specific compliance cost and pollutant removal estimates for We Energies facilities based on the information presented in this comment letter.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4475-A1, Excerpt Number 41 for EPA's response on the FGD flow for Oak Creek Power Plant.

See response to DCN EPA-HQ-OW-2009-0819-4475-A1, Excerpt Number 43 and Excerpt Number 59 for EPA's responses on the FGD and bottom ash flows for Pleasant Prairie Power Plant.

See response to DCN EPA-HQ-OW-2009-0819-4475-A1, Excerpt Number 57 for EPA's response on bottom ash flows at Presque Isle Power Plant and Valley Power Plant.

See response to DCN EPA-HQ-OW-2009-0819-4475-A1, Excerpt Number 67 for EPA's response on leachate flows.

Commenter Name: Bruce W. Ramme
Commenter Affiliation: We Energies
Document Control Number: EPA-HQ-OW-2009-0819-4475-A1
Comment Excerpt Number: 43
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

According to EPA's document *Incremental Costs and Pollutant Removals for the Proposed Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category* (IC&PR), EPA used an FGD wastewater flow rate normalized for 24 hours per day (hpd) and 365 days per year (dpy) operation in a number of its calculations.[16] Yet, the input table provided by EPA for Pleasant Prairie Power Plant provides a "Normalized FGD Wastewater Flow over 24 hrs" of 40 gpm. Information provided by We Energies in ICR Table D-3 shows the PPPP WWTS Influent flows in 2009 as 57 gpm, 12 hpd, 199 dpy. ICR Table D-4 provides the Wastewater Treatment System Effluent flows in 2009 as 40 gpm, 17 hpd, 199 dpy. Normalizing the effluent flow rate over 24 hours per day, 365 days per year results in a normalized flow rate of 15.45 gpm (40 gpm x 60min/hr x 17 hpd = 40,800 gpd; 40,800 gpd x 199 dpy = 8,119,200 gpy; 8,119,200 gpy/365 dpy = 22,244 gpd; 22,244 gpd/(24 hpd x 60 min/hr) = 15.45 gpm). We Energies believes 15.45 gpm provides a more realistic normalized flow rate (assuming the WWTS operates 24 hpd, 365 dpy) for the pollutant loading calculations from the Pleasant Prairie Power Plant. Table 4 below details EPA's estimates using 40 gpm and what the correct estimates should be using EPA's calculation methodology and the correct normalized flow rate of 15.45 gpm.

Table 4: PPPP FGD Wastewater Pollutant Removals

Wastestream	Technology	EPA's estimates, using incorrect normalized flow rate of 40 gpm		We Energies estimates, using correct normalized flow rate of 15.45 gpm and EPA's calculation methodology	
		Pollutant Removal (lb/yr)	Pollutant Removal (TWPE/yr)	Pollutant Removal (lb/yr)	Pollutant Removal (TWPE/yr)
FGD	CP + BIO	1,650,000	1,130	637,000	436
FGD	CP + VCE	3,750,000	1,510	1,446,000	582

[16] *Incremental Costs and Pollutant Removals for the Proposed Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category* (IC&PR), EPA-HQ-OW-2009-0819-2256 at 6-7.

Comment Response:

Based on the information provided in the comment from We Energies, EPA has updated the FGD wastewater flow in gallons per day used to estimate compliance costs and pollutant loadings for Pleasant Prairie Power Plant. As described in Section 4.1.1 of the Costs and Loads Report (DCN DCN SE05831/SE05832), EPA used the FGD scrubber purge rate reported in Part B Section 5 (FGD Wastewater Generation) as the basis for the FGD wastewater flow rate. In keeping with this methodology, the FGD wastewater water flow for Pleasant Prairie Power Plant has been corrected to 22,375 gallons per day (57 gpm x 60 min per hr x 12 hr per day x 199 day per year / (365 day per year), which equates to a normalized flow rate of 15.54 gpm.

Commenter Name: Bruce W. Ramme
Commenter Affiliation: We Energies
Document Control Number: EPA-HQ-OW-2009-0819-4475-A1
Comment Excerpt Number: 41
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Overestimated Oak Creek Power Plant FGD Wastewater Pollutant Removals Associated with Installing Biological Treatment or Vapor- Compression Evaporation Technologies.

A chemical precipitation wastewater treatment system is currently installed and operated to treat combined FGD wastewater from Oak Creek Power Plant ("Oak Creek" or "OCPP") and Elm Road Generating Station ("Elm Road" or "ERGS"). The input table provided by EPA had an inaccurate flow rate, which led to an overestimation of pollutant removals if biological treatment or vapor-compression evaporation technologies were installed after the chemical precipitation WWTS. The normalized FGD wastewater flow rate over 24 hours should be 240 gpm (this is the design 24-hour Daily Average of the WWTS, which includes receiving the blowdown from Oak Creek Units 5-8 and Elm Road Units 1 and 2. This information was provided in Table D-4 of the ICR.). It appears EPA mistakenly used a flow rate of 480 gpm by summing the design flow rates for the FGD Treatment System (24-Hour Daily Average) from Table B-2 in the ICR. By doubling the flow rate, the pollutant removal estimates were also doubled. Table 3 below details EPA's estimates using 480 gpm and what the correct estimates should be using EPA's calculation methodology and the correct flow rate of 240 gpm.

Table 3: OCPP FGD Wastewater Pollutant Removals

Wastestream	Technology	EPA's estimates, using incorrect flow rate of 480 gpm		We Energies estimates, using correct flow rate of 240 gpm and EPA's calculation methodology	
		Pollutant Removal (lb/yr)	Pollutant Removal (TWPE/yr)	Pollutant Removal (lb/yr)	Pollutant Removal (TWPE/yr)
FGD	CP + BIO	19,800,000	13,600	9,900,000	6,800
FGD	CP + VCE	45,000,000	18,200	22,500,000	9,100

Comment Response:

EPA agrees with We Energies. The flow rate used to estimate compliance costs and pollutant loadings at proposal did sum the values reported in Table B-2 of the Steam Electric Survey for Oak Creek Power Plant for both FGD systems. EPA has updated the FGD wastewater flow rate for Oak Creek Power Plant based on the information provided to 240 gallons per minute.

Commenter Name: Bruce W. Ramme
Commenter Affiliation: We Energies
Document Control Number: EPA-HQ-OW-2009-0819-4475-A1
Comment Excerpt Number: 57
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

EPA used inconsistent methodologies at We Energies facilities to estimate the plant-specific pollutant removals associated with transitioning from treating bottom ash transport water in impoundments to dry handling or closed loop.

First of all, pollutant removal estimates at Valley Power Plant ("VAPP") were calculated by multiplying the bottom ash transport water discharge flow rate of the *on-site chemical precipitation wastewater treatment plant* by the average effluent pollutant concentrations commonly found in *impoundment effluent*. Bottom ash transport water is not treated in an impoundment at Valley Power Plant; chemical precipitation technology is used. EPA is not accurately characterizing (and likely overestimating) the pollutant removals associated with converting to a closed loop system by incorrectly calculating the baseline pollutants discharged through a mix/match handling of the data.

This is in contrast to the pollutant removal estimates calculated for Presque Isle Power Plant ("PIPP"). Presque Isle Power Plant operates a recirculating bottom ash transport water system where a majority of the bottom ash transport water is reused for transporting, but a portion of the water is sent to the onsite clarifier-based wastewater treatment system to prevent the buildup of dissolved solids. The site is also permitted to send bottom ash transport water, on an emergency basis, to an emergency pond. It appears EPA did not calculate pollutant removals associated with converting from chemical precipitation technology to closed loop (which is justified since EPA only provided pollutant concentrations in impoundment effluent, not in chemical precipitation effluent). However, EPA did estimate the pollutants removed by eliminating the use of the emergency pond. As another matter of confusion, the 2009 Bottom Ash Transport Water *influent* flow rates to the emergency pond were used to calculate the pollutant removal estimates even though the pond has not discharged in years. Thus, it is not a true estimate of pollutant loading reduction.

Further, EPA should revise its bottom ash transport water pollutant removal estimates for We Energies Presque Isle Power Plant associated with discontinuing the use of the emergency pond. As specified on ICR Table D-4, the pond did not discharge in 2009 (and has not discharged in years).

Comment Response:

EPA acknowledges the additional operating data provided in the comment and acknowledges that the average effluent pollutant concentrations used to characterize discharges of ash transport water is based on effluent from ash ponds (impoundments). EPA does not have data available for pollutant concentrations in discharges from systems such as described by the commenter, nor did any commenters provide data for such systems. EPA notes that the commenter has not provided data from the two plants mentioned in the comment which are the commenter's own plants. Therefore, EPA used the data it has for surface impoundments to estimate removals for such systems.

Few plants treat their ash transport water using technologies other than surface impoundments, and for these few, EPA does not have data to demonstrate the resulting effluent is different than surface impoundment effluent. Even if EPA had such data, EPA's approach is reasonable for purposes of estimating national loadings estimates because these few plants represent a small portion of the total transport water discharge, and using different pollutant concentrations to represent their wastewater discharge would not substantially affect EPA's estimated pollutant removals for the industry. See the response to DCN EPA-HQ-OW-2009-0819-4475-A1, Excerpt Number 58.

EPA agrees that the majority of bottom ash transport water at Presque Isle Power Plant is sent to dewatering bins and the overflow is either recycled or sent to the onsite wastewater treatment system before discharging to surface water. The information provided by the plant in the 2009 Steam Electric Survey Part A Section 2.2 (Outfall Information) indicates the amount of bottom ash overflow that is discharged from the onsite clarifier-based wastewater treatment plant to surface water in 2009. EPA used this corrected normalized discharge flow to calculate pollutant loadings for the final rule.

EPA agrees that the bottom ash transport flow provided in Part D Section 3.2 (Pond Influent and Effluent Flow Data) indicates that the plant sends bottom ash transport water to the emergency pond, but does not discharge from said pond in 2009. This flow is not included for calculating pollutant removal estimates for the final rule.

Commenter Name: Bruce W. Ramme
Commenter Affiliation: We Energies
Document Control Number: EPA-HQ-OW-2009-0819-4475-A1
Comment Excerpt Number: 59
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Overestimated Pleasant Prairie Power Plant Bottom Ash Transport Water Pollutant Removals Associated with Installing Dry Handling/Closed Loop Technologies.

EPA used a normalized flow rate of 116,953 gpd for Pleasant Prairie Power Plant bottom ash transport water entering an impoundment unit to calculate the pollutant removal estimates associated with converting to dry handling/closed loop. This normalized flow cannot be re-created based on data provided in the ICR. The normalized flow rate should be 97,567 gpd (116,000 gpd for 307 dpy, as specified on Table D-3 of the ICR). Table 6 below details EPA's overestimated pollutant removal estimates using 116,953 gpd and what the correct estimates should be using EPA's calculation methodology and the correct normalized flow rate of 97,567 gpd.

Table 6: PPPP Bottom Ash Transport Water Pollutant Removal Estimates

Wastestream	Technology	EPA's estimates, using incorrect normalized flow rate of 116,953 gpm		We Energies estimates, using correct normalized flow rate of 97,567 gpm and EPA's calculation methodology	
		Pollutant Removal (lb/yr)	Pollutant Removal (TWPE/yr)	Pollutant Removal (lb/yr)	Pollutant Removal (TWPE/yr)
Bottom Ash	Closed Loop System (Bottom Ash Management Cost)	593,000	866	495,634	724
Bottom Ash	Closed Loop System (Bottom Ash Management Cost) (Except for units with a capacity of 400 MW or less)	593,000	866	495,634	724

We Energies asks EPA to correct its plant-specific analysis of compliance costs and pollutant removals, which impacts the industry-wide analysis, based on the information provided in this comment letter.

Comment Response:

EPA agrees with We Energies' comment that the normalized bottom ash flow used for pollutant removal calculations should be 97,567 gpd. EPA confirmed this flow with Part D Section 3.2 of the Steam Electric Questionnaire (2010 ICR) and used this value in pollutant loadings calculations for the final rule.

Commenter Name: Bruce W. Ramme
Commenter Affiliation: We Energies
Document Control Number: EPA-HQ-OW-2009-0819-4475-A1
Comment Excerpt Number: 67
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Table 7 below details EPA's overestimated landfill leachate flow rate estimates, derived using Equation 4-10, and the actual landfill leachate flow rates generated at each site.

Table 7: Landfill Leachate Flow Rates for PPPP and PIPP

Power Plant	EPA's estimated landfill leachate flow rate, using Equation 4-10 (gpd)	We Energies actual landfill leachate flow rate, as reported on ICR Table D-3 and Water Balance Diagrams (gpd)	Comments
Pleasant Prairie Power Plant	79,000	26,500	
Presque Isle Power Plant	24,000	12,500	Leachate comes from two landfills onsite: PIPP Landfill #3 (active landfill) and PIPP Landfill #2 (inactive landfill). No leachate is generated by PIPP Landfill #1 (inactive landfill).

Based on the information provided in this comment letter, We Energies asks EPA to correct its plant-specific inputs for landfill leachate for PPPP and PIPP as they impact the plant-specific compliance costs and pollutant removal estimates.

Comment Response:

EPA has updated the combustion residual landfill leachate flow rates for Pleasant Prairie Power Plant and Presque Isle Power Plant to reflect the values provided by We Energies. Compliance cost estimates and pollutant loadings for combustion residual landfill leachate for are calculated based on 26,500 gallons per day for Pleasant Prairie Power Plant and 12,500 gallons per day for Presque Isle Power Plant.

Commenter Name: Bruce W. Ramme
Commenter Affiliation: We Energies
Document Control Number: EPA-HQ-OW-2009-0819-4475-A1
Comment Excerpt Number: 68
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

EPA Should Correct We Energies Plant-Specific Compliance Cost and Pollutant Removal Estimates.

As previously discussed in the sections II – IV, we found a number of inaccuracies and inconsistencies with plant-specific compliance cost and pollutant removal estimates for our owned/operated facilities. A summary of these errors are as follows:

- Overestimation of OCPP and PPPP FGD wastewater pollutant removals associated with installing biological treatment or vapor-compression evaporation technologies due to mischaracterization of normalized flow rates.

- Inaccurate assumption that no pollutants would be removed and no technologies would need to be installed for FGD Wastewater under Option 3b at OCPP.

- Inconsistent methodologies used to estimate plant-specific pollutant removals of bottom ash transport water at PIPP and VAPP.

    - Sites discharging bottom ash transport water after chemical precipitation were not given "credit" for this treatment.
    - Pollutant removal estimates for impoundments were calculated based on the impoundment influent flow rate, even though the emergency pond has not discharged in years.

- Overestimation of PPPP Bottom Ash Transport Water pollutant removals associated with installing "dry handling/closed loop technologies" due to mischaracterization of normalized flow rates.

- Overestimated landfill leachate flow rate for PIPP and PPPP used for compliance cost and pollutant removal estimates instead of actual landfill leachate flow rates.

EPA should correct the plant-specific compliance cost and pollutant removal estimates for We Energies facilities based on the information presented in this comment letter.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4475-A1, Excerpt Number 41 for EPA's response on the FGD flow for Oak Creek Power Plant.

See response to DCN EPA-HQ-OW-2009-0819-4475-A1, Excerpt Number 43 and Excerpt Number 59 for EPA's responses on the FGD and bottom ash flows for Pleasant Prairie Power Plant.

See response to DCN EPA-HQ-OW-2009-0819-4475-A1, Excerpt Number 57 for EPA's response on bottom ash flows at Presque Isle Power Plant and Valley Power Plant.

See response to DCN EPA-HQ-OW-2009-0819-4475-A1, Excerpt Number 67 for EPA's response on leachate flows.

Commenter Name: Bruce W. Ramme
Commenter Affiliation: We Energies
Document Control Number: EPA-HQ-OW-2009-0819-4475-A1
Comment Excerpt Number: 87
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Various inaccuracies and inconsistencies were found when reviewing We Energies specific input data and compliance cost and pollutant removal estimates (e.g., overestimated FGD wastewater pollutant removal estimates associated with installing biological treatment or vapor-compression evaporation technologies due to the mischaracterization of normalized flow rates, inconsistent methodologies to estimate plant-specific pollutant removals of bottom ash transport water, and overestimated landfill leachate flow rates); therefore, these errors should be corrected.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4475-A1, Excerpt Number 68.

Commenter Name: Joseph G. Eutizi
Commenter Affiliation: San Miguel Electric Cooperative, Inc.
Document Control Number: EPA-HQ-OW-2009-0819-4485-A1
Comment Excerpt Number: 1
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Production facilities include one (1) lignite-fired power plant and one (1) lignite mine in South Central Texas. This lignite-fired power plant has a net capacity of 391 Megawatts and is a base load unit. The generating unit fires only low-rank virgin coal provided by the lignite mine. This one lignite-fired unit comprises 100% of SMEC's generating capacity and average yearly output is 2.9 million megawatt hours. The San Miguel Generating Station was commissioned on January 1, 1982 and is a Zero Liquid Discharge facility. The unit was built with and has operated a dry Fly Ash system, a closed loop Wet Bottom Ash system, a Wet Flue Gas Desulfurization system and a cold side Electrostatic Precipitator.

Comment Response:

Based on the public comments and reevaluation of the 2009 Steam Electric Survey data, EPA confirmed the zero discharge bottom ash system and does not estimate any bottom ash compliance costs for the San Miguel Generating Station.

Commenter Name: Kim Mireles
Commenter Affiliation: Luminant
Document Control Number: EPA-HQ-OW-2009-0819-4614-A1
Comment Excerpt Number: 8
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Although severalluminant facilities currently have authorized Outfalls for FGD or Bottom Ash Transport wastewater, these Outfalls have not discharged in over twenty years and most have never discharged. luminant's ability to forego the use of these outfalls has been based on intensive site-specific water management practices developed and used by luminant to achieve and maintain a negative water balance through reuse and/or recycling at these generating plants. Water reuse and/or recycling is aided by plant design features, the Texas climate and the use of low-chloride coals, such as lignite and/or Powder River Basin (PRB).

Comment Response:

EPA reviewed all nine generating plants surveyed in the 2009 Steam Electric Survey and confirmed from Luminant's survey responses that all are zero discharge plants. Therefore, for the final rule, EPA did not include any costs or estimate any pollutant removals associated with these plants.

8. FGD Wastewater

Commenter Name: David Y. Chung
Commenter Affiliation: Homer City Generation, L.P
Document Control Number: EPA-HQ-OW-2009-0819-5552-A2
Comment Excerpt Number: 5
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

B. EPA's Cost Effectiveness Analysis Is Flawed

Homer City agrees with UWAG's comments regarding how EPA's cost-effectiveness analysis significantly underestimates the costs per TWPE for FGD wastewater. According to EPA, the cost per TWPE for the proposed FGD wastewater options ranges from $60 to $69, in 1981 dollars. *See* EPA-HQ-OW-2009-0819-2255 (cost-effectiveness analysis). UWAG, by contrast, estimates the cost per TWPE as ranging from nearly $1,000 to several thousands of dollars, in 1981 dollars. UWAG's comments account for this staggering disparity by explaining various errors in EPA's cost-effectiveness analysis. In particular, EPA conducted a combined cost effectiveness analysis for chemical precipitation and biological treatment systems when it should have analyzed the costs and benefits of those systems separately. EPA also erroneously counted TWPEs for several pollutants (boron, magnesium, manganese, and cyanide) even though the Agency's own data reflect that such pollutants are not actually removed. These and other errors have led EPA to grossly underestimate cost per TWPE.

UWAG's analysis shows that even a low-end estimate of the cost per TWPE is much higher than EPA has ever approved in any other BAT rulemaking.[2] This suggests that none of EPA's proposed technology options for FGD wastewater is cost-effective. Before EPA proceeds with its rulemaking, it should address the concerns set forth by UWAG and recalculate the industry-wide cost estimates in light of those concerns.

---

[2] As the preamble to the proposed rule explains, EPA's "review of approximately 25 of the most recently promulgated or revised BAT limitations reflects BAT cost-effectiveness figures ranging from less than $1/lb-eq (Inorganic Chemicals) to $404/lb-eq (Electrical and Electronic Components), in 1981 dollars. 78 Fed. Reg. at 34,504. Notably, in 2003, EPA determined that a technology with a cost of $1000/lb-eq was not BAT in its Metal Products and Machinery rulemaking, observing that this figure was "substantially higher" than what EPA typically imposed for BAT technology in prior rulemakings, *i.e.*, less than $200/lb-eq. *See* 68 Fed. Reg. 26,686, 25,701-02 (May 13, 2003). Similarly, in discussing its cost-effectiveness analysis for this proposed rule, EPA observed that controlling leachate using chemical precipitation would exceed $1,000 per TWPE removed and that EPA was not including that among its preferred options. 78 Fed. Reg. at 34,474 n.38.

Comment Response:

EPA disagrees with the commenter. See response to DCN EPA-HQ-OW-2009-0819-4379-A1, Excerpt Number 149, DCN EPA-HQ-OW-2009-0819-4447-A1, Excerpt Number 13, and DCN EPA-HQ-OW-2009-0819-4446-A1, Excerpt Number 8.

Regarding underestimating costs for the biological treatment system, see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 30.

Regarding revisions to the pollutant loadings estimates, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 95.

Regarding the cost effectiveness of incremental biological treatment, see response to DCN EPA-HQ-OW-2009-0819-4460-A1, Excerpt Number 42.

For the role of cost-effectiveness in EPA's decisions for the final rule, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 27 in Comment Code 6.h.

Commenter Name: Elizabeth E. Aldridge, Hunton & Williams
Commenter Affiliation: UWAG
Document Control Number: EPA-HQ-OW-2009-0819-4655
Comment Excerpt Number: 105
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

G. UWAG's Cost-Effectiveness Analysis for a Model Plant Approach

UWAG used a flow-based model plant approach for calculation of $/TWPE for FGD wastewater treatment options. The maximum design flow rates used to estimate costs for each model plant ranged from 25 to 950 gpm. Annual TWPE removals are based on average design flow rates. The tables below show the UWAG calculations of the $/TWPE for three different types of FGD wastewater treatment:

- chemical precipitation,
- incremental biological treatment (*i.e.*, the pollutant loadings and costs associated only with adding on biological treatment to an existing chemical precipitation system), and
- incremental thermal ZLD with softening (*i.e.*, the pollutant loadings and costs associated with adding a ZLD system to an existing chemical precipitation system).

The following is a summary of our basic assumptions for estimating annualized 1981$/TWPE removed.

1. UWAG's capital and O&M costs are based on EPRI cost models for each type of treatment system. EPRI based its capital costs on the maximum design flow rate and its annual O&M costs on the average design flow rate.

EPRI has done three recent studies of costs of treating FGD wastewater. The three EPRI reports are:

- Cost Estimating Summary for Physical/Chemical Treatment of Flue Gas Desulfurization Wastewater,
- Cost Estimating Summary for Biological Treatment of Flue Gas Desulfurization Wastewater, and
- Cost Estimating Summary for Zero Liquid Discharge Treatment of Flue Gas Desulfurization Wastewater.

See EPRI's reports (submitted as a part of EPRI's comments on the rule) for more details about the EPRI cost studies and their results.

2. Capital costs for chemical precipitation treatment are based on 2 x 100% redundancy, just as EPA assumed.[38] UWAG used 2 x 100% due to lack of industry experience in operating FGD wastewater treatment systems. Capital costs for the incremental biological treatment are based on the GE ABMet process island cost curve. Capital costs for the incremental thermal ZLD system is based on 2 x 100% redundancy.

3. Annualized capital costs are based on a 15-year service life at 7% interest. EPA uses a 20-year service life at 7% interest. In previous rulemakings, EPA has used a 15-year service life for equipment. *See, e.g.*, Final Landfills Development Document, p. 9-9 (capital costs amortized using a 7% interest rate over 15 years); MP&M Development Document, p. 11-19 (Agency assumed a 7% discount rate over an estimated 15-year equipment life). UWAG finds a 15-year service life appropriate in this case because of the corrosive nature of FGD wastewater.

4. UWAG used data from 12 plants to calculate average FGD "settled" influent concentrations for the baseline. Those 12 plants include the seven plants sampled during the EPA sampling program (Allen, Belews Creek, Dickerson, Keystone, Miami Fort, Hatfield's Ferry, and Pleasant Prairie) plus Roxboro, and four plants sampled during the EPA Detailed Study (Big Bend, Homer City, Widows Creek, and Mitchell). UWAG used EPA's own data for the seven plants from the EPA Sampling Program and UWAG's split sample data from the EPA Detailed Study (Attachment 17 to these comments). UWAG calculated "settled" influent concentrations using EPA's methodology as documented in an ERG memorandum dated October 9, 2009. The only difference between what EPA used and what UWAG used is the four additional influent samples at the plants sampled during the Detailed Study.

5. UWAG – just like EPA – used EPA data from three of the seven sampling program plants (Miami Fort, Keystone, and Hatfield's Ferry) to calculate median chemical precipitation effluent concentrations during the EPA sampling events.

6. UWAG – just like EPA – used EPA data from two plants (Belews Creek and Allen) for the bioreactor effluent.

7. UWAG used all EPA analytes for the EPA sampling program to calculate percent reductions. However, UWAG also eliminated all analytes with less than 20% removal when calculating annual TWPE removals.

8. UWAG converted 2010 dollars to 1981 dollars by multiplying by 0.402. UWAG obtained this conversion factor from the Construction Cost Index, which is widely used by the construction industry.

9. UWAG did not adjust the flow rates of the five plants that EPA considered to have "high" FGD wastewater flows. EPA adjusted the FGD wastewater flows of these plants claiming the plants can reduce their flows at little cost. IC&PR, p. 4-14. However, EPA's analysis accounts only for chloride levels, and fails to consider other factors such as the build-up of fine solids within the system. EPRI concludes that it is unclear whether the five facilities EPA selected for minimization can employ recycling at their facilities without evaluating the build-up of fine solids and determining additional costs of making scrubber and other equipment modifications. *See* EPRI Comments on ELG Rule.

For chemical precipitation, the resulting $/TWPE range from $235 to $2,117 in 1981 dollars. For plants with maximum design flow rates ≤ 200 gpm, the $/TWPE is well over EPA's high-end cost per TWPE of $404/TWPE in 1981 dollars. Chemical precipitation is the most commonly applied technology among the options, and yet UWAG finds it is not cost effective for many power plants discharging FGD wastewater. The other technologies are even farther removed from cost effectiveness. UWAG's model plant costs per TWPE are summarized in the following table:

Technology Option	Range of $/TWPE
Incremental Chemical Precipitation	$235 – $2,117
Incremental Biological	$1,124 - $10,884
Incremental ZLD system	$1,238 - $6,533

Except for plants with maximum design flow rates >200 gpm, none of EPA's technology options pass the cost-effectiveness test after we apply proper TWPE removals and proper cost models. Even within the >200 gpm threshold level, there may be some plants that can demonstrate that chemical precipitation at their site is not cost-effective or, for site-specific reasons, chemical precipitation is either technically or economically unavailable. Therefore, EPA should reconsider its entire analysis and approach to FGD wastewater regulation.

Cost Effectiveness of Incremental Chemical Precipitation Treatment – $/TWPE[39]

Flow Range	Peak/Max Design Flow, gpm	Annual Capital + O&M Cost $2010	Annual Capital + O&M Cost $1981	TWPE Removed	$/TWPE $2010	$/TWPE $1981
<50	25	$2,335,927	$939,043	444	$5,266	$2,117
50-99	75	$2,700,027	$1,085,411	1,331	$2,029	$816
100-199	150	$3,243,607	$1,303,930	2,661	$1,219	$490
200-299	250	$4,000,669	$1,608,269	4,436	$902	$363
300-399	350	$4,776,970	$1,920,342	6,210	$769	$309
400-499	450	$5,572,511	$2,240,149	7,984	$698	$281
500-599	550	$6,387,291	$2,567,691	9,758	$655	$263
600-699	650	$7,221,312	$2,902,967	11,533	$626	$252
700-799	750	$8,074,573	$3,245,978	13,307	$607	$244
800-899	850	$8,947,073	$3,596,723	15,081	$593	$238
900-999	950	$9,838,813	$3,955,203	16,855	$584	$235

Annual capital and O&M costs are based on the EPRI model for chemical precipitation treatment of FGD wastewater. Capital costs are based on peak/maximum design flow rate. O&M costs and TWPE removals are based on average flow rate. Average flow rate is ½ the peak design flow rate.

Cost Effectiveness of Incremental Biological Treatment – $/TWPE[40]

Flow Range	Peak/Max Design Flow, gpm	Annual Capital + O&M Cost $2010	Annual Capital + O&M Cost $1981	TWPE Removed	$/TWPE $2010	$/TWPE $1981
<50	25	$1,155,087	$464,345	43	$27,074	$10,884
50-99	75	$1,476,450	$593,533	128	$11,536	$4,637
100-199	150	$2,013,225	$809,317	256	$7,865	$3,162
200-299	250	$2,439,484	$ 980,673	427	$5,718	$2,299
300-399	350	$2,809,014	$1,129,224	597	$4,703	$1,891
400-499	450	$3,142,862	$1,263,431	768	$4,093	$1,645

Flow Range	Peak/Max Design Flow, gpm	Annual Capital + O&M Cost $2010	Annual Capital + O&M Cost $1981	TWPE Removed	$/TWPE $2010	$/TWPE $1981
500-599	550	$3,451,662	$1,387,568	939	$3,677	$1,478
600-699	650	$3,741,657	$1,504,146	1,109	$3,373	$1,356
700-799	750	$4,016,881	$1,614,786	1,280	$3,138	$1,262
800-899	850	$4,280,113	$1,720,605	1,451	$2,951	$1,186
900-999	950	$4,533,364	$1,822,412	1,621	$2,796	$1,124

Annual capital and O&M costs are based on the EPRI model for GE ABMet biological treatment of FGD wastewater. Capital costs are based on peak/maximum design flow rate. O&M costs and TWPE removals are based on average flow rate. Average flow rate is ½ the peak design flow rate.

Cost Effectiveness of Incremental Thermal ZLD – $/TWPE[41]

Flow Range	Peak/Max Design Flow, gpm	Annual Capital + O&M Cost $2010	Annual Capital + O&M Cost $1981	TWPE Removed	$/TWPE $2010	$/TWPE $1981
<50	25	$6,076,623	$2,442,803	374	$16,252	$6,533
50-99	75	$9,506,043	$3,821,429	1,122	$8,475	$3,407
100-199	150	$13,496,261	$5,425,497	2,243	$6,016	$2,418
200-299	250	$17,996,830	$7,234,726	3,739	$4,813	$1,935
300-399	350	$22,031,423	$8,856,632	5,235	$4,209	$1,692
400-499	450	$25,782,766	$10,364,672	6,730	$3,831	$1,540
500-599	550	$29,334,708	$11,792,553	8,226	$3,566	$1,434
600-699	650	$33,969,045	$13,655,556	9,722	$3,494	$1,405
700-799	750	$37,327,467	$15,005,642	11,217	$3,328	$1,338

Flow Range	Peak/Max Design Flow, gpm	Annual Capital + O&M Cost $2010	Annual Capital + O&M Cost $1981	TWPE Removed	$/TWPE $2010	$/TWPE $1981
800-899	850	$40,567,133	$16,307,988	12,713	$3,191	$1,283
900-999	950	$43,741,858	$17,584,227	14,208	$3,079	$1,238

Annual capital and O&M costs are based on the EPRI model for incremental thermal ZLD treatment of FGD wastewater. Capital costs are based on peak/maximum design flow rate. O&M costs and TWPE removals are based on average flow rate. Average flow rate is ½ the peak design flow rate.

---

[38] *E.g.*, EPA costed two 100% capacity wastewater forwarding pumps (IC&PR, p. 6-9), two 100% capacity treated wastewater discharge pumps (IC&PR, p. 6-10), and two 100% capacity sump pumps (IC&PR, p. 6-11).

[39] See Attachment 37.

[40] *Id.*

[41] *Id.*

Comment Response:

Regarding EPRI's comments on EPA's FGD chemical precipitation cost methodology, see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Numbers 24-29 in Comment Code 9.b.

Regarding EPRI's comments on EPA's FGD biological treatment cost methodology, see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Numbers 30-34, 43-44, 46, and 105 in Comment Code 10.b.

Regarding EPRI's comments on EPA's FGD evaporation treatment cost methodology, see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 106 in Comment Code 11.b.

EPA disagrees with the commenter's approach for including a 2 x 100% redundant system for all treatment system components. See response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Numbers 104 in Comment Code 9.b and 106 in Comment Code 11.b.

Regarding the use of a 15-year service life to annualize costs, see response to DCN EPA-HQ-OW-2009-0819-4448-A1, Excerpt Number 12 in Comment Code 6.f.

Regarding the inclusion of the "four additional influent samples at the plants sampled during the Detailed Study," see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 48 in Comment Code 8.d.

Regarding EPA's flow minimization analysis and the reduction of the flow rate for certain "high flow" plants, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 102.

EPA disagrees with the commenter's "[elimination of] all analytes with less than 20% removal when calculating annual TWPE removals." EPA acknowledges that there were errors in EPA's calculation of the pollutant loadings at proposal, but EPA has revised its analyses to address the issues raised by commenters. Additionally, EPA finds no basis for the selection of 20% as an appropriate cutoff. EPA notes that in other comments, the commenter suggests using 30% as a cutoff. See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 95 in Comment Code 10.c.

EPA agrees with the commenter's approach for converting the costs from 2010 dollars to 1981 dollars.

EPA disagrees with the commenters assumption that the "[a]verage flow rate is ½ the peak design flow rate." EPA used its survey data to develop a ratio between the peak design flow rate and the average flow rate sent through the treatment system. EPA then used the median value of the calculated ratios to evaluate the estimate the peak design flow rate for each plant that was used to estimate the costs for the wastewater treatment equipment. From EPA's calculations, the median ratio used by EPA is well below 2.0, which is what the commenter is using based on its assumption. See Section 6.1.5 of the *Incremental Costs and Pollutant Removals for the Final Effluent Limitation Guidelines and Standards for the Steam Electric Generating Point Source Category* report and response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 26 in Comment Code 9.b.

EPA disagrees with the commenter that "none of EPA's technology options pass the cost-effectiveness test after we apply proper TWPE removals and proper cost models." First, the cost-effectiveness of the final rule is within the range of cost-effectiveness values of other ELGs. See preamble section XV. Second, for the role of cost-effectiveness in EPA's decisions for the final rule, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 27 in Comment Code 6.h. Additionally, EPA disagrees with the commenter's analysis evaluating the incremental cost effectiveness for the biological treatment and evaporation systems, see response to DCN EPA-HQ-OW-2009-0819-4305-A3, Excerpt Number 52 in Comment Code 10.c.

Regarding chemical precipitation at plants with maximum design flow rates less than 200 gpm, see response to DCN EPA-HQ-OW-2009-0819-4379-A1, Excerpt Number 89 in Comment Code 9.

Commenter Name: Elizabeth E. Aldridge, Hunton & Williams
Commenter Affiliation: UWAG

Document Control Number: EPA-HQ-OW-2009-0819-4655
Comment Excerpt Number: 102
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

b. EPA's Technical Analysis of Flow Minimization for High Flow Plants is Flawed

In addition to being beyond EPA's statutory authority, the additional limits on flow and metallurgy will be impractical or inordinately expensive at some generating stations. The problems include:

- corrosion due to concentrations in the FGD slurry,
- changes to blowdown/treatment equipment to accommodate lower flows, and
- negative effect of higher-chlorine coal.

For plants with an FGD wastewater flow of 1,000 gpm or greater, EPA did an analysis to determine if design and operating conditions allowed for an FGD recycle system. These plants are assumed to implement an FGD recycle system, if conditions allow, to limit the amount of FGD wastewater treated and discharged. *See* IC&PR Section 4.4.3, pp. 4-13 to 4-14 (nonredacted version).

EPA's FGD High Flow Analysis document is a spreadsheet designated EPA-HQ-OW-2009-0819-1959.06, which was initially posted to the ELG docket but later removed due to the CBI information it contained. The spreadsheet contains data from the 2010 ICR on plants with a normalized FGD flow rate greater than 1,000 gpm. The data include plant name, operating chloride level, design chloride level, and type of coal burned.

EPA used these data to estimate the amount of recycle that could potentially be realized for plants with FGD flows of >1,000 gpm. The spreadsheet also provides estimated costs for all the once-through FGD systems and each technology option. EPA calculates the percentage of the costs for the once-through plants to the total industry costs. The costs are 30% of the total chemical precipitation costs and 20% of the total biological treatment costs.

EPA used the reduced flow rates for five plants (Roxboro, Paradise, Cumberland, Widows Creek, and Milton R. Young) to reduce the total industry costs. Roxboro is currently operated by Duke Energy; Paradise, Cumberland, and Widows Creek by TVA. Both companies believe they cannot reduce the flow rates to EPA's revised flows. Duke says the reduced flow, based on 80% of the maximum chloride level, would limit its ability to switch fuels. TVA says it is impossible to recycle their FGD wastewater from its dedicated settling pond back into the scrubber due to the scrubber manufacturer's operational specifications (for maximum solids, for example). Milton R. Young reuses FGD wastewater in the FGD process; therefore, this analysis does not apply to that facility.

EPA is correct that all affected plants will look for ways to reduce the volume of FGD wastewater to be treated. However, EPA's estimates are flawed.

EPA's methodology for selecting plants and estimating the cost of recycling water/reducing flow is a screening approach to select units for further examination. As with most screening estimates, it is highly dependent on factoring, and therefore its accuracy probably is plus-or-minus 100%. Operators cannot make investment decisions based on this very rough level of estimate.

EPA's estimates of costs include purchasing and delivery of pumps, pipes, filters, and tanks but not, apparently, necessary infrastructure. Some infrastructure costs might be embedded in some of EPA's factors, but we cannot find that EPA accounted for instrumentation, controls, valves, foundations and subsurface works, electric supply, pipe supports and hangers, access platforms, or support steel. Oddly, EPA goes to some effort to get estimates of freight costs for the "purchased equipment" but pays little attention to these other more significant components of cost.

EPA's piping estimate does not reflect the high quality specifications that power plant piping must meet. EPA references a "frppiping.com" website, but we could not locate that site on the Internet. However, it appears that EPA used pricing for fabricated plastic pipe of the quality used for municipal water; this type of piping does not provide the quality of joints and supports that is necessary in power plant applications.

EPA's estimated pipe lengths are too short, because EPA used two-dimensional satellite images and simple assumptions regarding how piping would be routed from source to destination. It appears EPA made no allowances for what will obviously be greater-than-estimated quantities of pipe.

EPA's method of estimating a plant's ability to recycle water recovered from the scrubber purge does not take into account whether the scrubber can use water of this quality. Any scrubber, it is true, should be able to use recycled water for preparing limestone slurry. Beyond that use, however, a plant's ability to reuse water is limited. Most plants introduce their make-up water (make-up for water losses due to evaporation and gypsum slurry) to the scrubber vessel through washing of mist eliminators, inlet wet-dry interfaces, and similar sources. Water used for these washing applications must be clean enough not to plug the wash spray nozzles with suspended solids and not to form deposits from the dissolved solids. Tightening the water balance and increasing the cycles on the water usage increases the difficulty in finding uses for the recycled water. EPA asked questions about the quality requirements for different scrubber water uses in the ICR survey but apparently did not use this information in its estimates.

In short, EPA's analysis of the potential for FGD flow minimization is very flawed and does not support EPA's conclusions about the feasibility and costs of FGD flow minimization.

Comment Response:

EPA's flow minimization methodology is an estimation of the type of FGD wastewater treatment equipment that these "high flow" plants would install to comply with the final rule. EPA notes that nothing in the final rule requires flow minimization, although EPA anticipates that some plants may use flow minimization procedures as part of their efforts to meet the effluent limitations in the final rule because lowering their discharge flow rate reduces the amount of water that needs to be treated and therefore reduces the cost of the treatment system. The commenter acknowledges that EPA is correct that all affected plants will look for ways to reduce the volume of FGD wastewater to be treated.

EPA used data from the Questionnaire for the Steam Electric Power Generating Effluent Guidelines (Steam Electric Survey) to identify the "high flow" plants (i.e., those plants with a 24-hour plant-level FGD wastewater flow rates equal to or greater than 1,000 gpm) and evaluated each of the "high flow" plants for the potential to recycle a portion of the FGD wastewater back to the FGD system and thereby reduce the flow rate of the FGD wastewater transferred to the treatment system. EPA identified five "high flow" plants with the potential to incorporate recycling into their operations. EPA reviewed the operational characteristics of the FGD systems (i.e., maximum operating chlorides concentration compared to the maximum design chlorides concentration) at these five plants and determined that only three of the five plants would be able to incorporate any recycle of the FGD wastewater.

The three plants that EPA identified with a 24-hour plant-level FGD wastewater flow rate equal to or greater than 1,000 gpm and the ability to recycle were evaluated as part of the FGD flow minimization analysis. Based on the design chlorides concentration and the operating chlorides concentration reported in the Steam Electric Survey, EPA determined that the FGD systems at those three plants could support additional FGD recycle. EPA's methodology for determining the amount of FGD recycle is described further in Section 4.5.4 of the *Incremental Costs and Pollutant Removals for the Final Effluent Limitation Guidelines and Standards for the Steam Electric Generating Point Source Category* report, and is based on cycling up the chlorides to 80% of the maximum design chlorides concentration. The design chlorides concentration used for this evaluation was based on plant-specific responses to question B4-3 in the Steam Electric Survey. Question B4-3 directs plants to indicate the FGD system maximum design chlorides concentration and the FGD equipment that determines this maximum design concentration.

EPA updated the data used to estimate piping costs after considering the commenter's statement that "EPA used pricing for fabricated plastic pipe of the quality used for municipal water; this type of piping does not provide the quality of joints and supports that is necessary in power plant applications." EPA identified a paper by Ashland Performance Materials which specifies costs for materials specific to FGD installations. EPA's final rule uses a cost factor of 10% on top of the pipe distance estimated during proposal to account for bends and turns needed to route piping around existing plant equipment and other obstacles that require additional piping distance longer than a straight line from the pond or equalization tank to the FGD scrubber.

EPA disagrees with the commenter that the costs for recycling the FGD wastewater do not account for "necessary infrastructure." EPA's direct capital cost factor includes costs for site prep, which accounts for the foundation and subsurface work. Additionally, the direct capital cost factor includes the instrumentation and controls, electric supply, pipe supports and hangers, access platforms, or support steel. The *Incremental Costs and Pollutant Removals for the Final Effluent Limitation Guidelines and Standards for the Steam Electric Generating Point Source Category* report contains additional details.

Commenters suggested that EPA excluded an evaluation of increased solids and the potential for additional erosion due to high TSS from its analysis of "high flow" plants. However, EPA's methodology, as detailed in the *Incremental Costs and Pollutant Removals for the Final Effluent Limitation Guidelines and Standards for the Steam Electric Generating Point Source Category* report, assumes that the flow rate exiting the FGD scrubber will remain the same. This FGD wastewater is expected to be sent to either a currently operating dedicated FGD impoundment or a new equalization tank, which is included in the estimated compliance costs. Of the three "high flow" plants identified as being able to implement FGD recycle, all operate dedicated FGD impoundments. EPA judged that these impoundments will continue to operate as dedicated FGD wastewater impoundments and that a portion of the FGD wastewater from the effluent from the impoundment will be piped back to the scrubber where the water can be used as FGD reagent preparation water, mist eliminator wash water, or absorber make-up water. At these three plants, because the recycle stream is taken from the effluent of the settling pond, most of the solids present in the FGD wastewater will have dropped out in the impoundment. As shown by the data in the record, although settling ponds are not effective at removing certain pollutants such as dissolved metal, settling ponds that are well designed and operated can be effective at removing suspended solids at levels comparable to or below what plants would find in their intake water. Therefore, the recycled water would not be a significant source of additional solids for the FGD scrubber, nor would there be any solids accumulation in the scrubber because any solids that are introduced would be removed along with the scrubber blowdown (as currently happens with solids introduced by the plant makeup water).

Regarding the "problems" raised by the commenter related to flow minimization, EPA provides the following responses

- Corrosion will not be an issue because EPA has accounted for a level of recycle that is well below the maximum design chlorides concentration for the scrubber and is below the operational chlorides limit that the plant itself has established.
- The FGD system will not generate a blowdown stream at a lower flow rate, rather, the blowdown from the system will be at the same flow rate, but the partially treated FGD impoundment effluent will be transferred back to the FGD system for additional recirculation. As such, the blowdown equipment operation will not be changed due to reduced flow and the treatment equipment will be designed and built to handle the flow rate of the FGD wastewater transferred from the FGD impoundment to the treatment system.
- The commenter has not provided enough information regarding the "negative effect of higher-chlorine coal." EPA based its estimates for the ability of plants to incorporate water recycling on survey data reported by the plant for its actual characteristics and its own established operating limits, and only incorporated recycle into the cost estimates when the data clearly show that the recycle could be accommodated. The extent to which switching coal affects the chloride levels and wastewater flowrates is already reflected by the survey data for the plant.

For the comments related to the specific plants not being able to recycle at their plants, see the response to the following comments: regarding Duke Energy's Roxboro plant, see response to DCN EPA-HQ-OW-2009-0819-4305-A3 Excerpt Number 64; regarding TVA's Paradise, Cumberland, Widow's Creek, and Kingston plants, see response to DCN EPA-HQ-OW-0819-4607-A1, Excerpt Number 5. EPA notes that the commenter acknowledges that the Milton R. Young plant reuses FGD wastewater in the FGD process, demonstrating that EPA's methodology that includes basing costs on the reuse of FGD wastewater in the scrubber process is valid.

For information regarding once-through FGD systems, see response to DCN EPA-HQ-OW-2009-0819-4607-A1, Excerpt Number 4 in Comment Code 5.b.

Commenter Name: Cari Boyce
Commenter Affiliation: Duke Energy
Document Control Number: EPA-HQ-OW-2009-0819-4305-A3
Comment Excerpt Number: 64
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

In order for Roxboro to reduce the flow rate, EPA only included piping costs to recycle the wastewater. EPA's cost analysis does not include the following cost or risk items for operating an alloy 2205 vessel at 30,000 ppm chloride:

- *Corrosion:* Operating the scrubber at 30,000 ppm chlorides will result in significant corrosion of the alloy 2205 components of the FGD systems, especially in the absorber towers. The following items would be required to address this corrosion potential:
    - Line the alloy 2205 components in the absorber towers with a higher grade material.
    - Replace the alloy 2205 components (such as pipes valve, pumps) outside the absorber towers that are susceptible to high chloride corrosion.
      ◦Welds may also need to be upgraded.
- *Turndown*: The required decrease in FGD flow may not be allowable within the design turndown capability of the equipment. The following items would be required to address this issue:
    - Specific pumps, pipelines, tanks, valves, and hydrocyclone components may need to be replaced with equipment designed for the lower flow
    - Specific systems would change to batch operation versus the currently designed continuous mode, possibly requiring new equipment and higher maintenance.
- *Bioreactor Microorganisms (if applicable)*: Long term bioreactor performance at a chloride level of 30,000 ppm is unknown.
    - Bioreactor testing would be needed to determine the impact from the higher chloride levels.

    - A different type of microorganism may be needed that can handle the higher chloride levels. The impact on pollutant removal rates is unknown.
    - Since the other pollutants in the FGD wastewater would be more concentrated, the impact to the microorganisms would need to be evaluated.
    - All alloy 2205 components in the wastewater treatment system would need to be replaced.
    - Pond liners would need to also be evaluated due to the higher chlorides.
- *Gypsum*: Increasing the chloride concentration in the absorbers will also increase the chlorides in the gypsum slurry that is sent to the gypsum dewatering system. The following items would be required to address the impact of higher chlorides on the gypsum system:
    - Evaluate the dewatering system materials for corrosion potential, including the filter belts.
    - Since there are chloride limits on gypsum sold to third parties, larger washing equipment may be required to rinse out the increased amount of chlorides prior to distribution.
    - Gypsum purity requirements from third parties would need to be evaluated, since the concentration of the other pollutants in the FGD blowdown stream will also increase. Off-specification gypsum would have to be landfilled, rather than reused or recycled, resulting in an increased demand on limited landfill capacity.

In addition, the flow minimization requirement will increase the concentration of other constituents within the FGD wastewater matrix, such as the build-up of fine solids within the system. This flow minimization will result in the need for an even higher dilution ratio when analyzing these samples. The higher dilution ratio, in turn, results in higher analytical MDL/ML limits. The detection limits and minimum levels determined by laboratories could actually be higher than the proposed ELG BAT limits, just due to the necessary dilution ratio required for analyzing FGD wastewater, much less with the additional concentrating factor that the flow minimization requirement brings. This issue is explored further in the section that discusses the challenges with the "sufficiently- sensitive analytical method" provision.

Furthermore, FGD wastewater flow rates, and ultimately discharge mass rates, should be determined by the state agency to meet local water-quality standards and not through a federal standard which does not take into account site-specific criteria. The effects on receiving water bodies are already evaluated during the permitting process using an RPE (Reasonable Potential to Exceed) analysis.

Comment Response:

EPA agrees with the commenter that "EPA's cost analysis does not include the following cost or risk items for operating an alloy 2205 vessel at 30,000 ppm chloride" because EPA did not assume that the Roxboro plant would operate the system to recirculate the chlorides up to 30,000 ppm. For the proposal, EPA assumed that the Roxboro plant would recirculate the FGD wastewater to achieve a chlorides concentration of 16,000 ppm (80% of 20,000). However, EPA received comments stating that "the industry has witnessed severe corrosion on alloy 2205 at chloride levels above 10,000 ppm," Therefore, EPA has revised the maximum operating chloride concentration for Roxboro to 8,000 ppm for cost estimates associated with the final rule.

Based on the revised analysis for the Roxboro plant, the amount of recycle expected to be achieved at the plant is significantly less than it was at proposal. Because the plant is operating at a much lower concentration than the commenter assumed in its comments (i.e., 8,000 vs. 30,000), the issues raised by the commenter including corrosion, turndown, inhibition of bioreactor microorganisms, gypsum quality, and gypsum dewatering equipment corrosion are no longer a concern. Furthermore, EPA's methodology for including recycle at a plant is based on not exceeding any operational limits that the plant has identified. Any such constraints that the plant establishes for operational purposes necessarily take into account the metallurgy of the equipment involved and any other relevant factors, such as the gypsum quality. Since EPA's methodology is such that the plant's operational constraints would not be exceeded, there would be no adverse effect on equipment or gypsum quality. EPA also notes that gypsum that is marketed (e.g., as material for wallboard) is rinsed with fresh water to remove chlorides, thus any additional chlorides due to recycle would also be removed by the gypsum wash water.

EPA does not agree that any increase in chlorides associated with the FGD recycle that EPA considered in its cost methodology would have an adverse effect on the microorganisms in the biological treatment system. See the response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107, in comment code 10.a.

For more information regarding flow minimization, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 102.

Regarding the detection limits for increased dilutions, see response to DCN EPA-HQ-OW-2009-0819-4305-A3, Excerpt Number 67 in Comment Code 32. The data in the record demonstrate that analytical laboratories are able to quantify the pollutants in FGD wastewater at concentrations low enough to demonstrate compliance with the ELGs.

Commenter Name: Paul Chu
Commenter Affiliation: Electric Power Research Institute (EPRI)
Document Control Number: EPA-HQ-OW-2009-0819-4499-A1
Comment Excerpt Number: 28
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

3.1.5 *EPA's evaluation to reduce high wastewater flow rate from plants releasing more than 1,000 gpm is incomplete and does not consider additional costs to modify equipment. EPRI does not use these reduced flow rates to estimate costs for the industry.*

EPRI does not agree with EPA that five plants currently experiencing high wastewater flow rates can reduce these flow rates at little cost. While only a few plants are involved, using EPA's evaluation of flow rate reduction makes a significant difference in total cost to the industry.

EPRI agrees with EPA that flow rate minimization could be employed where possible to reduce wastewater flow rate and save FGD wastewater treatment costs. However, EPA's evaluation to determine whether increased recycling can be employed at a facility is incomplete because it considered only chlorides as a limiting factor for wastewater flow rate minimization in an FGD scrubber. Chlorides are only one aspect of process water management in FGD systems. Insuring equipment reliability by controlling FGD chemistry for solids content and mist eliminator wash water quality will all impact the overall water balance. Control of the FGD solids levels is impacted by fuel sulfur content and the performance of system dewater equipment. The overall water balance in FGD systems tends to be very site-specific, and dependent on the available water at the site as well as overall generating plant water usage.

Based on site visit discussions and data from the industry, EPA determined that plants can operate at up to 80 percent of the maximum design chlorides level without significant corrosion concerns [EPA, 2013]. EPRI understands that EPA considered only the cost of the recycle conveyance piping in determining costs to use recycling at these plants [EPA, 2013]. However, EPA is generally underestimating the cost of flow rate minimization by increased recycling when it does not consider the costs of modifications that may need to be made to facilities' scrubbers and associated equipment and piping. The allowable design chloride levels are currently undergoing significant revision due to the recent experience with the use of alloy 2205. Chloride pitting attack, which had been the basis for previous design criteria, is not the guiding failure mechanism. As a result, the allowable chloride levels are being reduced downward and other operating factors determine optimum operating levels.

Also, EPRI understands that the build-up of fine solids—in addition to chlorides—is another limiting factor for scrubber operation. The amount of fines generated in the FGD system will influence the performance of by-product handling and can adversely impact the overall water balance. For systems operating vacuum belt filters, the fines can blind the filter cloth; therefore it is important to manage the primary hydroclones operation to recycle the fines back to the process. These fines can adversely affect gypsum crystal growth in the recycled slurry and therefore the final gypsum quality of the by-product. For systems that produce disposal gypsum without vacuum belt filters, the fines present issues in primary dewating equipment, such as thickeners, and clarifier; even pond systems can have problems with settling of fines necessitating some removal mechanisms. Many facilities' scrubber operations are not limited by chlorides, but by limits on allowable percent solids in the blowdown stream. EPA does not include fine solids as a criterion in their evaluation. It is unclear whether the five facilities EPA selected for flow rate minimization (Table 3-5) can truly employ recycling at their facilities without evaluating the increase of fine solids and determining the additional costs of making scrubber and other equipment modifications.

The EPRI-recommended method of using ICR-supplied flow rates instead of EPA's reduced flow rates results in a 14 percent increase in total annualized cost for the industry.

Table 3-5
EPA High Flow Rate Plants

Facility	Flow Rate in ICR (gpm)	Reduced with EPA's High Flow Rate Analysis (gpm)
TVA Paradise	3,154	907
TVA Cumberland	3,990	2,188
TVA Widow's Creek	1,810	769
Minnkota Milton R. Young	1,205	631
Roxboro	1,094	375

gpm = gallons per minute

Comment Response:

For information regarding flow minimization, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 102.

For information regarding alloy 2205, see response to DCN EPA-HQ-OW-2009-0819-4305-A3, Excerpt Number 64.

Regarding the "increase of fine solids," EPA notes that neither company operating the systems at which EPA has determined that recycle is available commented that the increased levels of fine would lead to issues related to the operation of the FGD system. Additionally, Commenters have not provided any data to show that physical erosion due to the buildup of fines and other suspended solids will cause the service life of the FGD equipment to be significantly shorter than the 15 year service life that EPA assumed in its methodology. Also, commenters have not provided data demonstrating that fines "adversely affect gypsum crystal growth in the recycled slurry and therefore the final gypsum quality of the by-product." It is also possible that fines could provide nucleation sites for gypsum crystallization in the absorber tank slurry and actually improve the efficiency of gypsum generation. As another commenter noted, the Milton R. Young plant is effectively reusing FGD wastewater in the FGD process, demonstrating that EPA's methodology that, for some plants, includes the reuse of FGD wastewater in the scrubber process is valid. Nonetheless, although it is unlikely that plants would experience any difficulties associated with fines building up in the system, plants could address that situation by periodically adding a small amount of polymer to facilitate removing the fines before the FGD wastewater is recycled back to the scrubber.

Commenter Name: Elizabeth E. Aldridge, Hunton & Williams
Commenter Affiliation: UWAG

Document Control Number: EPA-HQ-OW-2009-0819-4655
Comment Excerpt Number: 104
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

10. EPA Failed to Include Contingency for FGD Wastewater Treatment Construction Costs

EPA mistakenly assumed zero costs for contingency because 90% of the plants reported either zero costs or did not report any costs for contingency in their ICR responses. IC&PR, p. 6-63. EPA assumed that contingency costs for the remaining 10% of plants are site-specific and not representative of the industry. *Id.* The class of cost estimates EPA used to develop costs for FGD wastewater treatment are, at most, screening level estimates for planning. The accuracy range for screening level estimates, which can be on the order of -30 to +70% or more, *includes* the application of contingency. Contingency is an allowance for costs that the facility knows it will need but for which it lacks enough detailed planning or engineering to identify, quantify, or price.

Some project risk factors include quantity variations (design is not complete), material unit price variations, labor productivity variations, labor rates variations, subcontract unit price variations, contractor indirect costs, poor scope definition, and market pressures (escalation, supply shortages, unusual demand, etc.). It is standard practice, based on the Project Management Institute, to include contingency developed for the defined scope of work (class of cost estimates) to cover within scope uncertainties. It is also consistent with EPA's past practice. *See, e.g.*, I&S Development Document, p. 10-4; CWT 2000 Development Document, p. 11-2, MP&M Development Document, p. 11-19. Therefore, EPA should include a contingency of at least 20% of the project direct costs for these unexpected costs.

11. EPA Should Have Used Maximum Design Flow Rate for Costing Out FGD Technologies

A major flaw in EPA's costing methodology arises from its selection of flow rates. EPA used the "typical" amount of FGD scrubber purge reported in Question B5-2 of the ICR to size and cost the pumps that transfer FGD wastewater from the FGD system to the FGD treatment system equalization tank and to size the majority of components in the treatment system. EPA should have used *the maximum design flow rate* reported in Question D5-3 for existing tanked-based systems or typical purge flow in B5-2 times a capacity factor of 2 to estimate maximum design flow rate for sizing and costing these pumps. When constructing a new treatment system, the operator will of course use the maximum design flow rate rather than an average or typical flow rate. Therefore, it is very inappropriate to base construction costs on an average or typical flow rate.

In contrast to EPA's approach, UWAG used the maximum design flow rates where available. For plants that did not report flow rates in D5-3, UWAG developed its capacity factor of 2 by calculating the average of the ratios of maximum design flow rates to typical (or average design) flow rates in D5-3 for 41 plants with existing tanked-based chemical precipitation treatment and three plants with existing biological treatment systems.

Comment Response:

Regarding contingency, see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 25 in Comment Code 9.b, 32 in Comment Code 10.b, and 106 in Comment Code 11.b.

Regarding the use of peak flow for estimating equipment costs, see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 26 and 27 in Comment Code 9.b. Section 6.1.5 (Key Variables Used in the Capital and O&M Cost Methodologies) of the *Incremental Costs and Pollutant Removals for the Final Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category* report (DCN SE05831/SE05832) contains additional information.

Commenter Name: John W. Myers
Commenter Affiliation: Tennessee Valley Authority (TVA)
Document Control Number: EPA-HQ-OW-2009-0819-4607-A1
Comment Excerpt Number: 5
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

b. TVA Believes that EPA has Underestimated Costs to Reduce Flows for Once- Through or High-Flow FGD scrubber systems

EPA's analysis of FGD wastewater treatment costs acknowledges that the FGD system's flow rate is a primary determinant of costs to build and operate wastewater treatment systems (Incremental Costs and Pollutant Removals for Proposed Effluent Limitation Guidelines and Standards for the Steam Electric Generating Point Source Category). This is to be expected considering the size and capacity of required treatment equipment is primarily dependent upon maximum design throughput and required residence time to meet treatment targets.

As previously described, EPA performed a feasibility analysis of potential flow reductions for the high-flow FGD systems. This analysis resulted in assumed FGD flow reductions at 12 plants, three of which are TVA facilities (Cumberland, Paradise, and Widows Creek). Based on the ICR data provided, that would be the extent of the affected TVA facilities; however, in TVA's opinion the Kingston FGD should also be added to EPA's list of potential high-flow FGD scrubber systems. This is due to the fact that the flow data reported in the ICR for Kingston was based on data from initial operations which consisted of only 14 hours of FGD operation in 2009. EPA specifically requested FGD data for calendar year 2009 in the ICR. However, for a typical design coal (i.e., 5 Lbs sulfur/MMBTU), based on TVA engineering estimates the Kingston FGD discharge is approximately 1,120 gallons per minute (gpm).

EPA states on page 34459 column 3 of the Federal Register:

"*Option 1 also incorporates the use of flow minimization for plants with high FGD discharge flow rates (i.e., greater than 1,000 gallons per minute (gpm)) and FGD system metallurgy and operating practices that can accommodate an increase in chlorides (e.g., scrubber systems constructed of non-metallic materials or corrosion-resistant metal alloys, or systems operating with absorber chloride concentrations substantially below the design chloride limit). The flow minimization at these plants would be achieved by either reducing the FGD purge rate or recycling a portion of their FGD wastewater*."

It is not clear if EPA's decision to reduce flows to provide for corresponding reductions in treatment costs takes into account all expenses associated with the recycle operating alternative. As a result, TVA has a number of concerns relative to the assumption of reduced flows due to recycle retrofits at TVA once-through systems. These concerns include the following:

1. While EPA assumes that there would be additional piping costs for recycle of purged wastewater, these costs do not include additional expenses due to the increased corrosion in the FGD system. This is based on TVA's experience with the maximum chloride levels acceptable for certain grades of stainless steel. Specifically, there are differences of opinion relative to EPA's assumptions on acceptable levels in the rule as opposed to those from technical documents available from EPRI as well as TVA's historical operating experience. EPRI-sponsored research indicates that stainless steel grade 316L is resistant to excessive corrosion at approximately 1,000 parts per million (ppm) chlorides (Flue Gas Desulfurization Materials Guidelines Update: Coatings and High Alloys, EPRI, Palo Alto, CA: 2001. 1004026); TVA's operating experience for 316L steel is that it will perform satisfactorily up to about 3,000 ppm. (Personal Communication, FGD Engineering- See Attachments 1,2, and 3) However, this is not consistently the case and TVA has noted that localized pitting can occur at lower concentrations. EPRI also considers grade 2205 stainless steel comparable to grade 317L-LM; or satisfactory up to about 5,000 ppm chlorides. TVA's operating experience, however, indicates that this level is too high; we have observed grade 2205 steel corroding at chloride concentrations of 3000 ppm. Consequently, it is TVA's opinion that EPA generally overestimated the corrosion resistance of the steel alloys it considered, thus underestimating the actual costs to comply with the rule.

2. Another factor that has been excluded from EPA's analysis is the presence of higher solids concentrations because of lower purge rates and the resultant physical erosion in piping due to those increased solids. The combination of higher levels of solids and elevated chlorides are known to be extremely abrasive which will further deteriorate FGD piping and components. It is not clear if potentially increased operating and maintenance (O&M) costs for piping have been considered in EPA's cost analyses.

3. Higher levels of solids are also problematic in maintaining FGD scrubber efficacy. TVA operates its scrubbers in accordance with original equipment manufacturer (OEM) specifications, which include targeted percent solids levels. Increasing concentrations in the FGD absorber due

to reduced blowdown frequency and/or recycle could cause "blinding" of the unreacted limestone reagent. Reagent blinding occurs when elevated concentrations of certain constituents (e.g., aluminum or fluoride) are present in the absorber that exhibits a tendency to coat the limestone. This phenomenon requires that additional reagents be added to ensure the required reactions dominate (i.e., formation of gypsum and corresponding reduction of SO2 gases). Blinding requires that the FGD gypsum purge flow rate be increased in order for the blinding contaminant concentrations to be reduced in the absorber solution.

4. Assuming that it is advisable to recycle treated wastewater for part of the FGD makeup water, this mode of operation introduces additional complications, concerns, and costs. These include:

• The resultant elevated chloride concentrations would remain a problem. If treated FGD water were recycled, the point of reintroduction to the process is unclear. Recycling as makeup water for limestone slurry is a possibility, but only if it is assumed that elevated chloride concentrations were considered in the design metallurgy of the limestone slurry piping. For TVA scrubbers, this is not the case; thus, not only would new piping be needed to allow for wastewater recycle, the existing scrubber piping would need to be replaced to accommodate the higher chlorides.

• A secondary recycle approach is spraying the FGD mist eliminators to prevent solids accumulation. This option is not advisable, however, as chlorides and other dissolved solids constituents could lead to corrosion of these expensive components. Additionally, this reuse could potentially increase acid gas (HCl) emissions from the stack.

• An additional recycle complication is uncertainty about gypsum marketing impacts and the potential for increased costs due to the additional necessity for washing chlorides to maintain gypsum marketability. TVA's Cumberland Fossil Plant has an on-site marketer that manufactures wallboard. The Cumberland gypsum supply contract to the wallboard manufacturer specifies that chlorides in the gypsum slurry cannot exceed 3,000 ppm and must contain between 10%-18% solids. TVA cannot determine from review of the rule and supporting documents if EPA considered the increased costs resulting from washing the byproduct to control chloride concentrations in gypsum. The costs associated with maintaining gypsum quality for wallboard production should be considered by EPA in evaluating the cost of its ELG rule and should not be simply passed on to the wallboard manufacturer.

5. Another area in which EPA appears to have excluded costs in their estimates for the proposed rule is for storage of excess post-treatment FGD wastewaters for recycling purposes. EPA has assumed that existing FGD impoundments may be used for storage; however, costs to retrofit or replace existing ponds to provide for suitable storage of recycle water have not been considered. If recycle were to be employed, treated water storage would likely be required because fresh water would need to be added to the FGD so that chloride limits appropriate for the materials/metallurgy of construction can be maintained. Further, if the CCR rule were to require that ponds be lined, then existing unlined impoundments would have to be retrofitted or replaced. This cost does not appear to have been considered by EPA in this rulemaking and therefore the cumulative cost per toxic-weighted pollutant equivalents (TWPE) appears to have been understated.

TVA has previously evaluated FGD retrofit projects, and it was determined that costs would be prohibitively high to retrofit an FGD system designed and constructed to operate as a once-through system to a recycle FGD system employing corrosion- resistant metallurgy compatible with the high levels of chlorides generated by such a system. Metallurgy retrofit costs have been estimated to be approximately $30 million at one TVA site (Cumberland Fossil Plant). As the existing FGD is effective in scrubbing sulfur dioxide (SO2) from the flue gas, a costly retrofit in itself would do little to improve wastewater quality and might actually add to treatment complexity since the hydraulic retention time would be longer and dissolved and other pollutant concentrations higher.

Comment Response:

For more information regarding flow minimization, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 102.

The commenter stated that their Kingston plant should also be identified as a "high flow" plant because based on their engineering estimates, the FGD discharge is approximately 1,120 gpm (which is equal to or greater than 1,000 gpm). EPA followed up with commenter regarding the FGD wastewater flow rate and the maximum operating and maximum design chlorides concentrations for the Kingston FGD scrubber to confirm the values provided in the EPA's *Questionnaire for the Steam Electric Power Generating Effluent Guidelines* (Steam Electric Survey) and as part of the comments (see DCN SE05859). During the follow up, TVA stated that the typical amount [volume] and duration of FGD purge sent to the dewatering plant/wastewater treatment facility was 950 gpm for 10 hours/day up to 1,200 gpm for 20 hours/day. This equates to 396 gpm up to 1,000 gpm over a 24-hour period. Based on these updated flow rates, EPA does not consider TVA's Kingston plant as a "high flow" plant. EPA used the updated flow rate provided by the commenter in the costs and loadings analysis for the final rule.

According to the Steam Electric Survey, TVA identified equipment constructed of 316L stainless steel as the limiting equipment for both Widow's Creek and Cumberland based on responses to Question B4-3 (design chlorides concentration). TVA's reported maximum design chlorides concentration for Widow's Creek was 3,000 ppm and for Cumberland it was 3,175 ppm. As discussed in the *Incremental Costs and Pollutant Removals for the Final Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category* report (DCN SE05831/SE05832, EPA's methodology assumes that Widow's Creek and Cumberland can cycle up their chlorides to a concentration equal to 80% of maximum design concentration of the current system; therefore, for the proposed rule, EPA had assumed that Widow's Creek would cycle up to a concentration of 2,400 ppm chlorides and Cumberland would cycle up to a concentration of 2,540 ppm chlorides. Because these values are below what the commenter considers its maximum design chlorides concentration, there should not be any corrosion issues with the FGD systems operating at these higher chlorides concentrations. EPA is not requiring the commenter's plants to retrofit or upgrade the existing FGD absorbers in order to achieve a reduction in FGD wastewater flow.

In addition, the commenter states that "TVA's operating experience for 316L steel is that it will perform satisfactorily up to about 3,000 ppm." EPA also reviewed TVA's source "Personal Communication, FGD Engineering- Attachment 1." As stated in both the comment and TVA's source document, the 3,000 ppm for 316L stainless steel seems to be an operating limit rather than a design limit; therefore, EPA concluded that the chlorides concentration at these plants could be cycled up to 3,000 ppm, instead of just 2,400 ppm (i.e., 80% of 3,000 ppm). This is a reasonable conclusion because the comment states that "it will perform satisfactorily up to…" and it would not make sense to include such language if the plant had a lower operational limit. In this case, EPA's methodology is underestimating the amount of recycle that can be achieved by plants with FGD systems constructed of 316L stainless steel, Widow's Creek and Cumberland, because the design concentration should be higher than the operating chloride concentration.

EPA also identified Paradise as a "high flow" plant capable of implementing flow minimization based on the FGD flow rate and the maximum operating and maximum design chlorides concentrations reported in the Steam Electric Survey. TVA identified equipment constructed of 2205 and 317LMN stainless steel as the limiting equipment in response to Question B4-3 of the Steam Electric Survey. Since the publication of the proposed rule, EPA has identified two press releases published by TVA on November 14, 2013 (see DCN SE04999 and DCN SE05016) which indicate that Paradise will be retiring two of its three generating units serviced by the FGD system and Widow's Creek will be retiring one of its two units serviced by their FGD system. In further discussions with TVA, the retirement of these units should occur by 4/16/2015 and will coincide with the startup of a natural gas plant at Paradise. For the final rulemaking, EPA has determined that generating units with a verified retirement before December 31, 2023 would not incur costs to comply with the ELGs because they will be retired before the date they will need to implement the new requirements. Because the two units at Paradise have announced a retirement prior to December 31, 2023, EPA has excluded the wastewater contributions from these units in determining these size of treatment system that the plant would need. As a result, based on the data from the Steam Electric Survey, Paradise would no longer generate a FGD purge flow rate equal to or greater than 1,000 gpm of FGD wastewater and is therefore, no longer categorized as a "high flow" plant. Therefore, EPA did not incorporate FGD recycle into the cost estimate for Paradise for the final rule. Widows Creek, even accounting for the retirement of one of the steam electric generating units, is still expected to generate 1,000 gpm of FGD wastewater and is categorized as a "high flow" plant; thus cost estimates for this plant incorporate FGD recycle.

Of the three plants implementing FGD recycle only TVA's Cumberland plant does not currently operate a dedicated FGD impoundment. EPA's estimated compliance costs for the Cumberland plant include a stirred-equalization tank. Cumberland's FGD system is unique in that their FGD blowdown is transferred to a gypsum-wallboard marketer. The gypsum-wallboard marketer removes the gypsum from the wastewater and then returns the wastewater back to the plant for treatment and disposal. The wastewater from the gypsum manufacturer will have fewer solids than raw FGD purge from the scrubber. EPA's methodology assumes that Cumberland's FGD wastewater, post gypsum manufacturer, will be routed to the stirred equalization tank. From this equalization tank a portion will be recycled back to the FGD scrubber for use as make-up water or other prep water while the remainder will be sent to the FGD treatment system. Because solids have been removed by the gypsum manufacturer EPA expects only a minimal buildup of solids.

Blinding can occur in FGD scrubbers as the amount of limestone in solution is reduced. This situation would require that more limestone be added to the system. Aluminum-fluoride blinding is often related to ash carryover in the scrubber. EPA's flow minimization methodology is not related to ash carryover and, therefore, EPA does not expect blinding to be an issue.

EPA's flow minimization methodology utilizes plant specific FGD system design information to determine the design chloride concentration for an individual plant. Based on data provided in the Steam Electric Survey, EPA's methodology assumes that plants can recycle FGD scrubber purge to reach a chloride concentration equivalent to 80% of the design chloride concentration each plant is currently capable of handling. EPA identified the plant-specific design chloride concentration from responses to question B4-3 of the Steam Electric Survey, which indicates the maximum design chlorides concentration and the equipment which determines this design concentration. No TVA facility, Paradise, Cumberland, or Widow's Creek identifies scrubber piping as the equipment setting a design chloride concentration of the FGD system in response to the survey.

EPA's flow minimization does not specify where or how plants are required to use the recycled FGD scrubber purge wastewater. Although the commenter suggest that plants could use the recycled wastewater as mist eliminator wash water, it is more likely that plants would use this wastewater to prepare FGD reagents or as absorber make-up water. The Milton R. Young plant already operates with some level of FGD scrubber purge recycle and routes FGD scrubber purge to a dedicated impoundment, then using the pond effluent (settled FGD scrubber purge wastewater) as mist eliminator wash water, FGD reagent preparation water, and absorber make-up water. EPA's flow minimization methodology takes this same approach assuming plants will send the current FGD scrubber purge to a dedicated FGD impoundment (or equalization tank) to allow for settling then recycle a portion of this settled wastewater back to the FGD scrubber to be reused.

Regarding the design requirements for the Cumberland Fossil Plant, again EPA's methodology is conservative in that it assumes plants will only recycle FGD scrubber purge up to a chloride concentration equivalent to 80% of the design chloride concentration of the FGD system. In response to the survey Cumberland identified 3,000 ppm (FGD-2) and 3,175 ppm (FGD-1) as the design chloride concentration in question B4-3. Based on these chloride concentrations, EPA's methodology calculates the amount of recycle based on the plant recycling FGD scrubber purge from the current operating chloride concentration up to 2,400 ppm (FGD-2) or 2,540 ppm (FGD-1) based on 80% of the chloride concentration from B4-3. These chloride concentrations are below the 3,000 ppm concentration that is required by Cumberland's gypsum supply contract.

EPA disagrees with the commenter that "costs to retrofit or replace existing ponds to provide for suitable storage of recycle water have not been considered." EPA's flow minimization methodology assumes that plants will recycle untreated FGD wastewater. The FGD scrubber purge would continue to be routed to the existing FGD impoundments, which is consistent with current operations. From the FGD impoundment a portion of wastewater will be recycled back to the FGD scrubber for reuse and the remaining wastewater will be sent on to a tank based treatment system. EPA's methodology does not require plants to reuse or store treated FGD wastewater.

Additionally, EPA is establishing effluent limitations and standards for steam power plant compliance, but plants are not required to install or operate a certain FGD wastewater treatment technology to meet the final ELG's. Therefore, EPA's flow minimization methodology does not require plants to retrofit the FGD system. The methodology as described in the *Incremental Costs and Pollutant Removals for the Final Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category* report (DCN SE05831/SE05832) assumes that plants will continue to operate FGD scrubbers as installed and FGD scrubber purge will continue to be routed to FGD impoundments. Any recycled FGD wastewater is assumed to be routed from the impoundment back to the scrubber; additional pumps and piping to facilitate this have been included in EPA's cost estimate.

Commenter Name: Chris M. Hobson
Commenter Affiliation: Southern Company
Document Control Number: EPA-HQ-OW-2009-0819-4379-A1
Comment Excerpt Number: 71
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Industry Cost-Effectiveness Analysis for a Model Plant Approach

A flow-based model plant approach for calculating cost per TWPE was used by UWAG to evaluate the cost-effectiveness of each FGD wastewater treatment option considered by EPA. Capital and O&M costs are based on Electric Power Research Institute (EPRI) cost models[12] for each treatment system. EPRI based its capital costs on the maximum design flow rate and its annual O&M costs on the average design flow rate. Capital costs for chemical precipitation treatment are based on 2 trains, 100% each (2 x 100%), just as EPA assumed. Capital costs for incremental biological treatments are based on the GE ABMet process island cost curve that GE provided to EPRI. Capital costs for incremental thermal ZLD with softening are based on 2 x 100%. Annualized capital costs are based on a 15-year service life at 7% interest.

To calculate TWPEs, average design flow rates were used along with average concentration data from EPA sampling events. For FGD settled influent concentrations (baseline), twelve plants[13] were used from EPA's Detailed Study and Sampling Program. Just like EPA, EPA data from three plants (Miami Fort, Hatfield's Ferry, and Keystone) were used to calculate average concentrations for chemical precipitation effluent and EPA data from two plants (Belews Creek and Allen) were used for biological treatment effluent. All EPA analytes for the EPA sampling program were used to calculate TWPEs, except for pollutants with less than 20% removals for each treatment system.

The tables below show the cost per TWPE for the incremental treatment technologies compared to the baseline (settling pond effluent).

Table 13: Cost-Effectiveness of Incremental Chemical Precipitation Treatment

Flow Range	Peak/Max Design Flow, gpm	Annual Capital + O&M Cost $2010	Annual Capital + O&M Cost $1981	TWPE Removed	$/TWPE $2010	$/TWPE $1981
<50	25	$2,335,927	$939,043	444	$5,266	$2,117
50-99	75	$2,700,027	$1,085,411	1,331	$2,029	$816
100-199	150	$3,243,607	$1,303,930	2,661	$1,219	$490
200-299	250	$4,000,669	$1,608,269	4,436	$902	$363
300-399	350	$4,776,970	$1,920,342	6,210	$769	$309
400-499	450	$5,572,511	$2,240,149	7,984	$698	$281
500-599	550	$6,387,291	$2,567,691	9,758	$655	$263
600-699	650	$7,221,312	$2,902,967	11,533	$626	$252
700-799	750	$8,074,573	$3,245,978	13,307	$607	$244
800-899	850	$8,947,073	$3,596,723	15,081	$593	$238
900-999	950	$9,838,813	$3,955,203	16,855	$584	$235

Annual capital and O&M costs are based on the EPRI cost model for chemical precipitation. Capital costs are based on peak/maximum design flow rates and TWPE removals and O&M costs are based on average design flow rates.

Table 14: Cost-Effectiveness of Incremental Biological Treatment

Flow Range	Peak/Max Design Flow, gpm	Annual Capital + O&M Cost $2010	Annual Capital + O&M Cost $1981	TWPE Removed	$/TWPE $2010	$/TWPE $1981
<50	25	$1,155,087	$464,345	43	$27,074	$10,884
50-99	75	$1,476,450	$593,533	128	$11,536	$4,637
100-199	150	$2,013,225	$809,317	256	$7,865	$3,162
200-299	250	$2,439,484	$ 980,673	427	$5,718	$2,299
300-399	350	$2,809,014	$1,129,224	597	$4,703	$1,891
400-499	450	$3,142,862	$1,263,431	768	$4,093	$1,645
500-599	550	$3,451,662	$1,387,568	939	$3,677	$1,478
600-699	650	$3,741,657	$1,504,146	1,109	$3,373	$1,356
700-799	750	$4,016,881	$1,614,786	1,280	$3,138	$1,262
800-899	850	$4,280,113	$1,720,605	1,451	$2,951	$1,186
900-999	950	$4,533,364	$1,822,412	1,621	$2,796	$1,124

Annual capital and O&M costs are based on the EPRI cost model for chemical precipitation. Capital costs are based on peak/maximum design flow rates and TWPE removals and O&M costs are based on average design flow rates.

Table 15: Cost-Effectiveness of Incremental ZLD Treatment

Flow Range	Peak/Max Design Flow, gpm	Annual Capital + O&M Cost $2010	Annual Capital + O&M Cost $1981	TWPE Removed	$/TWPE $2010	$/TWPE $1981
<50	25	$6,076,623	$2,442,803	374	$16,252	$6,533
50-99	75	$9,506,043	$3,821,429	1,122	$8,475	$3,407
100-199	150	$13,496,261	$5,425,497	2,243	$6,016	$2,418
200-299	250	$17,996,830	$7,234,726	3,739	$4,813	$1,935
300-399	350	$22,031,423	$8,856,632	5,235	$4,209	$1,692
400-499	450	$25,782,766	$10,364,672	6,730	$3,831	$1,540
500-599	550	$29,334,708	$11,792,553	8,226	$3,566	$1,434
600-699	650	$33,969,045	$13,655,556	9,722	$3,494	$1,405
700-799	750	$37,327,467	$15,005,642	11,217	$3,328	$1,338
800-899	850	$40,567,133	$16,307,988	12,713	$3,191	$1,283
900-999	950	$43,741,858	$17,584,227	14,208	$3,079	$1,238

Annual capital and O&M costs are based on the EPRI cost model for chemical precipitation. Capital costs are based on peak/maximum design flow rates and TWPE removals and O&M costs are based on average design flow rates.

A summary of the costs per TWPE for the each technology option are provided in the following table.

Table 16: Cost Effectiveness of FGD Wastewater Treatment Options for the Model Plant Approach

Technology Option	Maximum Design Flow Rates (gpm)	Range of $/TWPE (1981$)
Incremental Chemical Precipitation	25-950	$235 - $2,117
Incremental Biological	25-950	$1,124 - $10,884
Incremental Thermal ZLD	25-950	$1,238 - $6,533

For chemical precipitation treatment, the resulting cost per TWPE range from $235 to $2,117 in 1981 dollars. Based on Table 16 above, plants with maximum design flow rates of 200 gpm or less, the costs are well above the EPA high-end range of $404 per TWPE, and all plants are above EPA's typical range. Chemical precipitation is the most commonly applied technology among the technology options, and yet (even at the high-end range) it is not cost effective for about a third of the power plants discharging FGD wastewater. The other technologies are even farther removed from cost effectiveness. Based on this model plant approach, EPA should reconsider its entire approach to FGD wastewater regulation.

---

[12] See EPRI's reports (submitted as a part of EPRI's comments on the rule) for more details about the EPRI cost studies and their results.

[13] Average settled influent concentrations are based on data from twelve plants, including EPA data from Allen, Belews Creek, Dickerson, Keystone, Miami Fort, Hatfield's Ferry and Pleasant Prairie. Roxboro self-monitoring settling pond effluent data (taken from EPA's analytical database) was also used. In addition, UWAG data (measured from splits of EPA's samples) for Big Bend, Homer City, Widows Creek, and Mitchell were used to calculate the average concentrations. UWAG calculated settled influent concentrations using EPA's methodology as documented in an ERG memorandum dated October 9, 2009.

Comment Response:

Regarding EPRI's comments on EPA's FGD chemical precipitation cost methodology, see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Numbers 24-29 in Comment Codes 9.b and Excerpt Number 28 in this comment code.

Regarding EPRI's comments on EPA's FGD biological treatment cost methodology, see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Numbers 30-34, 43-44, 46, and 105 in Comment Code 10.b.

Regarding EPRI's comments on EPA's FGD evaporation treatment cost methodology, see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 106 in Comment Code 11.b.

EPA disagrees with the commenter's approach for including a 2 x 100% redundant system for all treatment system components. See response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Numbers 104 in Comment Code 9.b and 106 in Comment Code 11.b.

Regarding the use of a 15-year service life to annualize costs, see response to DCN EPA-HQ-OW-2009-0819-4448-A1, Excerpt Number 12 in Comment Code 6.f.

Regarding the inclusion of the "four additional influent samples at the plants sampled during the Detailed Study," see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 48 in Comment Code 8.d.

Regarding EPA's flow minimization analysis and the reduction of the flow rate for certain "high flow" plants, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 102.

Regarding the elimination of analytes with less than 20% removal when calculating annual TWPE removals, the conversion from 2010 dollars to 1981 dollars, the assumption that the average flow is ½ the peak flow, and the cost effectiveness, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 105.

Regarding chemical precipitation at plants with maximum design flow rates less than 200 gpm, see response to DCN EPA-HQ-OW-2009-0819-4379-A1, Excerpt Number 89 in Comment Code 9.

Regarding cost effectiveness see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 105.

Commenter Name: Tom DeLawrence
Commenter Affiliation: PowerSouth Energy Cooperative
Document Control Number: EPA-HQ-OW-2009-0819-4460-A1
Comment Excerpt Number: 27
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Flue Gas Desulfurization Wastewater.

EPA has proposed a wide array of technological options for regulating flue gas desulfurization ("FGD") wastewaters generated by the industry. Unfortunately, the agency's current administrative record is not sufficient to impose any of them, apart from establishing a best professional judgment ("BPJ") standard – which really isn't a standard at all. Option 1 would impose effluent limitations equivalent to imposing physical/chemical (or chemical precipitation) treatment. Option 3a would establish a BPJ standard and is one of EPA's four "preferred" options for regulating this waste stream. Options 2, 3, 3b, 4, and 4a would require limitations equivalent to a combination of biological treatment technology with physical/chemical treatment, with Options 3, 3b, and 4a comprising the remaining three agency- preferred options. Notably, Option 3b requires limits equal to the combined biological and chemical precipitation technologies only at facilities with a total scrubbed capacity of 2,000 MW or more and would prescribe BPJ for all remaining facilities subject to a final rule. Lastly, Option 5 would not permit any effluent discharges from this FGD waste stream. Instead, the industry would have to implement chemical precipitation treatment in conjunction with vapor compression evaporation technologies (a/k/a "zero liquid discharge" or "ZLD"). PowerSouth opposes each of EPA's proposed regulatory options for this waste stream, as none can be imposed in accordance with the tenets of the BAT standard absent additional justification by the agency. A BPJ standard may be acceptable. However, the agency must provide sufficient guidance to permit writers, should it select this regulatory option.

EPA's evaluation of FGD wastewater and various control technologies is flawed in numerous respects. Foundationally, the data upon which the agency based its proposed regulatory options is insufficient and does not account for the wide array of constituents found— at varying concentrations—in this waste stream within the industry that are affected by the types of coal burned, the types of scrubbers employed, plant operations, and other factors. This necessarily means EPA cannot reasonably justify imposing limits based on any of the proposed technologies on the industry without first gathering additional information that provides a true and accurate representation of the industry as a whole. Separately, after gathering the supplemental data required, should the agency seek to establish standards equivalent to requiring physical/chemical treatment, it must at the very least provide some flexibility to permit writers to approve alternative limits based on the individual circumstances at some facilities. Specifically, EPA should offer an exemption from any such standard to those facilities that can demonstrate that: 1) at their sites, treatment by chemical precipitation is not cost-effective; or 2) chemical precipitation is technically or economically unavailable because of site- or plant-specific factors.

The agency's analysis of biological treatment and zero liquid discharge technologies at BAT are flawed in numerous respects and cannot provide a justifiable basis for imposing either of those technologies as BAT for the industry. Collection of additional data by the agency has little chance to affect that conclusion.

Comment Response:

EPA disagrees with the commenter that proposal "[o]ption 5 would not permit any effluent discharges from this FGD waste stream." See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 108 in Comment Code 11.a.

EPA disagrees with the commenter that of the technology options evaluated for FGD wastewater, "none can be imposed in accordance with the tenets of the BAT standard absent additional justification by the agency." EPA has selected the chemical precipitation followed by biological treatment options as the basis for BAT limitations for FGD wastewater discharges from units that are greater than 50 MW and that are not oil-fired. See preamble section VIII for additional discussion regarding the rationale for EPA's selection of the technology basis.

Regarding requiring BPJ determinations for FGD wastewater, see response to DCN EPA-HQ-OW-2009-0819-4383-A1, Excerpt Number 6 in Comment Code 6.j.i.

Regarding the representativeness of the FGD wastewater used to characterize the effluent from the treatment technologies, see response to DCN EPA-HQ-OW-2009-0819-4655-A2, Excerpt Number 20 in Comment Code 8.c and EPA-HQ-OW-2009-0819-4655, Excerpt Numbers 107 in Comment Code 10.a and 124 in Comment Code 4.b.

EPA disagrees with the commenter that exemptions should be offered to specific steam electric power plants based on site-specific factors. The final rule establishes effluent limitations applicable to FGD wastewater discharges based on chemical precipitation plus biological treatment for units larger than 50 MW and that are not oil-fired. EPA's analyses demonstrate that the final limitations are technologically available and economically achievable. Additionally, although EPA has based the final FGD wastewater effluent limitations and standards on the use of chemical precipitation and biological treatment, the rule does not prescribe a specific type of treatment. Power plants may install and use alternative technologies to achieve the FGD wastewater limitations and standards.

Commenter Name: Tom DeLawrence
Commenter Affiliation: Alabama Power Company
Document Control Number: EPA-HQ-OW-2009-0819-4489-A1
Comment Excerpt Number: 10
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

IV. Flue Gas Desulfurization Wastewater

In three of its four "preferred" options (3, 3b, and 4a), EPA proposes to determine that combining biological treatment technology with chemical precipitation constitutes BAT. Under one option (3b), this technological combination would only be required for facilities with a total scrubbed capacity of 2,000 MWs or more and would prescribe best professional judgment ("BPJ") for all remaining facilities subject to a final rule. The last of its preferred options (3a) would leave the BAT determination for FGD wastewater up to the permit writer's BPJ for all facilities subject to a final rule. Other non-preferred options would require the imposition of effluent limits equivalent to imposing: physical/chemical (or chemical precipitation) treatment (Option 1); a combination of biological treatment technology with physical/chemical treatment (Option 2); and chemical precipitation treatment, coupled with vapor compression evaporation technologies (i.e. "zero liquid discharge" or "ZLD") (Option 5).

Alabama Power opposes each of EPA's proposed regulatory options for this waste stream, as none can be imposed in accordance with the tenets of the BAT standard absent additional justification by the agency. At most, chemical precipitation technology may be considered BAT for this waste stream at certain facilities if the additional data the agency must collect supports the imposition of such a standard. However, even then, a subset of facilities should be exempted from any chemical precipitation BAT determination, including the following:

- Facilities with less than 100 MW of generating capacity;
- Facilities with a maximum design flow rate of 200 gallons per minute or less for FGD wastewater;
- Facilities that can reasonably demonstrate that the implementation of chemical precipitation technology would not be cost-effective for the treatment of FGD wastewater; and
- Facilities that can reasonably demonstrate that the implementation of chemical precipitation technology would not be technically and/or economically achievable at their site.

Alternatively, a BPJ standard may be more appropriate for this waste stream. However, even that standard must be revised to provide sufficient guidance to permit writers. A review of available data and other information shows that neither biological treatment nor ZLD technologies can permissibly be labeled as BAT for the industry as a whole. EPA's assertions to the contrary are based on insufficient and erroneous data.

Comment Response:

Regarding chemical precipitation at plants with maximum design flow rate less than 200 gpm, see response to DCN EPA-HQ-OW-2009-0819-4379-A1, Excerpt Number 89 in Comment Code 9.

Regarding the selection of BAT for FGD wastewater, requiring BPJ determinations for FGD wastewater, and site-specific exemptions, see preamble section VIII and response to DCN EPA-HQ-OW-2009-0819-4460-A1, Excerpt Number 27.

Additionally, EPA disagrees with the commenter that "[f]acilities with less than 100 MW of generating capacity" should be exempted from the FGD wastewater limitations and standards. See preamble section VIII for additional information regarding EPA's analysis of the size thresholds and for information regarding EPA's rationale for the selection of BAT.

EPA disagrees that there should be an exemption in the final rule for "facilities that can reasonably demonstrate" that the final limitations "would not be technically and/or economically achievable at their site." ELGs are nationally applicable, technology-based standards, intended to be applied to categories or subcategories of point sources. The Act directs EPA to establish BAT based on technologies that are available and economically achievable for the industry *as a whole*. *Chem. Mfrs. Ass'n*, 870 F.2d 870 F.d 177, 262 (5th Cir. 1989); *BP Exploration & Oil v. EPA*, 66 F.3d 784, 799-800 (6th Cir. 1996). *See also Nat'l Wildlife Fed'n v. EPA*, 286 F.3d 554, 570 (D.C. Cir. 2002); *CPC Int'l Inc. v. Train*, 540 F.2d 1329, 1341-42 (8th Cir. 1976), *cert. denied,* 430 U.S. 966 (1977). EPA has determined that the final rule meets these criteria (see preamble section VIIII).

Commenter Name: Quinlan J. Shea III
Commenter Affiliation: Edison Electric Institute (EEI)
Document Control Number: EPA-HQ-OW-2009-0819-4487-A1
Comment Excerpt Number: 38
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

EPA's FGD Wastewater Control Technology Cost-Effectiveness Analysis is Flawed and Must be Redone.

Building upon limited and problematic data, as described above, EPA's assessment of the cost-effectiveness of potential control technologies is inherently flawed, and must be redone. Any reliance on the existing analysis would be arbitrary and capricious.

As is its standard practice, EPA has calculated the "cost-effectiveness" of the proposed BAT requirements, including those for FGD wastewaters. 78 Fed. Reg. at 34,503 col. 2. EPA has correctly judged that $404/TWPE in 1981 dollars is about the most a BAT requirement should cost. See 78 Fed. Reg. at 34,504 col. 1-2; see also 68 Fed. Reg. 25,686, 25,701 col. 3, see also 25,702 col. 2 (May 13, 2003) (EPA finding a technology was not BAT when it had a cost of $1000/PE because this was "substantially greater" than what EPA had typically imposed for BAT technology in other industries, generally less than $200/TWPE). But EPA's conclusion that the FGD proposal is within past precedent and range is mistaken. In fact, EPA has underestimated costs and overestimated benefits. The "real" $/TWPE of EPA's proposed FGD wastewater treatment options is significantly higher.

For example, EPA's cost-effectiveness calculations for FGD wastewater control technologies, chemical precipitation and biological treatment, incorporate significant flaws. The flaws include the agency's use of certain pollutants (e.g., boron) for purposes of assessing technology effectiveness, when those pollutants are not actually removed by the proposed technologies. EPA also relied on cyanide data that were affected by various interferences and should not have been used. In another example, EPA failed to follow its own precedent in treatment of pollutant removal efficiencies. EPA should have deleted any pollutant removals that were below 20% effectiveness. This is an especially important step given the issues noted above regarding the sampling.

Addressing these and various other flaws, UWAG and EPRI undertook their own cost-effectiveness analyses for FGD wastewater treatment. UWAG's analysis shows that none of the technology options that EPA has proposed for FGD wastewater treatment is cost effective, except possibly chemical precipitation treatment for plants with a maximum design flow rate of greater than 200 gpm. The table below shows the ranges of cost effectiveness that UWAG calculated for each technology option.

Technology Option	**Range of $/TWPE**
Incremental Chemical Precipitation	$235 – $2,117
Incremental Biological	$1,124 - $10,884
Incremental ZLD system	$1,238 - $6,533

Except for chemical precipitation at plants with maximum design flow rates > 200 gpm, none of EPA's technology options passes the cost-effectiveness test after proper TWPE removals and cost models are applied. Even within the >200 gpm threshold level, there may be some plants that can demonstrate that chemical precipitation at their site is not cost-effective or, for site-specific reasons, chemical precipitation is either technically or economically unavailable. Therefore, EPA should reconsider its entire approach to FGD wastewater regulation.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 105.

Regarding potential analytical interferences encountered with cyanide data, see response to DCN EPA-HQ-OW-2009-0819-4379-A1, Excerpt Number 69 in Comment Code 32.

Regarding artificial removals such as for boron see response to DCN EPA-HQ-OW-0819-4655, Excerpt Number 93 in Comment Code 10.c.

For information regarding chemical precipitation at plants with maximum design flow rates less than 200 gpm, see response to DCN EPA-HQ-OW-2009-0819-4379-A1, Excerpt Number 89 in Comment Code 9.

Commenter Name: Theresa Pugh
Commenter Affiliation: American Public Power Association (APPA)
Document Control Number: EPA-HQ-OW-2009-0819-5140-A2
Comment Excerpt Number: 57
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

EPA's evaluation of FGD wastewater, and the possible technologies available to address FGD wastewater, is not representative enough of the wide variations in coal types, scrubbers, and operational patterns within the industry. Both APPA and UWAG have concluded that incremental biological treatment and incremental thermal ZLD treatment are not cost effective. As to chemical precipitation, UWAG's *preliminary analysis* indicates that it may be cost effective for plants with a maximum design flow rate greater than 200 gpm, but it is not cost effective below that threshold.

Accordingly, UWAG recommends that EPA consider these and other comments on FGD wastewater and then reopen the record to collect more data. But even for the plants with flow rates greater than 200 gpm, APPA recommends that there be an exemption for:

- Plants below 100 MW in generating capacity;
- Plants that can demonstrate that, at their sites, treatment by chemical precipitation is not cost- effective; and
- Plants that can demonstrate that, because of site- or plant-specific factors, chemical precipitation is technically or economically unavailable.

UWAG's comments provide approximately twenty pages detailing EPA estimates for costs and how this ELG proposed rule makes significant departures from other industry ELGs. The UWAG comments include estimates for the FGD technology options for the electric utility sector that include:

Table 6:

EPA Technology Option	$/TWPE (1981)
Chemical precipitation	$311
Incremental biological treatment	$1,346
Incremental ZLD	$1,366

These costs are much higher than EPA's costs for any other industry's ELGs over the last ten years. The following sections describe (1) the flaws in EPA's TWPE analysis, and (2) how UWAG developed its industry-wide estimates.

Comment Response:

Regarding the representativeness of the FGD wastewater data used to characterize the effluent from the treatment technologies, see response to DCN EPA-HQ-OW-2009-0819-4655-A2, Excerpt Number 20 in Comment Code 8.c and EPA-HQ-OW-2009-0819-4655, Excerpt Numbers 107 in Comment Code 10.a and 124 in Comment Code 4.b.

Regarding cost effectiveness, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 105.

Regarding chemical precipitation at plants with maximum design flow rates less than 200 gpm, see response to DCN EPA-HQ-OW-2009-0819-4379-A1, Excerpt Number 89 in Comment Code 9.

Regarding the selection of BAT for FGD wastewater and site-specific exemptions, see response to DCN EPA-HQ-OW-2009-0819-4460-A1, Excerpt Number 27.

Regarding an exemption for plants with less than 100 MW of generating capacity, see response to DCN EPA-HQ-OW-2009-0819-4489-A1, Excerpt Number 10.

Commenter Name: Tom DeLawrence
Commenter Affiliation: Public Service Company of New Hampshire(PSNH)
Document Control Number: EPA-HQ-OW-2009-0819-4633-A1
Comment Excerpt Number: 21
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

EPA's evaluations of biological treatment and zero liquid discharge ("ZLD") technologies are flawed in numerous respects and cannot provide a justifiable basis for imposing either of those technologies as BAT for the industry. EPA's evaluation of biological treatment ignores important factors and does not adequately justify its proposed selection of this technology as BAT. Additionally, EPA's data set with respect to ZLD technologies is patently lacking and cannot provide the foundation upon which the agency may reasonably impose this technology upon the industry. Lastly, PSNH opposes any BPJ option as BAT for this waste stream because doing so would provide no certainty to the industry and has the potential to create an uneven playing field throughout the country based on the political persuasion and/or agendas of the various agencies charged with drafting NPDES permits throughout the country.

Ultimately, EPA's current evaluation of FGD waste water, as well as the possible technologies available to address FGD waste water, are flawed in numerous respects and do not provide an adequate foundation for regulating this waste stream. Therefore, prior to making any determinations, PSNH recommends that EPA re-evaluate the treatment of FGD waste water using a larger dataset that more accurately reflects the FGD influent characteristics of the industry and also perform a defensible cost-benefit analysis of the various treatment technologies. If after EPA collects additional data that ultimately supports the imposition of effluent limits based on chemical precipitation, PSNH believes certain facilities should still be excepted from the BAT determination, including the following:

• Facilities with less than 100 MW of generating capacity;

• Facilities with a maximum design flow rate of 200 gallons per minute or less for FGD wastewater;

• Facilities that can reasonably demonstrate that the implementation of chemical precipitation technology would not be cost-effective for the treatment of FGD wastewater; and

• Facilities that can reasonably demonstrate that the implementation of chemical precipitation technology would not be technically and/or economically achievable at their site.

Comment Response:

Regarding the data used for the evaporation system, see response to DCN EPA-HQ-OW-2009-0819-4631-A1, Excerpt Number 33 in Comment Code 11.c.

Regarding requiring BPJ determinations for FGD wastewater, see response to DCN EPA-HQ-OW-2009-0819-4383-A1, Excerpt Number 6 in Comment Code 6.j.i.

Regarding the representativeness of the FGD wastewater characterization data, see responses to DCN EPA-HQ-OW-2009-0819-4655-A2, Excerpt Number 20 in Comment Code 8.c and EPA-HQ-OW-2009-0819-4655, Excerpt Numbers 85 and 124 in Comment Code 4.b, and 107 in Comment Code 10.a..

Regarding the selection of BAT for FGD wastewater and site-specific exemptions, see response to DCN EPA-HQ-OW-2009-0819-4460-A1, Excerpt Number 27.

Regarding chemical precipitation at plants with maximum design flow rates less than 200 gpm, see response to DCN EPA-HQ-OW-2009-0819-4379-A1, Excerpt Number 89 in Comment Code 9.

Regarding an exemption for plants with less than 100 MW of generating capacity, see response to DCN EPA-HQ-OW-2009-0819-4489-A1, Excerpt Number 10.

Regarding cost effectiveness see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 105.

Commenter Name: Quinlan J. Shea III
Commenter Affiliation: Edison Electric Institute (EEI)
Document Control Number: EPA-HQ-OW-2009-0819-4487-A1
Comment Excerpt Number: 35
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

A. EPA's Proposed Options for FGD Wastewater

Flue gas desulfurization (FGD) wastewater is one of the seven "key wastestreams" for which EPA proposes a limit in the proposed rule. Three out of four of EPA's preferred options for FGD wastewater treatment, options 3, 3b, and 4a, would combine chemical precipitation with biological treatment. Option 3b would phase in this technology for facilities with a total wet scrubbed capacity of 2000 MW or greater, and would allow "best professional judgment" (BPJ) decisions for facilities with lower wet scrubbed capacity. The fourth preferred option 3a would apply BPJ to all FGD wastewater treatment decisions.

The record underlying EPA's proposed FGD limits exemplifies many of the concerns EEI and its members have with the proposed rule as a whole. In particular, as discussed below, the record suffers from insufficient representative data to support the proposed limits, as well as significant flawed assumptions, a lack of transparency, and resulting compounded flaws. These problems with the record have resulted in a proposal that is not cost-effective, except possibly for chemical precipitation treatment at plants with a maximum design flow rate over 200 gpm.

EPA's proposals for FGD wastewater do not meet the rulemaking objectives identified in section II.B above or the requirements of CWA section 304(b) as discussed in section IV.B above. As a result, EEI and its members do not support any of the proposed technologies or limitations based on the record as it stands. Instead, EEI recommends that EPA reopen the record. It is possible that, with additional data, EPA may be able to justify installing chemical precipitation for FGD wastewater at some plants. If so, an exception should be made for plants (a) with maximum design flow rates less than or equal to 200 gpm; (b) plants that can demonstrate that, for their treatment by FGD wastewater, chemical precipitation would not be cost-effective; and (c) plants that can demonstrate that, because of site- or plant-specific treatment features or conditions, chemical precipitation would be either technically or economically unavailable.

Comment Response:

Regarding the meeting the rulemaking objectives presented by the commenter, see response to DCN EPA-HQ-OW-2009-0819-4487-A1, Excerpt Number 10 in Comment Code 27. Regarding meeting the requirements of CWA section 304(b), see response to DCN EPA-HQ-OW-2009-0819-4487-A1, Excerpt Number 34 in Comment Code 2.

Regarding transparency in the record, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 222 in Comment Code 1.c.

Regarding the representativeness of the FGD wastewater characterization data, see responses to DCN EPA-HQ-OW-2009-0819-4655-A2, Excerpt Number 20 in Comment Code 8.c and EPA-HQ-OW-2009-0819-4655, Excerpt Numbers 85, 107, and 124.

Regarding chemical precipitation at plants with maximum design flow rates less than 200 gpm, see response to DCN EPA-HQ-OW-2009-0819-4379-A1, Excerpt Number 89 in Comment Code 9.

Regarding the selection of BAT for FGD wastewater and site-specific exemptions, see response to DCN EPA-HQ-OW-2009-0819-4460-A1, Excerpt Number 27.

Commenter Name: Ron Shipman
Commenter Affiliation: Georgia Power Company
Document Control Number: EPA-HQ-OW-2009-0819-4447-A1
Comment Excerpt Number: 19
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

BAT for Flue Gas Desulfurization Wastewater Should Be Limited To Chemical Precipitation, But Only After Further Industry-Wide Evaluation.

With an industry estimate of $315 per TWPE removed (1981 dollars), Georgia Power recognizes that chemical precipitation is closer to cost effectiveness than other options. However, $315 per TWPE is still well over the $200 per TWPE threshold EPA typically applies in effluent guideline rulemakings. Accordingly, Georgia Power recommends further evaluation of the effectiveness of chemical precipitation across a wider range of facilities that are representative of the industry. Of the other technology options presented, only chemical precipitation deserves further evaluation as BAT for FGD wastewater because (1) EPA's evaluation of FGD wastewater is flawed; (2) biological treatment is not feasible and available for all FGD wastewaters; (3) FGD wastewater treatment with chemical precipitation alone is below the high end of the cost-effectiveness limit of $404ffWPE (1981 dollars); (4) zero liquid discharge (ZLD) technologies (such as vapor compression evaporation) are not fully demonstrated and may create solid waste disposal problems; and (5) BPJ would not provide industry with much certainty.

Comment Response:

Regarding the representativeness of the FGD wastewater characterization data, see responses to DCN EPA-HQ-OW-2009-0819-4655-A2, Excerpt Number 20 in Comment Code 8.c and EPA-HQ-OW-2009-0819-4655, Excerpt Numbers 85, 107, and 124.

Regarding cost effectiveness see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 105.

Regarding the commenter's claim that biological treatment is not feasible or available, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107 in Comment Code 10.a.

Regarding the commenter's claim that the evaporation system is not demonstrated or technologically available, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 108 and 119 in Comment Code 11.a.

Regarding the disposal of the solid waste from evaporation systems, see responses to DCN EPA-HQ-OW-2009-0819-4305-A3, Excerpt Number 45; DCN EPA-HQ-OW-2009-0819-4489-A1, Excerpt Number 18; DCN EPA-HQ-OW-2009-0819-4447-A1, Excerpt Number 26 in Comment Code 11.a; and DCN EPA-HQ-OW-2009-0819-4379-A1, Excerpt Number 75 in Comment Code 11.d.

Regarding requiring BPJ determinations for FGD wastewater, see response to DCN EPA-HQ-OW-2009-0819-4383-A1, Excerpt Number 6 in Comment Code 6.j.i.

Commenter Name: Joe L. Citta
Commenter Affiliation: Nebraska Public Power District (NPPD)
Document Control Number: EPA-HQ-OW-2009-0819-4310-A1
Comment Excerpt Number: 7
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

FGD Wastewater from Existing Units Can Be Effectively Managed Using Chemical Precipitation or in Certain Circumstances, Best Professional Judgment

In the proposed rule, EPA discusses several regulatory options for managing FGD wastewater. This waste steam has grown in recent years as a result of increasingly stringent air emissions control requirements, which have led to much greater use of FGD controls. Surface impoundment s have been the predominant technology used to treat FGD wastewater at power plants. Surface impoundment s are effective at removing solid particles from the waste water, by allowing gravity to settle particles over time. EPA has noted that currently surface impoundments may not appropriately remo ve soluble pollutants that are present. EPA has suggested additional options for regulating such pollutants, including: chemical precipitation, "best professional judgment ," biological treatment, and vapor-compr ession evaporation.

NPPD generally agrees that tank -based chemical precipitation is an appropriate treatment option for facilities operating FGD systems. Industry experience has shown that chemical precipitation of FGD wastewater is cost-effective technology for limiting effluent discharges. However, this treatment should be sufficient, and EPA should not additionally require biological treatment of FGD wastewater. Among other things, NPPD is concerned that biological treatment systems have significant performance limitation s with respect to the treatment of FGD wastewater und er the full range of operating conditions at existing EGUs. Chemical precipitation treatment should be sufficient, and EPA should not require additional treatment of these sources by requiring biological treatment of FGD wastewater.

EPA's TDD recognizes that there is a wide assortment of FGD designs, coal types using FGD, and existing FGD wastewater control systems. To address this situation, NPPD suggests that State regulators should be given the flexibility to assess the circumstances present at an individual facility. Thus, source-specific Best Professional Judgm ent (BPJ) standards may be appropriate in certain instances. When needed, a BPJ process could be obtained by sources through an application or waiver process stating why the facility requires a separate process. A BPJ process would allow for considerations of factors including remaining life of the unit, size of the unit, discharge flow rate, and any physical constraints that would preclude chemical precipit ation, and thus would be an important option for small or uniquely situated units. However, NPPD emphasizes that the BPJ process should only be an alternative that the facility owner or operator to elect in those situations where the application of chemical precipitation is not technically or economically feasible.

Comment Response:

Regarding EPA's evaluation of FGD wastewater, see response to DCN EPA-HQ-OW-2009-0819-4487-A1, Excerpt Number 113.

Regarding the representativeness of the FGD wastewater data used to characterize the effluent from the treatment technologies, see response to DCN EPA-HQ-OW-2009-0819-4655-A2, Excerpt Number 20 in Comment Code 8.c and EPA-HQ-OW-2009-0819-4655, Excerpt Numbers 107 in Comment Code 10.a and 124 in Comment Code 4.b.

Regarding BPJ determinations for FGD wastewater, see response to DCN EPA-HQ-OW-2009-0819-4383-A1, Excerpt Number 6 in Comment Code 6.j.i.

Commenter Name: Chris M. Hobson
Commenter Affiliation: Southern Company
Document Control Number: EPA-HQ-OW-2009-0819-4379-A1
Comment Excerpt Number: 64
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Industry-wide cost estimates were developed for the three technology options under consideration using site-specific flows for each plant discharging FGD wastewater. The industry identified 98 plants that discharge FGD wastewater to surface waters. The specifics of these estimates are described in UWAG's comments.

The results of this industry-wide effort to estimate cost per TWPE are included in a report by NERA Consulting, Inc. (Attachment 14 to UWAG's comments). UWAG's estimates for the FGD technology options are:

Technology Option	$/TWPE (1981)
Chemical precipitation	$315
Incremental biological treatment	$1,346
Incremental thermal ZLD	$1,369

The industry-wide costs are much higher than EPA's estimated costs[11]. The chemical precipitation costs are $311 per TWPE which is well above the $200 per TWPE that EPA has typically imposed on other industries. *See* 68 Fed. Reg. 25,686, 25,701-02 (May 13, 2003). The incremental biological and thermal ZLD are clearly not cost effective using EPA's high-end range of $404/TWPE. Even though chemical precipitation appears to be cost effective based on the high-end $/TWPE range, it is still over 50% higher than EPA's typical $/TWPE range and should not be used as BAT for this rulemaking without additional data that represent the entire industry. If EPA nonetheless decides to proceed on the existing record, chemical precipitation should not be used as a national standard for this rulemaking without providing for exemptions based on site-specific technical or economical achievability.

---

[11] EPA's cost per TWPE is $69 for chemical precipitation and $60 for chemical precipitation plus biological treatment. EPA did not evaluate the incremental biological treatment cost per TWPE.

Comment Response:

Regarding cost-effectiveness, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 105.

Regarding the representativeness of the FGD wastewater data used to characterize the effluent from the treatment technologies, see response to DCN EPA-HQ-OW-2009-0819-4655-A2, Excerpt Number 20 in Comment Code 8.c and EPA-HQ-OW-2009-0819-4655, Excerpt Numbers 107 in Comment Code 10.a and 124 in Comment Code 4.b.

Regarding the selection of BAT for FGD wastewater and site-specific exemptions, see response to DCN EPA-HQ-OW-2009-0819-4460-A1, Excerpt Number 27.

Commenter Name: Ron Shipman
Commenter Affiliation: Georgia Power Company
Document Control Number: EPA-HQ-OW-2009-0819-4447-A1
Comment Excerpt Number: 25
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Georgia Power also agrees with UWAG's own cost-effectiveness analysis, which shows that chemical precipitation technology for FGD wastewater treatment is cost-effective for only FGD wastewater flows greater than 200 GPM. (See UWAG comments for detailed breakdown of chemical precipitation costs for increments of flow.) UWAG's cost estimates for the FGD technology options are presented in the table below.

Technology Option	$/TWPE (1981)
Chemical precipitation	$315
Incremental biological treatment	$1,346
Incremental thermal ZLD	$1,366

UWAG's estimated costs are much higher than EPA's estimated costs. The $/TWPE for incremental biological treatment and incremental ZLD treatment systems are higher than the highest cost per TWPE that EPA has ever approved ($404 per TWPE). Therefore, even though it is well above the typical $200 per TWPE, chemical precipitation appears to be below the cost high-end threshold of $404/TWPE (1981 dollars) while incremental treatment with biological process and incremental ZLD system treatment well exceeds the high-end limit. See 68 Fed. Reg. 25,686, 25,701 (May 13, 2003). Accordingly, Georgia Power agrees with Southern's recommendations that EPA provide an exception for:

• Plants with a maximum design flow rate of 200 gpm or less for FGD wastewater treatment;
• Plants demonstrating that, for their FGD wastewater, chemical precipitation would not be cost effective; or
• Plants demonstrating that, because of site- or plant-specific treatment features or conditions, chemical precipitation would be either technically or economically unachievable.

Comment Response:

Regarding cost effectiveness see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 105.

Regarding the selection of BAT for FGD wastewater and site-specific exemptions, see response to DCN EPA-HQ-OW-2009-0819-4460-A1, Excerpt Number 27.

For information regarding chemical precipitation at plants with maximum design flow rates greater than 200 gpm, see response to DCN EPA-HQ-OW-2009-0819-4379-A1, Excerpt Number 89 in Comment Code 9.

Commenter Name: Quinlan J. Shea III
Commenter Affiliation: Edison Electric Institute (EEI)
Document Control Number: EPA-HQ-OW-2009-0819-4487-A1
Comment Excerpt Number: 43
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Flexibility is Necessary if Chemical Precipitation is Required Contrary to EEI's Recommendations.

If contrary to the EEI's recommendations, EPA decides to require chemical precipitation as treatment for FGD wastewater, EPA should at a minimum provide a measure of flexibility in the rule.

First, EPA should make clear that chemical precipitation is not appropriate (1) for plants with maximum design flow rates less than or equal to 200 gpm and (2) where the FGD wastewater flow is large and cannot be reduced because of the materials from which the scrubber was constructed (e.g., chemical precipitation is not appropriate for once-through scrubbers).

Second, EPA should include an exception for plants where installing a chemical precipitation treatment system would be either (1) technically unavailable because there is not enough space to place the equipment or (2) economically unachievable because the cost is disproportionate to the benefits of removing the additional pollutants. For the latter, we suggest the following language: "Treatment for FGD wastewater will be determined using best professional judgment where the permittee demonstrates that the costs of meeting the otherwise applicable FGD limits would be disproportionate to the benefits."

Comment Response:

Regarding chemical precipitation at plants with maximum design flow rates greater than 200 gpm, see response to DCN EPA-HQ-OW-2009-0819-4379-A1, Excerpt Number 89 in Comment Code 9.

Regarding site-specific exemptions, see response to DCN EPA-HQ-OW-2009-0819-4460-A1, Excerpt Number 27.

Regarding an exemption for high flow/once-through FGD systems, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 102 and EPA-HQ-OW-2009-0819-4607-A1, Excerpt Number 4 in Comment Code 5.b.

Regarding BPJ determinations, see response to DCN EPA-HQ-OW-2009-0819-4383-A1, Excerpt Number 6 in Comment Code 6.j.i.

Commenter Name: Thomas Cmar
Commenter Affiliation: Earthjustice, et al.
Document Control Number: EPA-HQ-OW-2009-0819-4684-A1
Comment Excerpt Number: 60
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

3. The other BAT factors do not alter the conclusion that BAT limitations should be based on the use of mechanical evaporation.

While the BAT analysis begins with the best performing pollution reduction technologies, the statute also specifies the following factors that EPA must "take into account" in determining the BAT:

. . . the age of equipment and facilities involved, the process employed, the engineering aspects of the application of various types of control techniques, process changes, the cost of achieving such effluent reduction, non-water quality environmental impact (including energy requirements), and such other factors as the Administrator deems appropriate.[242]

EPA's record demonstrates that the age of the facility does not impair the suitability of mechanical evaporation for treating the FGD wastewater stream. Based on extensive industry surveys, it was determined that "the age of the plant and generating unit(s) do not impact the plants' ability to install the treatment technologies proposed as part of this rulemaking because the treatment system for the FGD wastewater is distinctly separate from the generating unit."[243] Mechanical evaporation, like the other technologies EPA considered, is a separate and self- contained process that does not affect the operation of the boilers or the other production processes at the facility.

In its permitting decision for the Merrimack plant in New Hampshire, EPA Region 1 concluded that the age of the power station would not preclude or create particular problems for operation of the mechanical evaporation system; that the system would not interfere with other production processes; and that it did not present any engineering issues.[244] The same conclusions can be drawn based on the present record, when making the BAT determination for the industry as a whole.

The type of coal burned in a generating unit affects the concentrations of chlorides, dissolved solids, and metals in the FGD blowdown. However, the pre-treatment steps that EPA has evaluated as part of the mechanical evaporation technology option are designed to bring each of these components into the range suitable for the brine concentration system. Therefore, no upstream process changes are required for proper operation of the mechanical evaporation system.

---

[242] 33 U.S.C. § 1314(b)(2)(B); *see also* 40 C.F.R. § 125.3(d)(3).

[243] ERG Non-CBI Subcategorization Memo, EPA-HQ-OW-2009-0819-2258, at 5.

[244] Merrimack TBEL Determination at 22.

Comment Response:

EPA disagrees with the commenter that BAT should be entirely based on the evaporation system. See preamble section VIII for EPA's rationale for not selecting the evaporation as the basis for BAT limitations applicable to FGD wastewater discharges from all existing steam electric power generating units. However, EPA notes that the final rule establishes a voluntary incentive program for plants electing to adopt more stringent BAT effluent limitations based on the evaporation technology.

Commenter Name: John McManus
Commenter Affiliation: American Electric Power System (AEP)
Document Control Number: EPA-HQ-OW-2009-0819-4448-A1
Comment Excerpt Number: 18
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

b. EPA cost estimates for chemical precipitation and biological treatment of FGD wastewaters need to be more reflective of actual industry costs.

As described in the ELG TDD, "EPA estimated the chemical precipitation, biological treatment, and vapor-compression evaporation system costs separately, and then summed the costs generated by the appropriate technology cost modules to achieve the total technology option costs (i.e., the chemical precipitation costs were added to the biological treatment and vapor-compression evaporation costs to calculate the total costs for the technology option."[15] The agency then presented the results of its analysis to determine the incremental costs and pollutant removals for each of the proposed technologies.[16] A portion of these results are presented below, along with similar data collected for several AEP FGD wastewater treatment facilities (Table 1).

The results of AEP's own analysis of the capital cost of FGD wastewater treatment installation varied greatly from those of EPA. AEP's costs are based on the actual installations of five chemical precipitation facilities that have occurred within the past six years. These installations all include a cold lime softening, ferric chloride addition, pH adjustment, organosulfide addition, and a variety of coagulating/flocculating polymers to enhance settling. All have a combination of flow equalization tanks, softening tanks, primary and secondary clarifiers, filter presses, and the ability to recycle a portion of the solids. All costs have been converted to 2010$.

Table 1. Estimated industry and company-level costs for FGD wastewater treatment (excludes oil- fired and units < 50 MWs).

Technology Option	EPA Capital Cost per Plant (2010$)	AEP Capital Cost per Plant (2010$)	ΔAEP-EPA (2010$)	Percent Increase
Chemical precipitation	$12,500,000	$38,528,164	$26,028,164	208%
Biological treatment*	$9,051,724	$22,299,874	$13,248,150	146%
Chemical precipitation plus biological treatment	$21,551,724	$58,620,327	$37,068,603	171%
Chemical precipitation plus biological treatment#	$35,294,118#	$47,336,433#	$12,042,315	34%

* Difference between chemical precipitation and chemical precipitation plus biological treatment.
\# Plants with total wet scrubbed capacity < 2000MW.

In all cases, AEP's capital cost estimates are significantly higher than what was presented by EPA. These differences are enough to raise concern about the accuracy of the EPA estimates. In addition, the EPA estimates were used as the basis for the cost effectiveness and $/TWPE analyses, which will be biased towards the low side based on the agency's unrealistically low values.

[15] EPA Technical Development Document for the Proposed Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category, EPA-821-R-13-002, [hereinafter EPA Technical Development Document], April 2013, at 9-19.

[16] Id., Tables 9-3 and 9-4

Comment Response:

In response to comments on the proposed rule, EPA has revised its cost estimates for the technologies considered for BAT: chemical precipitation, the combination of chemical precipitation and biological treatment; and the combination of chemical precipitation and evaporation. Regarding revisions to the chemical precipitation system costs, see responses to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Numbers 24-27, and 29 in Comment Code 9.b and Excerpt Number 28 in this comment code. Regarding revisions to the biological treatment system costs, see responses to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Numbers 30-34, 43-44, 46, and 105 in Comment Code 10.b.

Regarding the comparison of EPA's capital costs to AEP's capital costs, EPA notes that AEP informed EPA that for some of the plants where the plant instead chemical precipitation treatment systems, the company did not solicit bids for the contract work and instead chose contactors that could meet AEP's aggressive schedule for installing new treatment systems. As such, AEP's capital cost for those three plants are inflated due to the lack of competition; this would not be the case for plants installing new or upgraded treatment systems to meet the final effluent limitations (see the preamble and TDD for a discussion of the time plants will have to implement the ELGs). Additionally, EPA notes that AEP installed chemical precipitation systems including essentially a complete 2 x 100% redundant system. EPA has determined that although it is important for a well-designed treatment system to include some degree of redundancy, the level of redundancy included in the AEP design is unnecessary and is another reason for the high cost of the AEP treatment systems. See response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 104 in Comment Code 9.b.

Commenter Name: Paul Chu
Commenter Affiliation: Electric Power Research Institute (EPRI)
Document Control Number: EPA-HQ-OW-2009-0819-4499-A1
Comment Excerpt Number: 22
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

2 FGD WASTEWATER TREATMENT COST-EFFECTIVENESS ASSESSMENT

EPRI conducted an independent evaluation of the overall industry costs for each of the three FGD wastewater treatment technologies considered by EPA. EPRI also estimated the pollutant loading reductions (removals) and compared these with costs. This cost-effectiveness analysis is summarized in Section 2. The underlying calculations of industry costs and pollutant removals are presented in Sections 3 and 4, respectively. EPRI also provides technical comments on EPA's methodology to assist the Agency in developing Effluent Limitations Guidelines that are scientifically sound.

2.1 EPA's calculated cost/TWPE ratio for treatment of FGD wastewater via chemical precipitation, biological systems, and vapor-compression evaporation (VCE) are lower than EPRI's. The *incremental* pollutant removal achieved by biological and VCE treatments provides a direct comparison between the costs and pollutants removed for each individual technology.

EPRI calculated the cost/toxic-weighted pounds-equivalent (TWPE) ratio that the industry would experience for FGD wastewater treatment via chemical precipitation (CP), incremental biological treatment, and incremental vapor compression evaporation (VCE). EPA's cost-effectieness ratio for each technology is lower than EPRI's cost-effectiveness ration. Table 2-1 summarizes these cost/TWPE ratios for a 2010 basis year, as well as a 1981 basis year to be consistent with EPA's methodology for cost-effectiveness evaluation as defined in the proposed Effluent Guidelines rule.

Comparing the pollutant removal estimates of CP and biological treatment, it is important to consider that 85% of the benefit is accomplished in the CP treatment system, with the remaining 15% occurring in the biological treatment system. Accordingly, EPRI considered the *incremental* pollutant removal of biological treatment and the *incremental* pollutant removal of VCE. EPA considered only the combined CP + biological treatment and the combined CP + VCE treatment.

Table 2-1
Comparison of EPRI and EPA Cost/TWPE Ratios for FGD Wastewater Treatment

	EPRI		EPA[a]
Treatment	**Cost/TWPE ($1981)**	**Cost/TWPE ($2010)**	**Cost/TWPE ($2010)**
CP	273	716	216
Incremental Biological	737	1,939	149[b]
CP + Biological	--	--	188
Incremental VCE	1,417	3,712	882[b]
CP + VCE	--	--	541

[a] EPA's cost/WTPE ratio for FGD wastewater treatment was calculated using costs provided in Table 9-3 of the TDD and benefits provided in Table 10-10 of the TDD.
[b] The incremental values were calculated by subtracting the cost and pollutant removal that EPA calculated for CP from the cost and pollutant removal that EPA calculated for CP + Biological and CP + VCE.
TWPE = toxic-weighted pounds-equivalent

Comment Response:

Regarding EPRI's comments on EPA's FGD chemical precipitation cost methodology, *see response to DCN* EPA-HQ-OW-2009-0819-4499-A1, Excerpt Numbers 24-27, and 29 in Comment Code 9.b and Excerpt Number 28 in this comment code.

Regarding EPRI's comments on EPA's FGD biological treatment cost methodology, *see response to DCN* EPA-HQ-OW-2009-0819-4499-A1, Excerpt Numbers 30-34, 43-44, 46, and 105 in Comment Code 10.b.

Regarding EPRI's comments on EPA's FGD evaporation treatment cost methodology, *see response to DCN* EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 106 in Comment Code 11.b.

Regarding cost effectiveness see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 105.

Regarding evaluation of the incremental cost effectiveness for the biological treatment and evaporation systems, see response to DCN EPA-HQ-OW-2009-0819-4305-A3, Excerpt Number 52 in Comment Code 10.c. EPA does not agree that the pollutant removals and/or cost of the biological treatment stage or the evaporation stage should be evaluated separately from their respective chemical precipitation pretreatment stages. These technologies, as evaluated for BAT, are designed to be operated as combined treatment systems because the chemical precipitation (and in the case of evaporation, also the softening step) is a necessary pretreatment that conditions the wastewater for the subsequent process (i.e., biological treatment or evaporation).

The commenter's suggestion is analogous to carving the chemical precipitation treatment process into multiple parts and evaluating each of them separately; for example, reviewing the cost and pollutant removals for chemical addition separately from the clarifier. This would not be appropriate because the clarifier is needed to remove the precipitated metals resulting from the chemical addition and therefore the processes are inseparable. Similarly, the biological treatment and evaporation stages rely on the wastewater conditioning (i.e., pretreatment) that occurs in the chemical precipitation stage. See e.g., DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107 and DCN SE05846 (*Variability in Flue Gas Desulfurization Wastewater: Monitoring and Response).*

Commenter Name: John McManus
Commenter Affiliation: American Electric Power System (AEP)
Document Control Number: EPA-HQ-OW-2009-0819-4448-A1
Comment Excerpt Number: 22
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Table 2. Estimated industry and company-level $ per TWPE removed for FGD wastewater treatment (excludes oil-fired and units < 50 MWs).

Technology Option	EPA $/TWPE (1981$) 20-yr	AEP $/TWPE (1981$) 20-yr
Chemical precipitation	$70	$30 - $126
Chemical precipitation plus biological treatment	$60	$580 - $1208
Biological treatment	---	$550 - $1082
Chemical precipitation following settling	$70	$341 - $1791

AEP conducted a similar analysis for five of its plants based on cost data submitted to EPA as part of the AEP ELG ICR response or, for more recent projects, the actual installation costs. All cost data were adjusted to 2010$ using RS Means Historical Cost Indices. As done by EPA, costs were annualized over a 20-year period using a 7% annual inflation rate. Excepting the biological treatment options for which EPA did not provide an estimate, AEP's cost estimates are one to two orders of magnitude higher than those of EPA.

Flow data were obtained from the AEP ELG Information Collection Request (ICR) responses (2010) or from AEP operational or environmental data records. Samples were collected from the inlet and outlet of the FGD wastewater physical-chemical and biological treatment systems at

AEP plants and analyzed using EPA Methods 200.7, 200.8, 1631E (mercury) and SM20 4500NO3H (nitrate-nitrite as N). Pollutants that were not removed with an efficiency of at least 25% were deleted from the analysis. Typically, these pollutants were boron, magnesium, potassium, sodium or other pollutants that were not effectively removed by the treatment technology.

While AEP's analysis confirmed that, based on past ELG rulemakings, the proposed chemical precipitation technology may be cost effective, EPA's cost effective analysis results were much lower than those calculated by AEP for biological treatment. Based on a 20-year cost recovery period at a 7% annual inflation, AEP's estimates for chemical precipitation plus biological treatment were much greater than those of EPA. These are very significant differences illustrating that EPA's cost effectiveness analysis is biased low and does not account for the true costs of the proposed technologies.

Comment Response:

EPA disagrees with the commenter that "EPA's cost effectiveness analysis is biased low and does not account for the true costs of the proposed technologies." EPA revised its costs and loadings analyses for the final rule to address public comments. See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 105.

Additionally, regarding the high AEP cost estimates, see response to DCN EPA-HQ-OW-2009-0819-4448-A1, Excerpt Number 18.

Commenter Name: Becky Smith
Commenter Affiliation: Clean Water Action et al.
Document Control Number: EPA-HQ-OW-2009-0819-4548-A1
Comment Excerpt Number: 7
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Our organizations urge EPA to require chemical precipitation plus vapor evaporation to treat FGD wastewater, as proposed under Option 5. FGD, or "scrubber" wastewater is especially toxic, and this wastestream will only increase in volume and toxicity as more power plants install scrubbers to control air pollutants. Unfortunately, much of that toxic waste is ending up in our water. Of the 145 power plants identified by EPA to generate scrubber wastewater, over half use only surface impoundments (settling ponds) to treat that wastewater.[12] As mentioned previously, ponds are ineffective at treating dissolved metals, nutrients and total dissolved solids. Most of the options proposed by EPA would require existing and new power plants to control scrubber wastewater with a combination of chemical and biological treatment. However, neither of those technological options effectively treats for bromide and other total dissolved solids. Bromide is of particular concern for plants that discharge near drinking water intakes because it can create harmful byproducts when mixed with disinfectants used to treat drinking water. Vapor evaporation technology exists that can reduce scrubber discharges to near zero, the only way to eliminate this source of bromides from our drinking water supplies.

---

[12] 78 Fed. Reg. at 34,451

Comment Response:

EPA did not select the evaporation system as BAT for the treatment of FGD wastewater at all existing steam electric power generating units. See preamble section VIII for EPA's rationale for not selecting the evaporation system as BAT for all units. However, EPA did select the evaporation system as the technology basis for NSPS for FGD wastewater. Additionally, the BAT for the final rule includes a voluntary incentives program to encourage plants to adopt more stringent effluent limitations based on the evaporation technology.

Regarding the treatment of bromides near drinking water intakes, see preamble section XVI.

Commenter Name: Tom DeLawrence
Commenter Affiliation: PowerSouth Energy Cooperative
Document Control Number: EPA-HQ-OW-2009-0819-4460-A1
Comment Excerpt Number: 48
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Utilizing Best Professional Judgment for FGD Wastewater Limitations

PowerSouth would likely be amenable to EPA's regulatory Option 3, which would establish BPJ as the case-specific standard by which various permit writers would determine BAT at each facility for FGD wastewaters. PowerSouth perceives an obvious benefit in allowing its permit writers, with extensive knowledge about the Lowman Plant, to make a more thorough evaluation as to what technologies are appropriate as BAT for this waste stream. On the other hand, PowerSouth recognizes the substantial burden this has the potential to place at the feet of certain state agencies with limited and/or shrinking budgets. PowerSouth also acknowledges that such a standard provides no certainty for the industry as a whole and has the potential to create an unequal playing field for facilities within a region or throughout the country. Accordingly, should EPA select this regulatory option, PowerSouth requests that the agency provide some boundaries. Specifically, EPA should develop a BPJ standard that incorporates, and is premised on, the following tenet of the BAT standard: "Treatment for FGD wastewater will be determined using best professional judgment where the permittee demonstrates that the costs of meeting the otherwise applicable FGD limits would be disproportionate to the benefits."

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4383-A1, Excerpt Number 6 in Comment Code 6.j.i.

Commenter Name: Theresa Pugh
Commenter Affiliation: American Public Power Association (APPA)
Document Control Number: EPA-HQ-OW-2009-0819-5140-A2
Comment Excerpt Number: 74
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Finally, if (*contrary to the APPA's recommendations*), EPA decides to require chemical precipitation as treatment for FGD wastewater, EPA should *at least* provide a measure of flexibility by including the following provisions:

- Chemical precipitation (meaning arsenic and mercury) should not be required where the FGD wastewater flow is large and cannot be reduced because of the materials from which the scrubber was constructed; and
- Because the record shows so clearly that chemical precipitation is not cost-effective (by EPA's traditional standard of $404 per TWPE), there should be an exception for plants where installing a chemical precipitation treatment system would be either: (a) technically unavailable because there is enough space ("footprint") to place the equipment or (b) economically unachievable because the cost is <u>disproportionate to the benefits</u> of removing the additional pollutants.

With respect to the latter, we suggest the following: "Treatment for FGD wastewater will be determined using best professional judgment where the permittee demonstrates that the costs of meeting the otherwise applicable FGD limits would be disproportionate to the benefits."

Comment Response:

Regarding cost effectiveness see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 105.

Regarding an exemption for high flow/once-through FGD systems, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 102 and EPA-HQ-OW-2009-0819-4607-A1, Excerpt Number 4 in Comment Code 5.b.

Regarding the site-specific exemptions, see response to DCNEPA-HQ-OW-2009-0819-4460-A1, Excerpt Number 27.

Regarding requiring BPJ determinations, see response to DCN EPA-HQ-OW-2009-0819-4383-A1, Excerpt Number 6 in Comment Code 6.j.i.

Commenter Name: Elizabeth E. Aldridge, Hunton & Williams
Commenter Affiliation: UWAG
Document Control Number: EPA-HQ-OW-2009-0819-4655
Comment Excerpt Number: 133
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Finally, if (contrary to the UWAG's recommendations), EPA decides to require chemical precipitation as treatment for FGD wastewater, EPA should *at least* provide a measure of flexibility by including the following provisions.

First, chemical precipitation should not be required where the FGD wastewater flow is large and cannot be reduced because of the materials from which the scrubber was constructed. EPA should instead provide a subcategorization for these scrubbers.

Second, there should be an exception for plants where installing a chemical precipitation treatment system would be either (1) technically unavailable because there is not enough space to place the equipment or some other technical impediment; or (2) economically unachievable because the cost is disproportionate to the benefits of removing the additional pollutants.

For the latter, we suggest the following: "Treatment for FGD wastewater will be determined using best professional judgment where the permittee demonstrates that the costs of meeting the otherwise applicable FGD limits would be disproportionate to the benefits."

Comment Response:

Regarding cost effectiveness see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 105.

Regarding an exemption for high flow/once-through FGD systems, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 102 and EPA-HQ-OW-2009-0819-4607-A1, Excerpt Number 4 in Comment Code 5.b. Flow reduction, while it can reduce the size and cost of a treatment system, is not necessary to treat FGD wastewater to meet the effluent limitations and wastewater flow rate does not affect the availability of the BAT.

Regarding the site-specific exemptions, see response to DCNEPA-HQ-OW-2009-0819-4460-A1, Excerpt Number 27.

Regarding requiring BPJ determinations, see response to DCN EPA-HQ-OW-2009-0819-4383-A1, Excerpt Number 6 in Comment Code 6.j.i.

Commenter Name: Tom DeLawrence
Commenter Affiliation: Alabama Power Company
Document Control Number: EPA-HQ-OW-2009-0819-4489-A1
Comment Excerpt Number: 11
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

A. At Most, Chemical Precipitation Could be Considered BAT

Realistically, EPA can only permissibly consider the chemical/physical (i.e. chemical precipitation) treatment process as BAT for FGD wastewater. The physical/chemical system may be an available, proven, effective, and operationally efficient technology in some instances. This treatment system is used by power plants around the country, and has been relied upon by those using FGD systems to treat FGD wastewater. EPA's exclusion of this technology from its "preferred" options for treating FGD wastewater was improper.

EPA conflates the effectiveness of chemical precipitation technology with that of biological treatment.[7] EPA must consider the two treatment options separately. Their costs, modes of operation, and limitations—as well as their relative effectiveness—differ greatly and deserve separate analyses. By considering these two technologies in conjunction, the agency has masked the relative effectiveness of each. A review of EPA's own data—after excluding fabricated removals not associated with these technologies—reveals that chemical precipitation accounts for 93% of the total TWPE removed; whereas the incremental biological treatment accounts for only 7% of TWPE removed. In short, installing biological treatment following a chemical precipitation system provides only a small additional benefit.

These removal percentages are reflective of the cost-effectiveness numbers generated by UWAG's consultant, NERA Consulting, Inc. *See* UWAG Comments at Section VI, F-G. The incremental cost of implementing biological treatment in the industry is $1,346/TWPE (1981 dollars). Comparatively, chemical precipitation would cost $311/TWPE, according to NERA's calculations based on data made available by EPA through this rulemaking. Yet, even this latter cost number could dramatically increase if EPA had collected analytical data that was truly representative of the industry.

---

[7] Biological treatment of wastewater refers to various technologies that use microorganisms to target the removal of specific pollutants, including suspended growth activated sludge, sequential

batch reactor activated sludge, and the use of specialized microbes in a fixed film or a suspended growth system.

Comment Response:

See preamble section VIII for details on the selection of chemical precipitation followed by biological treatment as BAT.

Regarding the cost-effectiveness analysis, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 105.

Regarding evaluation of the incremental cost effectiveness for the biological treatment and evaporation systems, see response to DCN EPA-HQ-OW-2009-0819-4305-A3, Excerpt Number 52 in Comment Code 10.c. Also see the response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 22.

Commenter Name: Tom DeLawrence
Commenter Affiliation: PowerSouth Energy Cooperative
Document Control Number: EPA-HQ-OW-2009-0819-4460-A1
Comment Excerpt Number: 33
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Chemical Precipitation is Not BAT.

Effluent limitations based on chemical precipitation treatment technologies cannot be BAT for the steam electric power generating industry. As stated above, the agency's current record is insufficient to justify imposing any of the proposed regulatory options in the Draft Rule. This includes attempting to require limits based on physical/chemical treatment technologies, and, alone, necessitates a conclusion that this technology cannot be BAT. Separately, a review of the factors the agency must consider as a part of its legally required BAT analysis warrant a finding that the industry cannot be required to implement this technology.

As explained in the beginning of these comments, to permissibly be labeled BAT, EPA must first identify a technology as an "available" one by "survey[ing] the practicable or available pollution-control technology for an industry and assess[ing] its effectiveness." Nat'l Wildlife Fed'n, 286 F.2d at 561. Once it has identified all available technologies, EPA must consider the following factors to determine BAT: the age of equipment and facilities involved; the process employed; the engineering aspects of the application of various types of control techniques; process changes; the cost of achieving such effluent reduction; and non-water quality environmental impacts (including energy requirements and real estate/footprint concerns). 40 C.F.R. § 125.3(d)(3) (i) – (vi). Not one factor is determinative. Instead, EPA must consider each and balance the resulting analyses to determine BAT. Indeed, failure to consider even one factor renders EPA's effluent limits arbitrary and capricious. See, e.g., Texas Oil & Gas Ass'n, 161 F.3d at 934–35 (5th Cir. 1998) (noting that a failure to consider the age of the equipment and the facilities involved when determining the BAT would constitute an abuse of discretion); Am. Iron & Steel Inst., 526 F.2d at 1048 (remanding effluent limits because EPA did not consider the age of the facilities involved and the impact that age would have on the cost and feasibility of retrofitting older facilities).

Comment Response:

The final rule, which includes BAT effluent limitations for FGD wastewater based on chemical precipitation followed by biological treatment, is both technologically available and economically achievable. See preamble section VIII for a discussion of EPA's BAT selection for FGD wastewater.

Commenter Name: John McManus
Commenter Affiliation: American Electric Power System (AEP)
Document Control Number: EPA-HQ-OW-2009-0819-4448-A1
Comment Excerpt Number: 17
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

a. Rationale for the Proposed Best Available Technology to Treat FGD Wastewater

According to EPA, "Best Available Technology (BAT) represents the best available economically achievable performance of facilities in an industrial subcategory." (78 FR at 34468). After considering all of the technologies available for the treatment of FGD wastewater, the agency is proposing to establish the following options:

- Site-specific limits (BPJ)
- Numeric limits for mercury and arsenic that would require chemical precipitation
- Numeric limits for mercury, arsenic, selenium and nitrate-nitrite that would require chemical precipitation in combination with biological treatment, and
- Limits that would require chemical precipitation in combination with evaporation. The agency feels that the first three options are technologically available and well demonstrated, but it does recognize that there are concerns with the feasibility of biological treatment (78 FR at 34470).

EPA also assessed the projected economic impacts of the eight regulatory options, seven of which include chemical precipitation of FGD wastewater and four of which include biological treatment. As part of this analysis, the agency determined that "very few entities are likely to face economic impacts at any level for any of the four preferred BAT and PSES options (Options

3a, 3b, 3, and 4a)" (78 FR at 34495). Three of these options (3b, 3, and 4) include chemical precipitation of FGD wastewater in combination with biological treatment.

Despite the efforts of the agency to assess the costs and economic impacts of the proposed FGD wastewater treatment technologies, AEP found the agency's estimated costs to be well below those based on its own actual facility installations.

Comment Response:

In response to public comments, EPA revised its cost estimates for the final rule with respect to each of the technologies evaluated for the treatment of FGD wastewater:

Regarding FGD chemical precipitation costs, see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Numbers 24-27, and 29 in Comment Code 9.b and Excerpt Number 28 in this comment code

Regarding FGD biological treatment costs, see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Numbers 30-34, 43-44, 46, and 105 in Comment Code 10.b.

Regarding FGD evaporation treatment costs, see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 106 in Comment Code 11.b.

Regarding AEP's costs for chemical precipitation treatment, see response to DCN EPA-HQ-OW-2009-0819-4448-A1, Excerpt Number 18.

Commenter Name: Erin Bartlett
Commenter Affiliation: The Large Public Power Council (LPPC)
Document Control Number: EPA-HQ-OW-2009-0819-4573-A1
Comment Excerpt Number: 8
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

In the proposed rule, EPA discusses several regulatory options for managing FGD wastewater. This waste stream has grown in recent years as a result of increasingly stringent air emissions control requirements, which have led to much greater use of FGD systems. Surface impoundments continue to be the predominant technology used to treat FGD wastewater at power plants.[8] Surface impoundments are effective at removing solid particles from the wastewater, as gravity will settle the particles on the bottom over time.[9] EPA has noted that currently the surface impoundments may not appropriately remove pollutants that are present primarily in soluble form. The Agency has therefore suggested additional options for regulating such pollutants, including through chemical precipitation, "best professional judgment," biological treatment, and vapor-compression evaporation.

LPPC generally agrees that tank-based chemical precipitation is an appropriate treatment option for facilities operating FGD systems. Industry experience has shown that chemical precipitation of FGD wastewater is a cost-effective technology for limiting effluent discharges. However, this treatment should be sufficient, and EPA should not additionally require biological treatment of FGD wastewater. Among other things, LPPC is concerned that biological treatment systems have significant performance limitations with respect to the treatment of FGD wastewater under the full range of operating conditions at existing EGUs.

---

8 78 Fed. Reg. 34,451 (June 7, 2013). In the proposed rule EPA notes that 54 percent of plants that discharge FGD wastewater use surface impoundments as the sole treatment technology.

9 Id.

Comment Response:

Regarding EPA's evaluation of FGD wastewater, see response to DCN EPA-HQ-OW-2009-0819-4487-A1, Excerpt Number 113.

Regarding the representativeness of the FGD wastewater data used to characterize the effluent from the treatment technologies, see response to DCN EPA-HQ-OW-2009-0819-4655-A2, Excerpt Number 20 in Comment Code 8.c and EPA-HQ-OW-2009-0819-4655, Excerpt Numbers 107 in Comment Code 10.a and 124 in Comment Code 4.b.

Regarding BPJ determinations for FGD wastewater, see response to DCN EPA-HQ-OW-2009-0819-4383-A1, Excerpt Number 6 in Comment Code 6.j.i.

Commenter Name: Elizabeth E. Aldridge, Hunton & Williams
Commenter Affiliation: UWAG
Document Control Number: EPA-HQ-OW-2009-0819-4655
Comment Excerpt Number: 93
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

UWAG developed its own industrywide cost estimates for the various technology options using plant-specific flows and average concentration data. UWAG used the following hierarchy for developing maximum design flow rates for plants that discharge FGD wastewater:

1. maximum design and average or typical flow rates (2010 ICR, D5-3) for tank-based treatment systems;

2. maximum design and average flow rates from UWAG members;

3. for plants that did not provide maximum design flow rates, the "typical" purge flow rate (2010 ICR, B5-2) times a "capacity factor" of 2.0;

4. for plants that did not provide any flow rates or redacted them, calculated flow rates using Equation 4-1, from EPA's IC&PR:

FGD Wastewater Flow (gpd) = Tons of Coal Burned x Median GPD/Ton of Coal

Where:

Tons of Coal Burned = Reported tons of coal burned per year by the units serviced by the FGD system (ICR Part A, Section 8, Fuel Usage by Steam Electric Generating Unit), and

Median GPD/Ton of Coal = The calculated median FGD wastewater flow rate in GPD per ton of coal burned per year based on the type of coal burned: 0.1454 for bituminous, 0.0392 for subbituminous, 0.2313 for lignite, and 0.1017 for any coal blend.

The results of using UWAG's information are included in a report by NERA Economic Consulting (Attachment 14 to these comments). NERA's estimates based upon UWAG data for the three FGD technology options are:

Technology Option	$/TWPE (1981)
Chemical precipitation	$311
Incremental biological treatment	$1,346
Incremental ZLD	$1,369

These cost-effectiveness estimates are much higher than EPA's.

Comment Response:

EPA notes the following:

The commenter has not provided EPA with the "maximum design and average flow rates from UWAG members" which did not come from the survey and, therefore, EPA is unable to incorporate this into its analyses or verify the information.

EPA disagrees with the commenter's use of a "capacity factor" of 2.0. See response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Numbers 26 and 27 and Section 6.1.5 (Key Variables Used in the Capital and O&M Cost Methodologies) of the *Incremental Costs and Pollutant Removals for the Final Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category* report (DCN SE05831/SE05832).

Regarding the cost-effectiveness analysis, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 105.

Commenter Name: Mike Roddy
Commenter Affiliation: Seminole Electric Cooperative, Inc. (SECI)
Document Control Number: EPA-HQ-OW-2009-0819-4518-A2
Comment Excerpt Number: 6
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Option 3A/Best Professional Judgment

SECI fully supports the application of best professional judgment (BPJ) for FGD wastewater as proposed by EPA in the proposed rule Option 3A. SECI agrees with the EPA that new and emerging technologies are providing methods of source reduction that were not available recently. Additionally, some of the greatest potential technologies may still be in the development phase since the new limits proposed by EPA have required a level of treatment that has previously not been necessary for wastewater technology. Of note is recent research that has been conducted by the Energy Power Research Institute (EPRI) that shows a significant portion of selenium may not be in the form of selenite or selenate. EPRI has found that these other forms of selenium are not removed in conventional wastewater treatment, including biological, and may require new treatment technology. EPRI is concerned that the proposed options in the rule do not provide for this issue and have provided their evidence in their comments on the rule.

Determining best available technology at this point would not provide electric generating plants the flexibility to implement these new technologies and may discourage further research into metals removal. Therefore, SECI recommends EPA allow individual BPJ decisions by permit writers at this time in order to allow State regulators and the regulated industry to work together to develop the most effective treatment technology for their particular wastestream.

Comment Response:

Regarding requiring BPJ determinations, see response to EPA-HQ-OW-2009-0819-4383-A1, Excerpt Number 6 in Comment Code 6.j.i.

Regarding the treatment of selenium species other than selenite/selenate, see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 58 in Comment Code 10.a.

Commenter Name: Dennis Leonard
Commenter Affiliation: DTE Energy Company
Document Control Number: EPA-HQ-OW-2009-0819-4517-A2
Comment Excerpt Number: 9

External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

The vast majority of pollutant reduction that EPA subscribed to combined physical/chemical and biological systems was associated with the physical/chemical portion of the system. A rule requiring only physical/chemical treatment will be almost as effective as a rule requiring physical/chemical plus biological. Biological treatment of FGD is not cost effective and is not needed for most power plants, particularly at plants that practice fuel flexing. Requiring only physical/chemical treatment does not reduce nitrate concentration in FGD blowdown, but this should not be an issue. There is little mass of nitrate discharged in FGD blowdown, the highest concentrations are associated with little to no flow (during periods of extreme recirculation) and the amount of nitrate in power plant discharges is very small compared to Municipal Waste Water. EPA has chosen to not limit nitrate in this much larger Municipal WWT discharge. Regulatory jurisdictions, like the State of Michigan, direct Municipalities to convert NH3 to nitrate, yet the ELG proposal would go in the opposite direction and convert NO3 to NH3.

For the reasons provided above, EPA should base the final FGD blowdown ELG on physical/chemical treatment, eliminate the requirement for nitrate removal, and upwardly revise the allowable selenium concentration to that associated with physical/chemical treatment. UWAG, in its comments, identify an appropriate selenium standard associated with physical chemical treatment.

Comment Response:

EPA disagrees with the commenter's analysis evaluating the incremental cost effectiveness for the biological treatment system, see response to DCN EPA-HQ-OW-2009-0819-4305-A3, Excerpt Number 52 in Comment Code 10.c.

Regarding fuel flexing and the potential conversion from nitrate to ammonia in the biological treatment system, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107 in Comment Code 10.a.

EPA disagrees with the commenter that "[a] rule requiring only physical/chemical treatment will be almost as effective as a rule requiring physical/chemical plus biological" because the biological treatment controls the discharges of selenium in the FGD wastewater. Selenium discharges from FGD wastewater have caused significant environmental impacts to aquatic organisms and without the selenium limitations, there will continue to be environmental impacts due to selenium discharges. Therefore, EPA also disagrees with the commenter that EPA should "upwardly revise the allowable selenium concentration to that associated with physical/chemical treatment."

EPA disagrees with the commenter that EPA should "eliminate the requirement for nitrate removal." EPA has determined that the biological treatment system is capable of achieving significant removals of nitrate/nitrite (as N) and, as such, EPA is establishing a technology-based requirement for nitrate/nitrite (as N). See Section 11 of the TDD for more information regarding EPA's selection of pollutants for regulation.

Commenter Name: Cari Boyce
Commenter Affiliation: Duke Energy
Document Control Number: EPA-HQ-OW-2009-0819-4305-A3
Comment Excerpt Number: 24
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

FGD ***Wastewater:*** **Chemical Precipitation (as proposed under EPA's Option 1 without the flow reduction requirement)**

In evaluating the various options, it becomes clear that the treatment technology ultimately selected for FGD wastewater will have the largest impact on the industry's ability to demonstrate compliance on a consistent basis. Option 1 is the only option that proposes chemical precipitation alone as the model technology for FGD wastewater. Duke Energy has years of operating experience with both chemical precipitation and biological treatment systems and can provide meaningful comments on the effectiveness of these treatment systems, as well as, the operational challenges of biological treatment systems. Chemical precipitation is the most cost-effective and reliable means to treat FGD wastewater across all geographical regions and its performance has been demonstrated over a wide range of fuels. Furthermore, chemical precipitation removes a majority of the constituents within FGD wastewater, whereas, biological treatment only provides a small incremental reduction and should only be required in limited situations and should not be the basis for a national standard.

Comment Response:

EPA has determined that the chemical precipitation followed by biological treatment system is technologically available and economically achievable, and was selected as the basis for the BAT effluent limitations for FGD wastewater discharges from units that are greater than 50 MW and that are not oil-fired. See preamble section VIII for more information regarding EPA's selection of BAT for FGD wastewater.

EPA disagrees with the commenter's analysis evaluating the incremental cost effectiveness for the biological treatment system, see response to DCN EPA-HQ-OW-2009-0819-4305-A3, Excerpt Number 52 in Comment Code 10.c.

Regarding the "operational challenges" for biological treatment, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107 in Comment Code 10.a.

For more information regarding flow minimization, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 102.

Commenter Name: John McManus
Commenter Affiliation: American Electric Power System (AEP)
Document Control Number: EPA-HQ-OW-2009-0819-4448-A1
Comment Excerpt Number: 15
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

2. FGD Wastewater

EPA has proposed several different options for the treatment of flue gas desulfurization (FGD) wastewater (78 FR at 34458). Under Option1, physical/chemical treatment, employing hydroxide precipitation, iron coprecipitation and sulfide precipitation, is the basis of the proposed effluent limitations and standards for FGD wastewater. Under Options 2, 3b (for facilities with a total wet-scrubbed capacity of 2,000 MW or more), 3, 4a, and 4, the same physical/chemical treatment is the basis of the proposed effluent limitations, but it is to be used in combination with anoxic/anaerobic biological treatment optimized to remove selenium. Under Option 5, chemical precipitation/coprecipitation, in combination with vapor compression evaporation, is the basis of the proposed limitations and standards.

Of the eight proposed options, three of the four preferred by the agency promote chemical precipitation in combination with biological treatment (Options 3b, 3, and 4a). AEP has concerns with all of the proposed options; however, Option 1 (chemical precipitation) comes closest to meeting the regulatory test of best available technology for FGD wastewater.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4305-A3, Excerpt Number 24.

Commenter Name: Jay Hudson
Commenter Affiliation: Santee Cooper
Document Control Number: EPA-HQ-OW-2009-0819-4476-A1
Comment Excerpt Number: 6
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

FGD Wastewater

In the proposed rule, EPA established several ways to manage FGD wastewater. Surface impoundments are the predominant technology used to treat FGD wastewater at power plants and they are effective at removing solid particles by gravity settling. EPA has noted that surface impoundments may not appropriately remove pollutants that are present primarily in soluble form and therefore suggested additional ways of controlling such pollutants, including chemica l precipitation, biological treatment, and vapor-compressi on evaporation. EGUs with a wet-scrubbed capacity greater than 2000 MW produce sufficient quantities of FGD wastewater that a technology based standard may be warranted. Therefore,Santee Cooper generally agrees that chemical precipitation, Option 1,may be an appropriate treatment option for facilities operating FGD systems serving more than 2000 MW of generation capacity, if EPA can demonstrate that it is cost effective. However, this treatment would be sufficient, and EPA should not additionally require biological treatment of FGD wastewater.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4305-A3, Excerpt Number 24.

Regarding the 2,000 MW threshold for FGD wastewater, see response to DCN EPA-HQ-OW-2009-0819-4477-A1, Excerpt Number 15 in Comment Code 5.c.

EPA disagrees with the assertion that a treatment option can only be selected as BAT "if EPA can demonstrate that it is cost effective." See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 105.

Commenter Name: Bruce W. Ramme
Commenter Affiliation: We Energies
Document Control Number: EPA-HQ-OW-2009-0819-4475-A1
Comment Excerpt Number: 44
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Uncertain Effects on FGD Wastewater Cost Estimates Associated with Installing Biological Treatment or Vapor-Compression Evaporation Technology.

We Energies is uncertain how the corrected normalized flow rates will impact EPA's plant-specific cost estimates for installing Biological Treatment or Vapor-Compression Evaporation Technology at OCPP-ERGS and PPPP because due to CBI claims, the cost estimates were not provided to us. However, more importantly, We Energies has concerns regarding the way EPA developed its cost estimates using normalized flow rates over 24 hours. We believe the more appropriate way to develop cost estimates is by using a peak design flow rate (as the equipment must be sized to handle the peak design flow, not the average flow). For OCPP-ERGS, this peak design flow rate is 354 gpm. For PPPP, the peak design flow rate is 75 gpm.

We Energies asks EPA to correct its plant-specific analysis of compliance costs and pollutant removals, which impacts the industry-wide analysis, based on the information provided in this comment letter.

Comment Response:

See response to *DCN* EPA-HQ-OW-2009-0819-4499-A1, Excerpt Numbers 26-27 in Comment Code 9.b.

Commenter Name: Quinlan J. Shea III
Commenter Affiliation: Edison Electric Institute (EEI)
Document Control Number: EPA-HQ-OW-2009-0819-4487-A1
Comment Excerpt Number: 24
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

For FGD wastewater, UWAG's analysis shows that chemical precipitation treatment is not cost-effective for plants with a maximum design flow rate of 200 gallons per minute (gpm) or less. Because of shortcomings in the data and cost calculations, documented below, EPA has not justified chemical precipitation as a national standard for FGD wastewater for smaller flow rates. And biological treatment is not cost-effective for units of any size. It is possible that, with additional data and analysis, EPA might be able to justify installing chemical precipitation for FGD wastewater at some plants. If so, we anticipate that an exception would have to be made for:

• plants with maximum design flow rates less than or equal to 200 gpm;

• plants that can demonstrate that, for their treatment of FGD wastewater, chemical precipitation would not be cost-effective; and

• plants that can demonstrate that, because of site- or plant-specific treatment features or conditions, chemical precipitation would be either technically or economically unavailable.

Comment Response:

Regarding chemical precipitation at plants with maximum design flow rates less than 200 gpm, see response to DCN EPA-HQ-OW-2009-0819-4379-A1, Excerpt Number 89 in Comment Code 9.

Regarding site-specific exemptions, see response to DCN EPA-HQ-OW-2009-0819-4460-A1, Excerpt Number 27.

Regarding cost-effectiveness, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 105.

Commenter Name: Patrick O'Loughlin
Commenter Affiliation: Buckeye Power, Inc.
Document Control Number: EPA-HQ-OW-2009-0819-4183-A2
Comment Excerpt Number: 3
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

<u>EPA has Not Accurately Assessed the Cost Effectiveness of Its Flue Gas Desulfurization Wastewater Control Options</u>

EPA has proposed multiple technology options for FGD wastewater including: (1) chemical precipitation, (2) chemical precipitation followed by biological treatment, and (3) chemical precipitation plus a full thermal ZLD system *(i.e.*, a brine concentrator followed by a crystallizer). Based on Buckeye Power's preliminary analysis, *none* of these technologies is cost effective, and the latter two present serious feasibility concerns. Buckeye Power refers EPA to AEP's thoughtful and comprehensive analysis of the cost effectiveness of EPA's various proposed treatment methodologies and effluent limits. Suffice it to say that the Agency's estimated costs and economic impacts are significantly below those based on actual facility installation costs. On a per plant basis, EPA's capital costs alone are 25%-66% lower than those determined by AEP. Buckeye Power asks that EPA re-visit its cost/benefit analysis.

Comment Response:

Regarding the "feasibility concerns" for FGD biological treatment and evaporation treatment, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107 in Comment Code 10.a and DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 108 in Comment Code 11.a, respectively.

Regarding AEP's cost effectiveness evaluation, see response to DCN EPA-HQ-OW-2009-0819-4448-A1, Excerpt Numbers 18 and 22.

Commenter Name: Tom DeLawrence
Commenter Affiliation: Alabama Power Company
Document Control Number: EPA-HQ-OW-2009-0819-4489-A1

Comment Excerpt Number: 13
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

B. Biological Treatment Cannot be BAT

As stated above, EPA erroneously lists chemical precipitation plus biological treatment as the model technology option for FGD wastewater in BAT options 3b (scrubber capacity >2,000 MW), 3, and 4a. EPA proposes the following limits for FGD wastewater in the Proposed Rule:

Pollutant	**Daily Max**	**Monthly Avg.**
As	8 ppb	6 ppb
Se	16 ppb	10 ppb
Hg	242	119
Nitrate/Nitrite-N	0.17 ppm	0.13 ppm

However, biological treatment is not a proven technology in the industry and, therefore, it should not have been considered as a technology option in the Proposed Rule. Although EPA has some discretion when reviewing the technologies that it may consider when determining the BAT for a point source, once it chooses the available technologies, it must be prepared to justify its decisions. *See e.g., Nat'l Wildlife Fed'n v. EPA*, 286 F.3d 554, 562 (D.C. Cir. 2002). A proper analysis of the BAT factors makes clear that biological treatment is not BAT.

Comment Response:

EPA disagrees with the commenter that "biological treatment is not a proven technology in the industry." See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107 in Comment Code 10.a. Additionally, see preamble section VIII for a discussion of EPA's rationale for selecting the chemical precipitation followed by biological treatment as the BAT basis for FGD wastewater discharges from units that are greater than 50 MW and that are not oil-fired.

Commenter Name: Elizabeth E. Aldridge, Hunton & Williams
Commenter Affiliation: UWAG
Document Control Number: EPA-HQ-OW-2009-0819-4655
Comment Excerpt Number: 79
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Based on the available data, UWAG has concluded that incremental biological treatment and incremental thermal ZLD treatment are not cost-effective. As for chemical precipitation, UWAG's preliminary analysis indicates that it may be cost-effective for some plants with a maximum design flow rate greater than 200 gpm, but it is not cost-effective below that threshold.

Accordingly, UWAG recommends that EPA consider these and other comments on FGD wastewater and then reopen the record to collect more data. Even for plants with maximum design flow rates greater than 200 gpm, assuming new limits prove to be cost-effective on a fuller record, we recommend that there be special provision for

- plants that can demonstrate that, at their sites, treatment by chemical precipitation is not cost-effective, and
- plants that can demonstrate that, because of site- or plant-specific factors, chemical precipitation is technically or economically unavailable.

Comment Response:

Regarding cost effectiveness see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 105.

Regarding chemical precipitation at plants with maximum design flow rates greater than 200 gpm, see response to DCN EPA-HQ-OW-2009-0819-4379-A1, Excerpt Number 89 in Comment Code 9.

Regarding site-specific exemptions, see response to DCN EPA-HQ-OW-2009-0819-4460-A1, Excerpt Number 27.

Regarding the evaluation of the incremental cost effectiveness for the biological treatment and evaporation system, see response to DCN EPA-HQ-OW-2009-0819-4305-A3, Excerpt Number 52 in Comment Code 10.c.

Commenter Name: Brian Brazil
Commenter Affiliation: TransAlta Centralia Generation, LLC (TCG)
Document Control Number: EPA-HQ-OW-2009-0819-4665-A2
Comment Excerpt Number: 5
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

<u>Comments on FGD Wastewater</u>
TransAlta supports Option 3b for FGD wastewater so that the permitting agency has the discretion to determine BAT for FGD systems. This is appropriate and allows the use of technologies that are "economically feasible" for a particular system. It is necessary for

permitting agencies to have discretion on what wastewater treatment technology is used on forced oxidation FGD systems like those at TCG. The systems produce dry gypsum as a saleable byproduct and do not discharge gypsum solids in the bleed wastewater. The bleed stream from these systems is a very low volume wastewater stream and is treated with chemical precipitation prior to going into the rest of the wastewater treatment system. The permitting agency must have complete discretion to allow this form of treatment and not be required force installation of additional treatment on low volume effluent streams that are already well treated.

Comment Response:

Regarding requiring BPJ determinations for FGD wastewater, see response to DCN EPA-HQ-OW-2009-0819-4383-A1, Excerpt Number 6 in Comment Code 6.j.i.

EPA notes that the regulations do not require facilities to implement the specific technologies that form the bases of the technology options, but only that the appropriate facility effluent limitations and standards be achieved. Plants may find that optimized chemical precipitation systems with enhanced solids separation technologies may be able to achieve the limitations.

Commenter Name: Ron Shipman
Commenter Affiliation: Georgia Power Company
Document Control Number: EPA-HQ-OW-2009-0819-4447-A1
Comment Excerpt Number: 23
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

EPA's cost per TWPE estimates for the various FGD options are as follows:

Technology Option	$/TWPE(1981)
Chemical Precipitation	$69
Chemical Precipitation and biological	$60
Chemical Precipitation and Vapor-Compression Evaporation	Not provided

EPA's TWPE analysis has two major flaws. First, EPA merged the benefits of chemical precipitation with the benefits of biological treatment. By doing so, EPA presented erroneous results which showed the TWPEs removed for the combination of these two treatment systems. These results are erroneous because most of the TWPEs are removed by the chemical precipitation system. Based on EPA's own sampling data, chemical precipitation accounts for 93% of the total TWPE removed and incremental biological treatment only accounts for 7%. Chemical precipitation and biological treatment systems are separate, and their costs and benefits should be evaluated independently.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4305-A3, Excerpt Number 52 in Comment Code 10.c.

Commenter Name: Daniel K. Plath
Commenter Affiliation: Northern Indiana Public Service Company (NIPSCO)
Document Control Number: EPA-HQ-OW-2009-0819-4508-A2
Comment Excerpt Number: 12
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

<u>FGD Wastewater BAT Options</u>

NIPSCO supports Options 3a and 3b in that they recognize the control of FGD wastewaters for direct discharge power plants using chemical precipitation or the allowance of a site-specific best professional judgment determination for facilities with < 2000 MW FGD scrubbing capacity. Given that various methods of chemical precipitation achieve low wastewater concentrations of arsenic, mercury, and selenium, we believe it appropriate to require controls to achieve trace levels of these metals and low levels of nitrate+nitrite as needed to protect the designated use of the power plant's receiving water. As an assessment is conducted to determine site-specific FGD wastewater controls, the development of additional controls may be tailored for the site whether via another stage of chemical precipitation, ion exchange, enhanced flow minimization, and/or biological treatment.

Comment Response:

Regarding requiring BPJ determinations for FGD wastewater, see response to DCN EPA-HQ-OW-2009-0819-4383-A1, Excerpt Number 6 in Comment Code 6.j.i.

Regarding the 2,000 MW threshold for FGD wastewater, see response to DCN EPA-HQ-OW-2009-0819-4477-A1, Excerpt Number 15 in Comment Code 5.c.

See response to DCN EPA-HQ-OW-2009-0819-4305-A3, Excerpt Number 24. EPA notes that the regulations do not require facilities to implement the specific technologies that form the bases of the technology options, but only that the appropriate facility effluent limitations and standards be achieved. Plants may find that optimized chemical precipitation systems with enhanced solids separation technologies may be able to achieve the limitations.

Commenter Name: Quinlan J. Shea III
Commenter Affiliation: Edison Electric Institute (EEI)
Document Control Number: EPA-HQ-OW-2009-0819-4487-A1
Comment Excerpt Number: 42
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

BPJ is Not Favored.

EPA also suggests a possible BPJ approach to determining proper FGD wastewater treatment under one of its preferred options 3a. EEI does not favor a BPJ approach. However, if EPA applies a BPJ approach, EPA must specify that the permit writer must follow the standards for making BPJ decisions as have long been prescribed by 40 C.F.R. § 125.3(d). The permit writer "must consider" the listed statutory factors, including cost, at least for BCT and BAT requirements.

If EPA does include an option for BPJ limits for FGD wastewater, it also should acknowledge that the data developed in this rulemaking establish that chemical precipitation with biological treatment and zero discharge are not cost-effective, for the reasons set out above. Therefore none of these treatments can be required if BPJ is used, at least without further investigation at a particular site.

Comment Response:

Regarding requiring BPJ determinations for FGD wastewater, see response to DCN EPA-HQ-OW-2009-0819-4383-A1, Excerpt Number 6 in Comment Code 6.j.i.

EPA established BAT effluent limitations based on the combination of chemical precipitation and biological treatment, as explained in Section VIII of the preamble.

Commenter Name: Michalene Reilly
Commenter Affiliation: Hoosier Energy Rural Electric Cooperative
Document Control Number: EPA-HQ-OW-2009-0819-4471-A1
Comment Excerpt Number: 11
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Flue Gas Desulfurization (FGD) wastewater limits based on chemical precipitation, but only for plants with maximum design flow (mdf) rate greater than 200 gallons per minute (gpm). EPA has not demonstrated that chemical precipitation is cost-effective for plants with mdf rates of 200 gpm or less, and EPA's record does not support biological treatment as cost-effective for plants of any size. Because of the weakness of EPA' s FGD analyses, the Agency should also allow plants with mdf rates greater than 200 gpm an opportunity to demonstrate that chemical precipitation is not cost effective or, for site- specific reasons, that chemical precipitation is technically or economically unavailable. (See UWAG comments Section VI - BAT for Flue Gas Desulfurization Wastewater, Section VII - EPA' s Proposed FGC Wastewater Limits are Flawed, and Section VIII -Miscellaneous FGD Issues.)

Comment Response:

Regarding chemical precipitation at plants with maximum design flow rates less than 200 gpm, see response to DCN EPA-HQ-OW-2009-0819-4379-A1, Excerpt Number 89 in Comment Code 9.

Regarding plant-specific exemptions, see response to DCN EPA-HQ-OW-2009-0819-4460-A1, Excerpt Number 27.

Regarding cost effectiveness see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 105.

Commenter Name: Chris M. Hobson
Commenter Affiliation: Southern Company
Document Control Number: EPA-HQ-OW-2009-0819-4379-A1
Comment Excerpt Number: 21
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

As to FGD wastewater, all technology options – with the possible exception of chemical precipitation *at some plants* – are not cost effective. As the industry analysis shows, chemical precipitation is not cost effective for plants with a maximum design flow rate of 200 gpm (gallons per minute) or less. Even for plants above that flow rate, site-specific circumstances can render the technology not technically or economically feasible. Therefore, Southern recommends that EPA provide an exception for:

- Plants with a maximum design flow rate of 200 gpm or less for FGD wastewatertreatment;
- Plants demonstrating that, for their FGD wastewater, chemical precipitation would not be cost effective; or
- Plants demonstrating that, because of site- or plant-specific treatment features or conditions, chemical precipitation would be either technically or economically unachievable.

Comment Response:

Regarding chemical precipitation at plants with maximum design flow rates less than 200 gpm, see response to DCN EPA-HQ-OW-2009-0819-4379-A1, Excerpt Number 89 in Comment Code 9.

Regarding plant-specific exemptions, see response to DCN EPA-HQ-OW-2009-0819-4460-A1, Excerpt Number 27.

Regarding cost-effectiveness, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 105.

Commenter Name: Chris M. Hobson
Commenter Affiliation: Southern Company
Document Control Number: EPA-HQ-OW-2009-0819-4379-A1
Comment Excerpt Number: 53
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Southern believes that the three technologies EPA evaluated – chemical precipitation, chemical precipitation plus biological treatment, and chemical precipitation plus vapor compression and evaporation – all present issues that challenge EPA's BAT determination rationale pursuant to the statutory factors of 304(b)(2). Southern Company recommends that EPA re-evaluate the treatment of FGD wastewater, using a larger dataset that more accurately reflects the FGD influent characteristics of the industry. EPA's current evaluation of FGD wastewater, and the possible technologies available to address FGD wastewater, is flawed and does not provide an adequate foundation for regulating this wastestream to the extremely stringent levels proposed for chemical precipitation, biological or zero liquid discharge (ZLD) treatment.

Comment Response:

Regarding EPA's evaluation of FGD wastewater, see response to DCN EPA-HQ-OW-2009-0819-4487-A1, Excerpt Number 113. EPA established BAT effluent limitations applicable to discharges of FGD wastewater from units that are greater than 50 MW and that are not oil-fired based on the combination of chemical precipitation and biological treatment, as explained in Section VIII of the preamble.

Commenter Name: Tom DeLawrence
Commenter Affiliation: Public Service Company of New Hampshire(PSNH)
Document Control Number: EPA-HQ-OW-2009-0819-4633-A1

Comment Excerpt Number: 42
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

PSNH opposes any regulation of FGD waste water utilizing a BPJ option as BAT. Imposing such a standard, or lack thereof, provides no certainty for the industry. It also has the potential to create an unequal playing field for facilities within a region or throughout the country. For instance, promulgating a BPJ standard could result in two facilities located only miles away from one another—but in separate states—having vastly different regulatory standards and, in turn, operational costs, solely because of the political persuasion and/or agendas of the agencies charged with drafting their respective NPDES permits. The agency should not promulgate a standard that has the potential for this disparate regulation of similar facilities merely because of their geographic location.

Comment Response:

EPA agrees with the commenter that a BPJ requirements "provides no certainty for the industry [and] has the potential to create an unequal playing field for facilities within a region or throughout the country." The final rule does not leave up to permitting authorities to establish BAT limitations applicable to FGD wastewater using their best professional judgment. See response to DCN EPA-HQ-OW-2009-0819-4383-A1, Excerpt Number 6 in Comment Code 6.j.i.

Commenter Name: Quinlan J. Shea III
Commenter Affiliation: Edison Electric Institute (EEI)
Document Control Number: EPA-HQ-OW-2009-0819-4487-A1
Comment Excerpt Number: 113
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

If EPA is determined to require chemical precipitation for some subset of plants with FGD wastewater, it cannot do it on the present record. Because of the problems with the EPA analyses of FGD wastewater identified in these comments, EPA should reopen the record, use better data, and correct the statistical problems with its calculations. With additional information, and subject to further public comment, EPA could then, if it wished, propose FGD wastewater limits. But if it does propose chemical precipitation, it should be only for plants with wet scrubbed capacity above 200 gpm and only for plants that do not demonstrate that, at a particular site, chemical precipitation is not cost-effective or not technically or economically available.

Comment Response:

In response to public comments, EPA has updated its analyses for FGD wastewater for the final rule, including its costs and loadings analyses. The final rule establishes BAT effluent limitations for FGD wastewater based on chemical precipitation plus biological treatment for units that are greater than 50 MW and that are not oil-fired. EPA determined that the final limitations are both technologically available and economically achievable. See Section VIII of the preamble.

Regarding site-specific exemptions, see response to DCN EPA-HQ-OW-2009-0819-4460-A1, Excerpt Number 27.

Regarding chemical precipitation at plants with maximum design flow rates less than 200 gpm, see response to DCN EPA-HQ-OW-2009-0819-4379-A1, Excerpt Number 89 in Comment Code 9.

Commenter Name: Elizabeth E. Aldridge, Hunton & Williams
Commenter Affiliation: UWAG
Document Control Number: EPA-HQ-OW-2009-0819-4655
Comment Excerpt Number: 137
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

If EPA is determined to require chemical precipitation for some subset of plants with FGD wastewater, it cannot do it on the present record. Because of the problems with the EPA analyses of FGD wastewater identified in these comments, EPA should reopen the record, use better data, and correct the statistical problems with its calculations. With additional information, and subject to further public comment, EPA could then if it wished propose FGD wastewater limits. But if it does propose chemical precipitation, it should be only for plants with a maximum design flow above 200 gpm and only for plants that do not demonstrate that, at a particular site, chemical precipitation is not cost-effective or not technically or economically available.

Comment Response:

Regarding EPA's evaluation of FGD wastewater, see response to DCN EPA-HQ-OW-2009-0819-4487-A1, Excerpt Number 113. Also see Section VIII of the preamble.

Regarding site-specific exemptions, see response to DCN EPA-HQ-OW-2009-0819-4460-A1, Excerpt Number 27.

Regarding chemical precipitation at plants with maximum design flow rates less than 200 gpm, see response to DCN EPA-HQ-OW-2009-0819-4379-A1, Excerpt Number 89 in Comment Code 9.

Commenter Name: Paul Ling
Commenter Affiliation: Kansas City Power & Light Company
Document Control Number: EPA-HQ-OW-2009-0819-5406-A2
Comment Excerpt Number: 9
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Except for plants with maximum design flow rates > 200 gallons per minute (gpm), none of EPA's technology options passes the cost-effectiveness test after proper TWPE removals and cost models are applied. Even within the >200 gpm threshold level, there may be some plants that can demonstrate that chemical precipitation at their site is not cost-effective, or for site-specific reasons, chemical precipitation is either technically or economically unavailable. Therefore, EPA should reconsider its entire approach to FGD wastewater regulation. EPA has failed to prove that chemical precipitation plus biological treatment is feasible or available, as required under CWA section 304(b) and should not be applied industry-wide.

Comment Response:

Regarding EPA's evaluation of FGD wastewater, see response to DCN EPA-HQ-OW-2009-0819-4487-A1, Excerpt Number 113.

Regarding site-specific exemptions, see response to DCN EPA-HQ-OW-2009-0819-4460-A1, Excerpt Number 27.

Regarding chemical precipitation at plants with maximum design flow rates less than 200 gpm, see response to DCN EPA-HQ-OW-2009-0819-4379-A1, Excerpt Number 89 in Comment Code 9.

Regarding the feasibility and availability of the chemical precipitation plus biological treatment system, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107 in Comment Code 10.a.

Commenter Name: Chris M. Hobson
Commenter Affiliation: Southern Company
Document Control Number: EPA-HQ-OW-2009-0819-4379-A1
Comment Excerpt Number: 63
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

EPA's industry-wide TWPE removals for FGD wastewater treatment are as follows:

Technology Option	TWPE/Year
One-Stage Chemical Precipitation	1,530,000
One-Stage Chemical Precipitation with Biological Treatment	2,620,000
One-Stage Chemical Precipitation with Evaporation/Crystallization	2,990,000

2013 TDD, Table 10-10 at 10-25.

EPA's cost per TWPE estimates for the various FGD options are as follows:

Technology Option	$/TWPE(1981)
Chemical Precipitation	$69
Chemical Precipitation and Biological	$60
Chemical Precipitation and Vapor-Compression Evaporation	Not provided

Cost Effectiveness of the Removing Toxic Pollutants for Direct Dischargers at a Wastestream/Technology Level (EPA-HQ-OW-2009-0819-2255).

Comment Response:

Regarding cost effectiveness see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 105.

Commenter Name: Elizabeth E. Aldridge, Hunton & Williams
Commenter Affiliation: UWAG
Document Control Number: EPA-HQ-OW-2009-0819-4655
Comment Excerpt Number: 92
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

EPA's industrywide TWPE removals for FGD wastewater treatment are as follows:

Technology Option	TWPE/Year
One-Stage Chemical Precipitation	1,530,000
One-Stage Chemical Precipitation with Biological Treatment	2,620,000

Technology Option	TWPE/Year
One-Stage Chemical Precipitation with Evaporation/Crystallization	2,990,000

2013 TDD, Table 10-10 at 10-25.

EPA's cost per TWPE estimates for the various FGD options are as follows:

Technology Option	$/TWPE(1981)
Chemical Precipitation	$69
Chemical Precipitation and Biological	$60
Chemical Precipitation and Vapor-Compression Evaporation	Not provided

Cost Effectiveness of the Removing Toxic Pollutants for Direct Dischargers at a Wastestream/Technology Level (EPA-HQ-OW-2009-0819-2255).

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4379-A1, Excerpt Number 63.

Regarding cost effectiveness see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 105.

Commenter Name: Dorothy Kellogg and Michael Leitman
Commenter Affiliation: National Rural Electric Cooperative Association (NRECA)
Document Control Number: EPA-HQ-OW-2009-0819-4565-A1
Comment Excerpt Number: 8
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Flue Gas Desulfurization (FGD) wastewater limits based on chemical precipitation, but only for plants with maximum design flow (mdf) rate greater than 200 gallons per minute (gpm). EPA has not demonstrated that chemical precipitation is cost-effective for plants with mdf of 200 gpm or less, and EPA's record does not support biological treatment as cost-effective for plants of any size. Because of the weakness of EPA's FGD analyses, the Agency should also allow plants with mdf greater than 200 gpm an opportunity to demonstrate that chemical precipitation is not cost effective or, for site-specific reasons, that chemical precipitation is technically or economically unavailable.

Comment Response:

Regarding chemical precipitation at plants with maximum design flow rates less than 200 gpm, see response to DCN EPA-HQ-OW-2009-0819-4379-A1, Excerpt Number 89 in Comment Code 9.

Regarding plant-specific exemptions, see response to DCN EPA-HQ-OW-2009-0819-4460-A1, Excerpt Number 27.

Regarding cost effectiveness see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 105.

Commenter Name: Jamie Rhodes
Commenter Affiliation: Environment Council of Rhode Island
Document Control Number: EPA-HQ-OW-2009-0819-4034-A2
Comment Excerpt Number: 8
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Our organizations urge EPA to require chemical precipitation plus vapor evaporation to treat FGD wastewater, as proposed under Option 5. FGD, or "scrubber" wastewater is especially toxic, and this wastestream will only increase in volume and toxicity as more power plants install scrubbers to control air pollutants. Unfortunately, much of that toxic waste is ending up in our water. Of the 145 power plants identified by EPA to generate scrubber wastewater, over half use only surface impoundments (settling ponds) to treat that wastewater[12]. As mentioned previously, ponds are ineffective at treating dissolved metals, nutrients and total dissolved solids.

---

[12] 78 Fed. Reg. at 34,451

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4548-A1, Excerpt Number 7.

Commenter Name: Elizabeth E. Aldridge, Hunton & Williams
Commenter Affiliation: UWAG
Document Control Number: EPA-HQ-OW-2009-0819-4655
Comment Excerpt Number: 14
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Again, EPA should reopen the record. It is possible that, with additional data and analysis, EPA might be able to justify installing chemical precipitation for FGD wastewater *at some plants*. If so, UWAG anticipates that an exception would have to be made for:
• plants with maximum design flow rates less than or equal to 200 gpm;
• plants that can demonstrate that, for their treatment by FGD wastewater, chemical precipitation would not be cost-effective; and
• plants that can demonstrate that, because of site- or plant-specific treatment features or conditions, chemical precipitation would be either technically or economically unavailable.

Comment Response:

Regarding EPA's evaluation of FGD wastewater, see response to DCN EPA-HQ-OW-2009-0819-4487-A1, Excerpt Number 113.

Regarding site-specific exemptions, see response to DCN EPA-HQ-OW-2009-0819-4460-A1, Excerpt Number 27.

Regarding chemical precipitation at plants with maximum design flow rates less than 200 gpm, see response to DCN EPA-HQ-OW-2009-0819-4379-A1, Excerpt Number 89 in Comment Code 9.

Commenter Name: Cari Boyce
Commenter Affiliation: Duke Energy
Document Control Number: EPA-HQ-OW-2009-0819-4305-A3
Comment Excerpt Number: 41
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Other technologies included in the Proposed Rule, such as biological treatment and vapor-compression evaporation, will require a chemical precipitation system as an upstream treatment in order to reduce the TSS. Given the effective removal of a majority of the FGD wastewater constituents by the upstream chemical precipitation system, the additional treatment provided by either a biological or vapor-compression evaporation system has only a marginal incremental benefit. Duke Energy performed an independent evaluation of the TWPE removal for the FGD wastewater to support this conclusion.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4305-A3, Excerpt Number 52 in Comment Code 10.c.

Commenter Name: Tom DeLawrence
Commenter Affiliation: PowerSouth Energy Cooperative
Document Control Number: EPA-HQ-OW-2009-0819-4460-A1
Comment Excerpt Number: 36
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Should EPA reject PowerSouth's assertions that physical/chemical treatment is not BAT, PowerSouth requests that the agency at least provide permit writers some discretion to exempt certain facilities from any BAT standard based on unique circumstances. Specifically, PowerSouth supports EPA permitting an exemption from the FGD wastewater BAT standard any facility able to demonstrate that: 1) treatment by chemical precipitation is not cost-effective at their site; or 2) chemical precipitation is technically or economically unavailable because of site- or plant-specific factors.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4460-A1, Excerpt Number 27.

Commenter Name: Quinlan J. Shea III
Commenter Affiliation: Edison Electric Institute (EEI)
Document Control Number: EPA-HQ-OW-2009-0819-4487-A1
Comment Excerpt Number: 119
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

EPA has not justified chemical precipitation as a national standard for FGD wastewater for smaller flow rates. And biological treatment is not cost-effective for units of any size. EPA should reopen the record to determine whether, with additional data and analysis, installing chemical precipitation for FGD wastewater *at some plants* might be justified. If so, EEI anticipates that an exception would needed for certain plants with smaller flow rates or that can demonstrate chemical precipitation is not cost-effective or available on a site-specific basis.

Comment Response:

Regarding cost effectiveness see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 105.

Regarding the representativeness of the FGD wastewater data used to characterize the effluent from the treatment technologies, see response to DCN EPA-HQ-OW-2009-0819-4655-A2, Excerpt Number 20 in Comment Code 8.c and EPA-HQ-OW-2009-0819-4655, Excerpt Numbers 107 in Comment Code 10.a and 124 in Comment Code 4.b.

Regarding the selection of BAT for FGD wastewater and site-specific exemptions, see Section VIII of the preamble and the response to DCN EPA-HQ-OW-2009-0819-4460-A1, Excerpt Number 27.

For information regarding chemical precipitation at plants with maximum design flow rates less than 200 gpm, see response to DCN EPA-HQ-OW-2009-0819-4379-A1, Excerpt Number 89 in Comment Code 9.

Commenter Name: Stephen M. Frank
Commenter Affiliation: NRG Energy, Inc.
Document Control Number: EPA-HQ-OW-2009-0819-4510-A2
Comment Excerpt Number: 15
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

In light of the foregoing concerns that biological systems are inherently unstable and subject to upsets, EPA should reconsider its proposed FGD wastewater limits and adopt a standard that is economically feasible. As part of EPA's consideration of technological availability and economic achievability of its proposed FGD limits for this regulatory option, EPA should reconsider the magnitude and complexity of process changes and new equipment installations that would be required at facilities to meet the requirements of the rule.

Comment Response:

EPA disagrees with the commenter that the "biological systems are inherently unstable and subject to upsets." See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107 in Comment Code 10.a regarding the performance of the biological treatment system. Additionally, see response to DCN EPA-HQ-OW-2009-0819-5140-A2, Excerpt Number 60 regarding upset and bypass accommodations, should there be an upset of the biological treatment system.

EPA notes that it did consider the magnitude and complexity of process changes and new equipment installations for the final rule in respect to the costs that would be incurred to comply with the final rule. See the TDD and the Cost & Loads Report.

Commenter Name: Tom DeLawrence
Commenter Affiliation: Alabama Power Company
Document Control Number: EPA-HQ-OW-2009-0819-4489-A1
Comment Excerpt Number: 20
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

D. Utilizing Best Professional Judgment for FGD Wastewater Limitations

Alabama Power would likely be amenable to EPA's regulatory Option 3, which would establish BPJ as the case-specific standard by which various permit writers would determine BAT at each facility for FGD wastewaters. Alabama Power perceives an obvious benefit in having permit writers and others with extensive knowledge about its specific facilities making the determination as to what technologies are appropriate as BAT for this waste stream.

Comment Response:

Regarding EPA's evaluation of FGD wastewater, see response to DCN EPA-HQ-OW-2009-0819-4487-A1, Excerpt Number 113.

Regarding requiring BPJ determinations for FGD wastewater, see response to DCN EPA-HQ-OW-2009-0819-4383-A1, Excerpt Number 6 in Comment Code 6.j.i.

Commenter Name: Stephen M. Frank
Commenter Affiliation: NRG Energy, Inc.
Document Control Number: EPA-HQ-OW-2009-0819-4510-A2
Comment Excerpt Number: 16
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Preferred Options 3a & 3b

Under Option 3a and Option 3b (for units located at facilities with a total wet- scrubbed capacity of fewer than 2,000 MW), effluent limitations representing BAT for discharges of FGD wastewater would be determined on a site-specific best professional judgment (BPJ) basis. NRG supports Option 3a and 3b. Use of BPJ in Pennsylvania has been applied successfully across the Commonwealth where necessary to protect the receiving water using water quality-based effluent limits (WQBELs).

Comment Response:

Regarding EPA's evaluation of FGD wastewater, see response to DCN EPA-HQ-OW-2009-0819-4487-A1, Excerpt Number 113.

Regarding requiring BPJ determinations for FGD wastewater, see response to DCN EPA-HQ-OW-2009-0819-4383-A1, Excerpt Number 6 in Comment Code 6.j.i.

Commenter Name: Leonard F. Hopkins
Commenter Affiliation: Southern Illinois Power Cooperative (SIPC)
Document Control Number: EPA-HQ-OW-2009-0819-4309-A1
Comment Excerpt Number: 9
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

5) EPA has not demonstrated that chemical precipitation is cost-effective for plants with mdf of 200 gpm or less, and EPA's record does not support biological treatment as cost-effective for plants of any size. Because of the weakness of EPA's FGD analyses, the Agency should also allow plants with mdf greater than 200 gpm an opportunity to demonstrate that chemical precipitation is not cost effective or, for site-specific reasons, that chemical precipitation is technically or economically unavailable.

Comment Response:

Regarding chemical precipitation at plants with maximum design flow rates less than 200 gpm, see response to DCN EPA-HQ-OW-2009-0819-4379-A1, Excerpt Number 89 in Comment Code 9.

Regarding site-specific exemptions, see response to DCN EPA-HQ-OW-2009-0819-4460-A1, Excerpt Number 27.

Regarding cost effectiveness see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 105.

Commenter Name: P. J. Becker
Commenter Affiliation: City Water, Light and Power (CWLP)
Document Control Number: EPA-HQ-OW-2009-0819-4349-A2
Comment Excerpt Number: 2
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Wet Flue Gas Desulphurization Systems (WFGD)

CWLP agrees with USEPA technology options 3a and 3b for WFGD wastewater effluent limits. Options 3a and 3b (under 3b option allows for a smaller unit exemption - for units located at facilities with a total wet-scrubbed capacity of less than 2,000 MW), effluent limitations representing best available technology economically achievable (BAT) for discharges of WFGD wastewater would be determined on a site-specific best professional judgment (BPJ) basis.

Comment Response:

Regarding EPA's evaluation of FGD wastewater, see response to DCN EPA-HQ-OW-2009-0819-4487-A1, Excerpt Number 113.

Regarding requiring BPJ determinations for FGD wastewater, see response to DCN EPA-HQ-OW-2009-0819-4383-A1, Excerpt Number 6 in Comment Code 6.j.i.

Commenter Name: Pamela F. Faggert
Commenter Affiliation: Dominion Resources, Inc.
Document Control Number: EPA-HQ-OW-2009-0819-4631-A1
Comment Excerpt Number: 7
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

We support EPA's intent to add flexibility for the treatment of FGD wastewaters. Specifically, EPA contemplates a Best Professional Judgment (BPJ) standard for FGD wastewaters which would allow permitting agencies to balance treatment, plant operations, and costs when evaluating FGD treatment systems. While a BPJ standard does not provide regulatory certainty for dischargers, we do support EPA's acknowledgement of the site-specific intricacies of treating FGD effluent at existing facilities.

Comment Response:

Regarding EPA's evaluation of FGD wastewater, see response to DCN EPA-HQ-OW-2009-0819-4487-A1, Excerpt Number 113.

Regarding requiring BPJ determinations for FGD wastewater, see response to DCN EPA-HQ-OW-2009-0819-4383-A1, Excerpt Number 6 in Comment Code 6.j.i.

Commenter Name: Chris M. Hobson
Commenter Affiliation: Southern Company
Document Control Number: EPA-HQ-OW-2009-0819-4379-A1
Comment Excerpt Number: 94
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Finally, if (contrary to our recommendations), EPA decides to require chemical precipitation as treatment for FGD wastewater, EPA should *at least* provide a measure of flexibility by including an exception for plants where installing a chemical precipitation treatment system would be either (1) technically unavailable because there is enough space to place the equipment or (2) economically unachievable because the cost is disproportionate to the benefits of removing the additional pollutants.

Comment Response:

Regarding EPA's evaluation of FGD wastewater, see response to DCN EPA-HQ-OW-2009-0819-4487-A1, Excerpt Number 113.

Regarding site-specific exemptions, see response to DCN EPA-HQ-OW-2009-0819-4460-A1, Excerpt Number 27.

Commenter Name: Paul Chu
Commenter Affiliation: Electric Power Research Institute (EPRI)
Document Control Number: EPA-HQ-OW-2009-0819-4499-A1
Comment Excerpt Number: 35
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

3.2.5 *EPA's evaluation to reduce high flow rate from plants releasing more than 1,000 gpm is incomplete and does not consider additional costs to modify equipment. EPRI does not use these reduced flow rates to estimate costs for the industry.*

Using the ICR-supplied flow rates instead of EPA's reduced flow rates results in an estimate of increase in total annualized cost for the industry that is 3 percent higher than EPA's calculation. Please see Section 3.1.5 for further discussion.

Comment Response:

For more information regarding flow minimization, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 102.

Commenter Name: Paul Chu
Commenter Affiliation: Electric Power Research Institute (EPRI)
Document Control Number: EPA-HQ-OW-2009-0819-4499-A1
Comment Excerpt Number: 1
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Key Comments on FGD Wastewater Treatment Cost-Effectiveness Assessment

EPA's calculated cost/toxic-weighted pounds-equivalent (TWPE) ratios for treatment of FGD wastewater via chemical precipitation (CP), biological systems, and vapor-compression evaporation (VCE) are lower than EPRI's. The incremental pollutant removal of biological and VCE treatments should be considered, as it provides a direct comparison between the costs and pollutant removals for each individual technology.

Comment Response:

For information regarding cost-effectiveness, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 105.

Regarding the evaluation of the incremental cost effectiveness for the biological treatment and evaporation system, see response to DCN EPA-HQ-OW-2009-0819-4305-A3, Excerpt Number 52 in Comment Code 10.c.

Commenter Name: Dean Ellis
Commenter Affiliation: Dynegy Inc.
Document Control Number: EPA-HQ-OW-2009-0819-4491-A1
Comment Excerpt Number: 19
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Accordingly, Dynegy supports UWAG's recommendation that EPA consider these and other comments on FGD wastewater and then reopen the record to collect more data. If the EPA should open the record with a NODA and chemical precipitation for FGD wastewater is justified at some plants, exceptions should be allowed for plants that can demonstrate that chemical precipitation is not cost effective and because of site-specific conditions it would be economically unavailable.

Comment Response:

Regarding EPA's evaluation of FGD wastewater, see response to DCN EPA-HQ-OW-2009-0819-4487-A1, Excerpt Number 113.

Regarding cost effectiveness see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 105.

Regarding site-specific exemptions, see response to DCN EPA-HQ-OW-2009-0819-4460-A1, Excerpt Number 27.

Commenter Name: John W. Myers
Commenter Affiliation: Tennessee Valley Authority (TVA)
Document Control Number: EPA-HQ-OW-2009-0819-4607-A1
Comment Excerpt Number: 15
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

c. Adding Nitrate-Nitrite ELGs to FGD Wastewaters Hinders Cost-Effective Compliance Flexibility and is Not Demonstrated to Be Achievable

In its resource stewardship role, TVA believes that there is work to be done in improving the nation's water quality, especially with regard to nutrients. However, we are not convinced that EPA's establishment of a nitrate-nitrite technology-based effluent limitation is the most effective way to improve water quality for nutrients.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4517-A2, Excerpt Number 9.

Commenter Name: Doris Cooksey
Commenter Affiliation: City Public Service of San Antonio (CPS Energy)
Document Control Number: EPA-HQ-OW-2009-0819-4283-A1
Comment Excerpt Number: 11
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Based on industry studies, EPA appears to have overestimated the removal efficiencies of chemical physical +biological treatment and also appears not to have fully captured all costs for retrofits required for these technologies. When corrected, the results are a very high TWPE cost. (See detailed comments from Electric Power Research Institute.) The corrected cost benefit for biological treatment is not warranted nor the cost of vapor compression evaporation.

Comment Response:

EPA has revised its cost estimates for the chemical precipitation and the biological treatment system. Regarding revisions to the chemical precipitation system costs, see responses to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Numbers 24-29. Regarding revisions to the biological treatment system costs, see responses to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Numbers 30-34, 43-44, 46, and 105.

EPA has also revised its pollutant loading estimates, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 95 in Comment Code 10.c.

Regarding cost effectiveness see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 105.

Commenter Name: Glen Porter
Commenter Affiliation: Prairie State Generating Company, LLC (PSGC)
Document Control Number: EPA-HQ-OW-2009-0819-4651-A2
Comment Excerpt Number: 4
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

PSGC is particularly supportive of EPA's proposal for flue gas desulfurization (FGD) wastewater for units located at facilities with a total of web-scrubbed capacity of less than 2000 MW to establish effluent limitations representing best available technology economically achievable (BAT) on a site specific best professional judgment (BPJ) basis. This allows technological innovations for treatment of FGD wastewater to be developed for each site as appropriate.

Comment Response:

Regarding the 2,000 MW threshold for FGD wastewater, see response to DCN EPA-HQ-OW-2009-0819-4477-A1, Excerpt Number 15 in Comment Code 5.c.

Regarding requiring BPJ determinations for FGD wastewater, see response to DCN EPA-HQ-OW-2009-0819-4383-A1, Excerpt Number 6 in Comment Code 6.j.i.

Commenter Name: Jacob G. Smeltz
Commenter Affiliation: Electric Power Generation Association (EPGA)
Document Control Number: EPA-HQ-OW-2009-0819-4450-A1
Comment Excerpt Number: 12
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

In reviewing the Proposal, EPGA is concerned that the standards required for the flue gas desulfurization ("FGD") wastestream are unachievable and that the cost estimates provided by EPA are severely understated. While UWAG's comments provide much more specificity on these issues, EPGA raises our concerns that EPA would ultimately promulgate a rule that would provide no reasonable method(s) for compliance while simultaneously imposing significant costs.

Comment Response:

Regarding the achievability of the numeric limitations for FGD wastewater, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107 in Comment Code 10.a.

In response to public comments on the proposed rule, EPA has revised its cost estimates for the chemical precipitation and the biological treatment system. Regarding revisions to the chemical precipitation system costs, see responses to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Numbers 24-27, and 29 in Comment Code 9.b and Excerpt Number 28 in this comment code. Regarding revisions to the biological treatment system costs, see responses to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Numbers 30-34, 43-44, 46, and 105 in Comment Code 10.b.

Commenter Name: Cecile M. Conroy
Commenter Affiliation: International Brotherhood of Boilermakers (IBB)
Document Control Number: EPA-HQ-OW-2009-0819-4557-A1
Comment Excerpt Number: 4
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Similarly, several of the treatment technologies for FGD wastewater provide minimal incremental environmental benefits beyond that which is already achievable through chemical precipitation. Two notable examples are the combination of chemical precipitation with either biological treatment or evaporative technologies. Ineach case, EPA should reject the regulatory option that poorly optimizes the proposed treatment technology and compliance costs.

Comment Response:

Regarding EPA's evaluation of FGD wastewater, see response to DCN EPA-HQ-OW-2009-0819-4487-A1, Excerpt Number 113.

Regarding the additional treatment achieved through biological treatment or evaporation treatment, see response to DCN EPA-HQ-OW-2009-0819-4305-A3, Excerpt Number 52 in Comment Code 10.c.

Commenter Name: Theresa Pugh
Commenter Affiliation: American Public Power Association (APPA)
Document Control Number: EPA-HQ-OW-2009-0819-5140-A2
Comment Excerpt Number: 98
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

1. There should be no ELG revisions for plants that can demonstrate that, for their treatment by Flue Gas Desulfurization (FGD) wastewater, chemical precipitation would **not** be cost-effective;
2. The final rule should allow for plants that can demonstrate that, because of site- or plant-specific treatment features and conditions, chemical precipitation would be either technically or economically unavailable to have no additional ELG requirements

Comment Response:

Regarding EPA's evaluation of FGD wastewater, see response to DCN EPA-HQ-OW-2009-0819-4487-A1, Excerpt Number 113

For more information regarding site-specific exemptions, see response to DCN EPA-HQ-OW-2009-0819-4460-A1, Excerpt Number 27.

Commenter Name: Paul Chu
Commenter Affiliation: Electric Power Research Institute (EPRI)
Document Control Number: EPA-HQ-OW-2009-0819-4499-A1
Comment Excerpt Number: 42
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

3.5 Additional treatment costs not captured by EPA or industry estimates

This section discusses a number of situations or factors that could increase the costs of the proposed numeric limits for FGD wastewater treatment beyond those estimated quantitatively by EPRI, as described above. Thus, they suggest that those costs represent a floor, or minimum, cost to the industry of the proposed FGD wastewater numeric limits.

Comment Response:

See responses to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Numbers 43-46 in Comment Code 10.b.

Commenter Name: Cari Boyce
Commenter Affiliation: Duke Energy
Document Control Number: EPA-HQ-OW-2009-0819-4305-A3
Comment Excerpt Number: 42
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

While biological treatment systems have been deployed to address specific water-quality standards, a national effluent guideline based on this technology is not reasonable, especially based on a dollars per TWPE removed. As stated above, the majority of TWPE removed in a combined chemical precipitation and biological treatment system is removed in the chemical precipitation component (potentially greater than 90%).

Comment Response:

Regarding cost effectiveness see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 105.

Regarding evaluation of the incremental cost effectiveness for the biological treatment and evaporation systems, see response to DCN EPA-HQ-OW-2009-0819-4305-A3, Excerpt Number 52 in Comment Code 10.c.

Commenter Name: J. Michael Brown
Commenter Affiliation: Ohio Valley Electric Corporation (OVEC)
Document Control Number: EPA-HQ-OW-2009-0819-4182-A2
Comment Excerpt Number: 2

External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Chemical precipitation is the Best Available Technology (BAT) for FGD waste water

Chemical precipitation prior to discharge to a surface impoundment is the best option for treatment. This allows facilities to use existing surface impoundments as a source of secondary treatment. We refer EPA to the comments submitted by AEP, UWAG, EPRI and EEI for additional details supporting chemical precipitation as BAT.

Comment Response:

Regarding EPA's evaluation of FGD wastewater, see response to DCN EPA-HQ-OW-2009-0819-4487-A1, Excerpt Number 113.

EPA notes that the regulations do not require facilities to implement the specific technologies that form the bases of the technology options, but only that the appropriate facility effluent limitations and standards be achieved. Plants may find that optimized chemical precipitation systems with enhanced solids separation technologies may be able to achieve the limitations.

Commenter Name: Dean Ellis
Commenter Affiliation: Dynegy Inc.
Document Control Number: EPA-HQ-OW-2009-0819-4491-A1
Comment Excerpt Number: 13
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

With respect to **FGD wastewater**, three of EPA's preferred options (Options 3b, 3, and 4a) would require both chemical precipitation and biological treatment. Option 3b, as applied to facilities with total wet scrubbed capacity of less than 2,000 MW, and Option 3a would apply BPJ effluent limits to FGD wastewater. Dynegy believes the existing record can only justify BPJ requirements for FGD wastewater.

Comment Response:

Regarding EPA's evaluation of FGD wastewater, see response to DCN EPA-HQ-OW-2009-0819-4487-A1, Excerpt Number 113.

Regarding requiring BPJ determinations for FGD wastewater, see response to DCN EPA-HQ-OW-2009-0819-4383-A1, Excerpt Number 6 in Comment Code 6.j.i.

Regarding the 2,000 MW threshold for FGD wastewater, see response to DCN EPA-HQ-OW-2009-0819-4477-A1, Excerpt Number 15.

Commenter Name: Douglas J. Fulle
Commenter Affiliation: Oglethorpe Power Corporation
Document Control Number: EPA-HQ-OW-2009-0819-4449-A1
Comment Excerpt Number: 2
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

For FGD wastewater, none of EPA's technology options are cost-effective, once proper cost models are used and compared to the appropriate $/TWPE threshold. EPA has misjudged the cost effectiveness of FGD options by failing to evaluate chemical precipitation and biological treatment methods separately and by assuming the removal of certain pollutants that are not removed by biological treatment.

Comment Response:

Regarding cost effectiveness see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 105.

Regarding the pollutant removal estimates, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 95 in Comment Code 10.c.

Regarding evaluation of the incremental cost effectiveness for the biological treatment and evaporation systems, see response to DCN EPA-HQ-OW-2009-0819-4305-A3, Excerpt Number 52 in Comment Code 10.c.

Commenter Name: Jay Hudson
Commenter Affiliation: Santee Cooper
Document Control Number: EPA-HQ-OW-2009-0819-4476-A1
Comment Excerpt Number: 5
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

We are particularly concerned that EPA's evaluation of FGD wastewater , and the possible technologies available to address FGD wastewater, is not representative enough of the wide variations in coal types, scrubbers, and operational patterns within the industry to appropriately address the costs . Most importantly,we do not believe that biological treatment and ZLD treatment are cost effective.

Comment Response:

Regarding the representativeness of the FGD wastewater data used to characterize the effluent from the treatment technologies, see response to DCN EPA-HQ-OW-2009-0819-4655-A2, Excerpt Number 20 in Comment Code 8.c and EPA-HQ-OW-2009-0819-4655, Excerpt Numbers 107 in Comment Code 10.a and 124 in Comment Code 4.b.

Regarding cost effectiveness see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 105.

Regarding evaluation of the incremental cost effectiveness for the biological treatment and evaporation systems, see response to DCN EPA-HQ-OW-2009-0819-4305-A3, Excerpt Number 52 in Comment Code 10.c.

Commenter Name: Cari Boyce
Commenter Affiliation: Duke Energy
Document Control Number: EPA-HQ-OW-2009-0819-4305-A3
Comment Excerpt Number: 44
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Duke Energy supports EPA's conclusion that vapor-compression evaporation, a thermal zero liquid discharge (ZLD) system, for FGD wastewater is not a preferred technology. This technology is not cost-effective compared to other technologies evaluated and has a very limited experience base in the U.S. for treating FGD wastewater and then, with only a relatively low volume treatment capacity.

Comment Response:

Regarding EPA's evaluation of FGD wastewater, see response to DCN EPA-HQ-OW-2009-0819-4487-A1, Excerpt Number 113. The combination of chemical precipitation and evaporation was selected as the basis for NSPS, and for the BAT effluent limitations in the voluntary incentives program. See Section VIII of the preamble.

Regarding the demonstration of the evaporation system, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 108 in Comment Code 11.a.

Regarding the cost effectiveness of the evaporation system, see response to DCN EPA-HQ-OW-2009-0819-4460-A1, Excerpt Number 47 in Comment Code 11.

Commenter Name: Michael G. Cashin
Commenter Affiliation: Minnesota Power (MP)
Document Control Number: EPA-HQ-OW-2009-0819-4484-A1
Comment Excerpt Number: 3
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

FGD Treatment Technology. MP comments that EPA's technology based treatment methods for Flue Gas Desulfurization (FGD) wastewaters are unproven due to the lack of commercial demonstration of treatment equipment performance at the operating capacity and under the field conditions typical of electric generating units. FGD wastewaters should be managed by Best Professional Judgment (BPJ).

Comment Response:

Regarding the representativeness of the FGD wastewater data used to characterize the effluent from the treatment technologies, see response to DCN EPA-HQ-OW-2009-0819-4655-A2, Excerpt Number 20 in Comment Code 8.c and EPA-HQ-OW-2009-0819-4655, Excerpt Numbers 107 in Comment Code 10.a and 124 in Comment Code 4.b. The availability of the biological and evaporation technologies, as well as other technologies and processes that would be able to meet the effluent limitations, is well demonstrated. See the TDD and record for the rule.

Regarding requiring BPJ determinations for FGD wastewater, see response to DCN EPA-HQ-OW-2009-0819-4383-A1, Excerpt Number 6 in Comment Code 6.j.i.

Commenter Name: Barbara A. Walz
Commenter Affiliation: Tri-State Generation and Transmission Association, Inc.
Document Control Number: EPA-HQ-OW-2009-0819-4465-A1
Comment Excerpt Number: 1
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

The Electric Power Research Institute (EPRI) analyzed the EPA cost-benefit analysis for several wastewater streams, including FGD wastewater and bottom ash transport wastewater, identifying significant calculation and assumptions errors. The chemical precipitation, biological and vapor compression evaporation treatment costs for FGD wastewater underestimated total installed costs.

Comment Response:

Regarding EPRI's comments on EPA's FGD chemical precipitation cost methodology, see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Numbers 24-27 and 29 in Comment Code 9.b and Excerpt Number 28 in this comment code.

Regarding EPRI's comments on EPA's FGD biological treatment cost methodology, see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Numbers 30-34, 43-44, 46, and 105 in Comment Code 10.b.

Regarding EPRI's comments on EPA's FGD evaporation treatment cost methodology, see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 106 in Comment Code 11.b.

Commenter Name: Cari Boyce
Commenter Affiliation: Duke Energy
Document Control Number: EPA-HQ-OW-2009-0819-4305-A2
Comment Excerpt Number: 1
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Chemical precipitation alone, without the flow minimization requirements, should be the technology basis for treating FOG wastewater . EPA has not proven that incremental biological treatment is cost-effective or feasible over a wide range of plants. Likewise, EPA has not proven that incremental vapor-compression evaporat ion is cost-effective or commercially available.

Comment Response:

Regarding EPA's evaluation of FGD wastewater, see response to DCN EPA-HQ-OW-2009-0819-4487-A1, Excerpt Number 113.

Regarding evaluation of the incremental cost effectiveness for the biological treatment and evaporation systems, see response to DCN EPA-HQ-OW-2009-0819-4305-A3, Excerpt Number 52 in Comment Code 10.c.

Regarding the commercial availability of the biological treatment system, DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107 in Comment Code 10.a.

Regarding the commercial availability of the evaporation system, DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 108 in Comment Code 11.a.

Regarding flow minimization, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 102.

Commenter Name: Cari Boyce
Commenter Affiliation: Duke Energy
Document Control Number: EPA-HQ-OW-2009-0819-4305-A3
Comment Excerpt Number: 131
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Chemical precipitation alone, without the flow minimization requirements, should be the technology basis for treating FDG wastewater. EPA has not proven that incremental biological treatment is cost-effective or feasible over a wide range of plants. Likewise, EPA has not proven that incremental vapor-compression evaporation is cost-effective or commercially available.

Comment Response:

Regarding EPA's evaluation of FGD wastewater, see response to DCN EPA-HQ-OW-2009-0819-4487-A1, Excerpt Number 113.

Regarding evaluation of the incremental cost effectiveness for the biological treatment and evaporation systems, see response to DCN EPA-HQ-OW-2009-0819-4305-A3, Excerpt Number 52 in Comment Code 10.c.

Regarding the commercial availability of the biological treatment system, DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107 in Comment Code 10.a.

Regarding the commercial availability of the evaporation system, DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 108 in Comment Code 11.a.

Regarding flow minimization, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 102.

Commenter Name: Doris Cooksey
Commenter Affiliation: City Public Service of San Antonio (CPS Energy)
Document Control Number: EPA-HQ-OW-2009-0819-4283-A1
Comment Excerpt Number: 8

External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

EPA has proposed several options for Flue Gas Desulfurization (FGD) wastewater; chemical treatment, chemical +biological treatment, and vapor compression evaporation. Settling remains a very effective and cost efficient way to remove solid particles. However, it is understood additional treatment, such as chemical precipitation, is needed to remove soluble pollutants.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4487-A1, Excerpt Number 113.

Commenter Name: Elizabeth E. Aldridge, Hunton & Williams
Commenter Affiliation: UWAG
Document Control Number: EPA-HQ-OW-2009-0819-4655
Comment Excerpt Number: 1
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Flue gas desulfurization wastewater

The record is inadequate for the selection of any technology option and the development of limits. Based on our preliminary analysis, using the available data, no additional treatment can be justified on a cost-effectiveness basis for plants with a maximum design flow rate less than or equal to 200 gpm

Comment Response:

Regarding EPA's evaluation of FGD wastewater, see response to DCN EPA-HQ-OW-2009-0819-4487-A1, Excerpt Number 113.

Regarding cost effectiveness see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 105.

Regarding plants with maximum design flow rates less than 200 gpm, see response to DCN EPA-HQ-OW-2009-0819-4379-A1, Excerpt Number 89 in Comment Code 9.

Commenter Name: Theresa Pugh
Commenter Affiliation: American Public Power Association (APPA)
Document Control Number: EPA-HQ-OW-2009-0819-5140-A2
Comment Excerpt Number: 22
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

The state of the record, with the BAT options it supports, is as follows:

Table 2:

Wastestream	**Record Supports No More than This Option**
Flue gas desulfurization wastewater	No additional treatment can be justified on a cost-effectiveness basis for plants with a maximum design flow rate less than or equal to 200 gallons per minute (gpm)

Comment Response:

Regarding EPA's evaluation of FGD wastewater, see response to DCN EPA-HQ-OW-2009-0819-4487-A1, Excerpt Number 113.

Regarding cost effectiveness see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 105.

Regarding plants with maximum design flow rates less than 200 gpm, see response to DCN EPA-HQ-OW-2009-0819-4379-A1, Excerpt Number 89 in Comment Code 9.

Commenter Name: Raven Power Holdings, LLC
Commenter Affiliation: Raven Power Holdings, LLC
Document Control Number: EPA-HQ-OW-2009-0819-4467-A1
Comment Excerpt Number: 4
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Raven Power submits that best available technology economically achievable (BAT) limits should be based on chemical precipitation. EPA has not demonstrated that any other technology or combination of technologies represents BAT. In particular, EPA has not demonstrated that the proposed nitrate limitations are achievable with BAT.

Comment Response:

Regarding EPA's evaluation of FGD wastewater, see response to DCN EPA-HQ-OW-2009-0819-4487-A1, Excerpt Number 113.

Regarding the achievability of the nitrate/nitrate (as N) limitation, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107 in Comment Code 10.a. Also see the Statistical Support Document for Effluent Limitations (DCN SE05733).

Commenter Name: Chris M. Hobson
Commenter Affiliation: Southern Company
Document Control Number: EPA-HQ-OW-2009-0819-4379-A1
Comment Excerpt Number: 90
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

If EPA decides not to conduct additional sampling, then it should allow plants with maximum design flow rates above 200 gpm an opportunity to demonstrate that chemical precipitation at their site is not cost effective or, for site-specific reasons, that chemical precipitation is either technically or economically unavailable.

Comment Response:

Regarding EPA's evaluation of FGD wastewater, see response to DCN EPA-HQ-OW-2009-0819-4487-A1, Excerpt Number 113.

Regarding plants with maximum design flow rate less than 200 gpm, see response to DCN EPA-HQ-OW-2009-0819-4379-A1, Excerpt Number 89 in Comment Code 9.

For more information regarding site-specific exemptions, see response to DCN EPA-HQ-OW-2009-0819-4460-A1, Excerpt Number 27.

Commenter Name: Elizabeth E. Aldridge, Hunton & Williams
Commenter Affiliation: UWAG
Document Control Number: EPA-HQ-OW-2009-0819-4655
Comment Excerpt Number: 129

External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

If EPA decides not to conduct additional sampling, then it should allow plants with maximum design flow rates above 200 gpm an opportunity to demonstrate that chemical precipitation at their site is not cost effective or, for site-specific reasons, that chemical precipitation is either technically or economically unavailable.

Comment Response:

Regarding EPA's evaluation of FGD wastewater, see response to DCN EPA-HQ-OW-2009-0819-4487-A1, Excerpt Number 113.

Regarding plants with maximum design flow rate less than 200 gpm, see response to DCN EPA-HQ-OW-2009-0819-4379-A1, Excerpt Number 89 in Comment Code 9.

For more information regarding site-specific exemptions, see response to DCN EPA-HQ-OW-2009-0819-4460-A1, Excerpt Number 27.

Commenter Name: Cari Boyce
Commenter Affiliation: Duke Energy
Document Control Number: EPA-HQ-OW-2009-0819-4305-A3
Comment Excerpt Number: 55
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

While Duke Energy supports EPA's Option 1, which bases treatment of FGD wastewater on chemical precipitation, it also contends that the BAT limits should be revised to account for the process capability on variable FGD wastewater. Duke proposes that more sampling data is required to develop the basis for these limits.

Comment Response:

Regarding the representativeness of the FGD wastewater data used to characterize the effluent from the treatment technologies, see response to DCN EPA-HQ-OW-2009-0819-4655-A2, Excerpt Number 20 in Comment Code 8.c and EPA-HQ-OW-2009-0819-4655, Excerpt Numbers 107 in Comment Code 10.a and 124 in Comment Code 4.b. Additionally, EPA obtained additional FGD wastewater data from industry data requests and public comments for the final rule. See Section 3 of the TDD for additional details.

Commenter Name: Floyd Gilzow
Commenter Affiliation: Missouri Joint Municipal Electric Utility Commission (MJMEUC)
Document Control Number: EPA-HQ-OW-2009-0819-4576-A1
Comment Excerpt Number: 6
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

- Plants that can demonstrate that, for their treatment by FGD wastewater, chemical precipitation would not be cost-effective; and
- Plants that can demonstrate that, because of site- or plant-specific treatment features or conditions, chemical precipitation would be either technically or economically unavailable

Comment Response:

Regarding EPA's evaluation of FGD wastewater, see response to DCN EPA-HQ-OW-2009-0819-4487-A1, Excerpt Number 113.

Regarding cost effectiveness see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 105.

For more information regarding site-specific exemptions, see response to DCN EPA-HQ-OW-2009-0819-4460-A1, Excerpt Number 27.

Commenter Name: Theresa Pugh
Commenter Affiliation: American Public Power Association (APPA)
Document Control Number: EPA-HQ-OW-2009-0819-5140-A2
Comment Excerpt Number: 36
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Plants that can demonstrate that, for their treatment by FGD wastewater, chemical precipitation would **not** be cost-effective; and

Plants that can demonstrate that, because of site- or plant-specific treatment features or conditions, chemical precipitation would be either technically or economically unavailable.

Comment Response:

Regarding EPA's evaluation of FGD wastewater, see response to DCN EPA-HQ-OW-2009-0819-4487-A1, Excerpt Number 113.

Regarding cost effectiveness see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 105.

For more information regarding site-specific exemptions, see response to DCN EPA-HQ-OW-2009-0819-4460-A1, Excerpt Number 27.

Commenter Name: F. Gilzow
Commenter Affiliation: Missouri Joint Municipal Electric Utility Commission
Document Control Number: EPA-HQ-OW-2009-0819-5517-A2
Comment Excerpt Number: 8
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Plants that can demonstrate that, for their treatment by FGD wastewater, chemical precipitation would not be cost-effective; and

Plants that can demonstrate that, because of site- or plant-specific treatment features or conditions, chemical precipitation would be either technically or economically unavailable.

Comment Response:

Regarding EPA's evaluation of FGD wastewater, see response to DCN EPA-HQ-OW-2009-0819-4487-A1, Excerpt Number 113.

Regarding cost effectiveness see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 105.

For more information regarding site-specific exemptions, see response to DCN EPA-HQ-OW-2009-0819-4460-A1, Excerpt Number 27.

Commenter Name: Tom DeLawrence
Commenter Affiliation: PowerSouth Energy Cooperative
Document Control Number: EPA-HQ-OW-2009-0819-4460-A1
Comment Excerpt Number: 3
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

PowerSouth believes the record supports the following best available technology options:

Flue Gas Desulfurization Wastewater – Best professional judgment. Chemical precipitation may be BAT; however, EPA should provide exemptions for cost- effectiveness and site-specific factors.

Comment Response:

Regarding EPA's evaluation of FGD wastewater, see response to DCN EPA-HQ-OW-2009-0819-4487-A1, Excerpt Number 113.

Regarding cost effectiveness see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 105

Regarding site-specific exemptions, see response to DCN EPA-HQ-OW-2009-0819-4460-A1, Excerpt Number 27.

Regarding requiring BPJ determinations for FGD wastewater, see response to DCN EPA-HQ-OW-2009-0819-4383-A1, Excerpt Number 6 in Comment Code 6.j.i.

Commenter Name: Pamela F. Faggert
Commenter Affiliation: Dominion Resources, Inc.
Document Control Number: EPA-HQ-OW-2009-0819-4631-A1
Comment Excerpt Number: 12
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

If EPA is compelled to move forward with technology standards for FGD effluent, the BPJ option, while not preferred, accounts for a site-specific consideration of plant operations, including the specific amounts of pollutants potentially removed relative to the projected costs.

Comment Response:

Regarding EPA's evaluation of FGD wastewater, see response to DCN EPA-HQ-OW-2009-0819-4487-A1, Excerpt Number 113.

Regarding site-specific exemptions, see response to DCN EPA-HQ-OW-2009-0819-4460-A1, Excerpt Number 27.

Regarding requiring BPJ determinations for FGD wastewater, see response to DCN EPA-HQ-OW-2009-0819-4383-A1, Excerpt Number 6 in Comment Code 6.j.i.

Commenter Name: Paul Chu
Commenter Affiliation: Electric Power Research Institute (EPRI)
Document Control Number: EPA-HQ-OW-2009-0819-4499-A1
Comment Excerpt Number: 2
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

EPA underestimated the cost of chemical precipitation, biological, and VCE treatment for the industry, primarily because all the cost factors that are typical of these projects were not incorporated to accurately extrapolate from vendor equipment costs to total installed costs.

Comment Response:

Regarding FGD chemical precipitation cost estimates, see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Numbers 24-27 and29 in Comment Code 8 and Excerpt Number 28 in Comment Code 8.

Regarding FGD biological treatment cost estimates, see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Numbers 30-34, 43-44, 46, and 105 in Comment Code 10.b.

Regarding FGD evaporation treatment cost methodology, see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 106 in Comment Code 11.b.

Commenter Name: Chris M. Hobson
Commenter Affiliation: Southern Company
Document Control Number: EPA-HQ-OW-2009-0819-4379-A1
Comment Excerpt Number: 18
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Regarding FGD wastewater, the two options of (1) chemical precipitation followed by biological treatment and (2) zero liquid discharge (*i.e.*, chemical precipitation followed by vapor compression and evaporation) are not technologically feasible and/or cost effective.

Comment Response:

Regarding EPA's evaluation of FGD wastewater, see response to DCN EPA-HQ-OW-2009-0819-4487-A1, Excerpt Number 113.

Regarding evaluation of the incremental cost effectiveness for the biological treatment and evaporation systems, see response to DCN EPA-HQ-OW-2009-0819-4305-A3, Excerpt Number 52 in Comment Code 10.c.

Regarding the commercial availability of the biological treatment system, DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107 in Comment Code 10.a.

Regarding the commercial availability of the evaporation system, DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 108 in Comment Code 11.a.

Commenter Name: Cari Boyce
Commenter Affiliation: Duke Energy
Document Control Number: EPA-HQ-OW-2009-0819-4305-A3
Comment Excerpt Number: 4
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Duke Energy supports EPA's Option 1 in establishing chemical precipitation, without the flow minimization requirements, as the model technology for FGD wastewater. This technology removes the majority of the constituents in FGD wastewater, and is readily available.

Comment Response:

Regarding EPA's evaluation of FGD wastewater, see response to DCN EPA-HQ-OW-2009-0819-4487-A1, Excerpt Number 113.

Regarding evaluation of the incremental cost effectiveness for the biological treatment and evaporation systems, see response to DCN EPA-HQ-OW-2009-0819-4305-A3, Excerpt Number 52 in Comment Code 10.c.

Regarding flow minimization, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 102.

Commenter Name: Theresa Pugh
Commenter Affiliation: American Public Power Association (APPA)
Document Control Number: EPA-HQ-OW-2009-0819-5140-A2
Comment Excerpt Number: 7

External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

The final rule should allow for plants that can demonstrate that, because of site- or plant-specific treatment features and conditions, chemical precipitation would be either technically or economically unavailable to have no additional ELG requirements.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4460-A1, Excerpt Number 27.

Commenter Name: Quinlan J. Shea III
Commenter Affiliation: Edison Electric Institute (EEI)
Document Control Number: EPA-HQ-OW-2009-0819-4487-A1
Comment Excerpt Number: 17
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

EPA relied on a very few plants to identify the best achievable technology, including only two similar plants for flue gas desulfurization wastewater. This analysis does not meet the requirements of CWA section 304(b).

Comment Response:

EPA disagrees with the commenter that its "[BAT] analysis does not meet the requirements of CWA section 304(b)" see preamble section VII for EPA's evaluation of BAT.

Regarding the representativeness of the FGD wastewater data used to characterize the effluent from the treatment technologies, see response to DCN EPA-HQ-OW-2009-0819-4655-A2, Excerpt Number 20 in Comment Code 8.c and EPA-HQ-OW-2009-0819-4655, Excerpt Numbers 107 in Comment Code 10.a and 124 in Comment Code 4.b.

Commenter Name: Theresa Pugh
Commenter Affiliation: American Public Power Association (APPA)
Document Control Number: EPA-HQ-OW-2009-0819-5140-A2
Comment Excerpt Number: 13
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

EPA should not presume that Zero Liquid Discharge (ZLD) or biological systems should be required everywhere just because they while have worked very well in some locations (especially western locations.)

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 108 in Comment Code 11.a.

Commenter Name: Theresa Pugh
Commenter Affiliation: American Public Power Association (APPA)
Document Control Number: EPA-HQ-OW-2009-0819-5140-A2
Comment Excerpt Number: 103
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

EPA should not presume that Zero Liquid Discharge (ZLD) or biological systems should be required everywhere just because they while have worked very well in some locations (especially western locations.)

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 108 in Comment Code 11.a.

Commenter Name: Tom DeLawrence
Commenter Affiliation: PowerSouth Energy Cooperative
Document Control Number: EPA-HQ-OW-2009-0819-4460-A1
Comment Excerpt Number: 45
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

ZLD is not an available or appropriate technology to consider for FGD wastewater treatment, and EPA should not consider Option 5 or any other scenario which requires utilizing this unproven technology.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 108 in Comment Code 11.a.

Commenter Name: John W. Myers
Commenter Affiliation: Tennessee Valley Authority (TVA)
Document Control Number: EPA-HQ-OW-2009-0819-4607-A1
Comment Excerpt Number: 14
External Review Flag: Statistics
External Review Incorporated into Response: No

Comment Excerpt:

TVA recommends that the ELGs for FGD wastewaters be based on chemical precipitation alone and set at appropriate 95 percentile UCL using a robust data set that reflects the variability of the industry.

Comment Response:

Regarding EPA's evaluation of FGD wastewater, see response to DCN EPA-HQ-OW-2009-0819-4487-A1, Excerpt Number 113.

Regarding the representativeness of the FGD wastewater data used to characterize the effluent from the treatment technologies, see response to DCN EPA-HQ-OW-2009-0819-4655-A2, Excerpt Number 20 in Comment Code 8.c and EPA-HQ-OW-2009-0819-4655, Excerpt Numbers 107 in Comment Code 10.a and 124 in Comment Code 4.b.

EPA disagrees that the UCL95 is appropriate for setting limitations. The UCL95 is the same as the tolerance limitation addressed in Appendix A, Essay Section 4.2.1.

Commenter Name: Theresa Pugh
Commenter Affiliation: American Public Power Association (APPA)
Document Control Number: EPA-HQ-OW-2009-0819-5140-A2
Comment Excerpt Number: 65
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

APPA is not convinced that ZLD is appropriate for all sizes and types of plants. Chemical precipitator technology is preferable (with the inclusion of the smaller plant threshold as recommended).

Comment Response:

Regarding EPA's evaluation of FGD wastewater, see response to DCN EPA-HQ-OW-2009-0819-4487-A1, Excerpt Number 113.

For more information about the rationale for "small" units, see response to DCN EPA-HQ-OW-2009-0819-4477-A1, Excerpt Number 2 in Comment Code 5.b.

Commenter Name: Theresa Pugh
Commenter Affiliation: American Public Power Association (APPA)
Document Control Number: EPA-HQ-OW-2009-0819-5140-A2
Comment Excerpt Number: 6
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

There should be no ELG revisions for plants that can demonstrate that, for their treatment by Flue Gas Desulfurization (FGD) wastewater, chemical precipitation would **not** be cost-effective.

Comment Response:

For more information regarding site-specific exemptions, see response to DCN EPA-HQ-OW-2009-0819-4460-A1, Excerpt Number 27.

Regarding cost effectiveness see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 105.

Commenter Name: Floyd Gilzow
Commenter Affiliation: Missouri Joint Municipal Electric Utility Commission (MJMEUC)
Document Control Number: EPA-HQ-OW-2009-0819-4576-A1
Comment Excerpt Number: 4
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

- Chemcalprecipitationreatentistt-effective for plants with a maximum design flow rate of 200 (gallons per minute) gpm or less

Comment Response:

Regarding treatment at plants with maximum design flow rates less than 200 gpm, see response to DCN EPA-HQ-OW-2009-0819-4379-A1, Excerpt Number 89 in Comment Code 9.

Commenter Name: Dean Ellis
Commenter Affiliation: Dynegy Inc.
Document Control Number: EPA-HQ-OW-2009-0819-4491-A1
Comment Excerpt Number: 15
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

UWAG has demonstrated that incremental biological treatment and incremental thermal ZLD treatment are not cost effective.

Comment Response:

EPA disagrees with the commenter's analysis evaluating the incremental cost effectiveness for the biological treatment and evaporation systems, see response to DCN EPA-HQ-OW-2009-0819-4305-A3, Excerpt Number 52 in Comment Code 10.c.

Commenter Name: Raven Power Holdings, LLC
Commenter Affiliation: Raven Power Holdings, LLC
Document Control Number: EPA-HQ-OW-2009-0819-4467-A1
Comment Excerpt Number: 36
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Chemical precipitation should be the BAT technology basis for treating FGD wastewater.

Comment Response:

Regarding EPA's evaluation of FGD wastewater, see response to DCN EPA-HQ-OW-2009-0819-4487-A1, Excerpt Number 113.

Commenter Name: Thomas Cmar
Commenter Affiliation: Earthjustice, et al.
Document Control Number: EPA-HQ-OW-2009-0819-4684-A1
Comment Excerpt Number: 53
External Review Flag: Legal
External Review Incorporated into Response: No

Comment Excerpt:

A. CHEMICAL PRECIPITATION PLUS MECHANICAL EVAPORATION IS BAT FOR FGD WASTEWATER.

EPA should set BAT limits for FGD wastewater based on chemical precipitation plus mechanical evaporation for all facilities regardless of size.[180] The BAT standard requires achievement of 'effluent limitations . . . which . . . shall require application of the best available technology economically achievable . . . , which will result in reasonable further progress toward the national goal of eliminating the discharge of all pollutants."[181] According to the CWA's legislative history, the starting point for identifying BAT is not the average plant, but the "single best performing plant in an industrial field" in terms of its capacity to reduce pollutant discharges.[182] EPA may look to technologies in use in other industries that could be transferred to the industry in question and may also consider technologies that have not been implemented in full scale but have been shown to be viable in research.[183]

The leading technology for treatment of FGD wastewater—and the only one that will push the industry towards the national goal of zero liquid discharge as soon as possible—is chemical precipitation, followed by vapor-compression evaporation and crystallization, which we will refer to as "mechanical evaporation."

Mechanical evaporation is also the only technology evaluated by EPA that addresses all pollutants present in the FGD waste stream, as EPA itself acknowledges in the Proposed Rule: "Option 5 would control other pollutants in FGD wastewater that Options 1 through 4 do not effectively control, namely boron, bromides, and TDS.[184] An industry study conducted six years ago also concluded that "[mechanical] [e]vaporation is a comprehensive means of dealing with FGD wastewaters, resulting in the capture of essentially all of the water's pollutants and returning clean water to the process or other plant uses."[185] Mechanical evaporation is the BAT option required by this record, because as EPA notes, "without question, Option 5 would remove the most pollutants from steam electric power plant discharges."[186] EPA cannot elect to ignore boron, bromides, and TDS. Because a feasible technology exists to curb harmful discharges of boron, bromides, and TDA, EPA must select that technology as BAT both as a matter of law under the Clean Water Act and responsible public health policy.

180 EPA's proposed 50 MW threshold is not supported by the record. Only one plant with an FGD wastewater stream is smaller than 50 MW, which results in an unreasonably high cost estimate for that category. *See* EPA-HQ- OW-2009-0819-2258, at Table 7. Figures 5 and 6 in that document do not show any relationship between plant size and the cost per MW of installing an FGD treatment system.

181 33 U.S.C. § 1311(b)(2)(A).

182 *Chem Mfrs. Ass'n v. EPA*, 870 F.2d 177, 239 (5th Cir. 1989) (*citing* Congressional Research Service, *A Legislative History of the Water Pollution Control Act Amendments of 1972* at 170 (1973) at 170).

183 These determinations, arising out of the CWA's legislative history, have repeatedly been upheld by the courts. *E.g., Am. Petroleum Inst. v. EPA*, 858 F.2d 261, 264–65 (5th Cir. 1988); *Pac. Fisheries*, 615 F.2d at 816–17.

184 78 Fed. Reg. at 34,477.

185 Electric Power Research Institute, Treatment Technology Summary for Critical Pollutants of Concern in Power Plant Wastewaters, Jan. 2007 ("EPRI 2007"), Docket No. EPA-HQ-OW-2009-0819-2168, at 4-3.

186 78 Fed. Reg. at 34,473.

Comment Response:

EPA agrees with the commenter that the evaporation system is technologically available and that it results in the most pollutant removal of all the options evaluated by EPA for the treatment of FGD wastewater. However, EPA decided it would not be appropriate to identify evaporation as the basis for BAT limitations for FGD wastewater at all steam electric power plants because of the high cost of possible regulatory requirements based on evaporation for FGD wastewater. See preamble section VIII for additional details.

Commenter Name: Thomas Cmar
Commenter Affiliation: Earthjustice, et al.
Document Control Number: EPA-HQ-OW-2009-0819-4684-A1
Comment Excerpt Number: 80
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

3. The other BAT factors do not alter the conclusion that biological treatment is technologically and economically achievable.

None of the other factors that EPA has considered under 33 U.S.C. § 1314(b)(2)(B) counsel against selecting biological treatment as BAT. EPA's record supports that the age of a generating unit does not affect the feasibility of biological treatment. Because the FGD wastewater is transferred to a pond or wastewater treatment system and treated in a distinct system, the plant's age is irrelevant.[313] Over a dozen of the plants that operate chemical precipitation systems are at least 40 years old, and all five plants operating biological treatment systems are at least 20 years old, while one is a 50 years old.[314]

Nor does the size of a given facility affect the feasibility of biological treatment. The ABMet reactor system can be scaled upward to treat the FGD blowdown from multiple units or larger units. EPA analyzed unit-level annualized costs for FGD wastewater treatment compared to unit capacity, and the data show no discernible trends as the capacity of a unit increases.[315] This outcome is sensible, because the cost to treat FGD wastewater using a biological system depends in large part on the FGD blowdown rate, with is more strongly related to scrubber type and construction, coal type, and permitted SO2 emission limits.

For the vast majority of plants, available space will not be not a constraint for installation of the chemical precipitation plus biological treatment system. The chemical precipitation and biological treatment option involves, in a physical sense, a series of connected tanks. This system is unlike lagoon-based aerobic biological systems or constructed wetlands which may have a larger footprint.[316] At the Allen plant, five acres were set aside for the ABMet system, which ended up using only half of that space.[317] For the Roxboro plant, which has the largest flow of any scrubber treated with ABMet,[318] the footprint is less than one acre.[319] Considerable space is already used at these plant areas for the massive impoundments currently used to "treat" the wastewater prior to discharge. A single surface impoundment can occupy up to 300 acres of the plant site.[320] Closure of these ponds would free up considerable space for the relatively small tank system needed for the biological treatment option. Many coal-burning power plants are located in rural, undeveloped areas, and could readily purchase a few acres of adjacent land if necessary. Moreover, the biological treatment system need not be located in any particular area on the plant site—it can be relatively remote from the FGD system, so long as there is a clear path for a pipe or conduit to transmit the FGD wastewater to the initial equalization tank.[321]

---

[313] EPA-HQ-OW-2009-0819-2258, at 5-6.

[314] *Id.* at 6.

[315] *See* ERG Non-CBI Subcategorization Memo, EPA-HQ-OW-2009-0819-2258, at Figures 5 & 6.

[316] *See, e.g., Ass'n of Pac. Fisheries v. E.P.A.*, 615 F.2d 794, 819-20 (9th Cir. 1980) (noting large land area required for aerated lagoon-based treatment system).

[317] Blankenship, Docket No. EPA-HQ-OW-2009-0819-1233, at 3.

[318] *Id.*

[319] Sonstegard, Full Scale Operation, EPA-HQ-OW-2009-0819-2079, at 3.

[320] TDD at 8-6.

[321] *See* ERG Non-CBI Subcategorization Memo, EPA-HQ-OW-2009-0819-2258, at 5-6.

Comment Response:

EPA agrees with the commenter that "[n]one of the other factors that EPA has considered under 33 U.S.C. § 1314(b)(2)(B) counsel against selecting biological treatment as BAT." As such, EPA has selected the chemical precipitation followed by biological treatment as the basis for the BAT limitations for discharges of FGD wastewater from units that are greater than 50 MW and that are not oil-fired (see preamble section VIII). See Section 5 of the TDD for a discussion of the criteria evaluated and EPA's determination regarding the subcategorization of the industry.

Commenter Name: Becky Hayat
Commenter Affiliation: Natural Resources Defense Council (NRDC)
Document Control Number: EPA-HQ-OW-2009-0819-4490-A1
Comment Excerpt Number: 17
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

In summary, from a cost efficiency point of view, only larger plants (i.e. plants with a FGD wastewater discharge flow rate greater than 1,000 gpm) are likely to recycle their FGD wastewater; furthermore, because plants only have the potential to recycle if they are operating below 80 percent of the maximum design level threshold, the majority of plants across the U.S. do not fit under this category and thus are not able to recycle their FGD wastewater.

Based on these aforementioned reasons, we urge EPA to choose Option 5, or at a minimum Option 4, as the final rule because in addition to requiring the most stringent standard for controlling pollutants, the projected water savings from the technology treatment for FGD wastewater will be at its maximum. As discussed above, the potential to produce water savings from FGD wastewater under Option 4 is limited.[32] By contrast, the technology basis for the effluent limitations and standards for FGD wastewater in Option 5 is chemical precipitation/coprecipitation used in combination with vapor compression evaporation.[33] This technology uses an evaporator to produce a concentrated wastewater stream and a reusable distillate stream. The concentrated wastewater stream is either disposed of or further processed to produce a solid byproduct and additional distillate. Because the evaporation process pulls out the chlorides in the FGD wastewater, the distillate water can be either recycled back to the FGD process or used in other plant operations (e.g. boiler make-up water). Consequently, plants that are subject to compliance with the technology standard under Option 5 will be able to recycle their FGD wastewater, resulting in greater reductions in water use.[34]

[32] This is further supported by the fact that based on responses from the Steam Electric industry survey that was sent out to the 733 plants, EPA estimated that only five plants would be able to incorporate recycling within their FGD systems based on the maximum operating chlorides concentration compared to the design maximum chlorides concentration. See ELGs at 34,522.

[33] ELGs at 34,460.

[34] In estimating the reductions in water use associated with the regulatory options, EPA operated under the assumption that plants would recycle their FGD wastewater as part of their treatment system if chemical precipitation and biological treatment were the applicable technology basis (Options 3, 4a, and 4). However, in arriving at these water savings estimations, EPA did not take into account the additional FGD wastewater that may be recycled under a chemical precipitation and vapor compression evaporation technology treatment (Option 5). This explains for why even though Option 5 is the only regulatory measure that proposes chemical precipitation/coprecipitation and vapor compression evaporation as the BAT for treating FGD wastewater, EPA's projected water savings for Options 4 and 5 are nevertheless the same (153 billion gallons per year).

Comment Response:

EPA agrees with the commenter that the evaporation system "in addition to requiring the most stringent standard for controlling pollutants, the projected water savings from the technology treatment for FGD wastewater will be at its maximum." EPA acknowledges the any reductions in water use associated with FGD wastewater are limited due to the high chloride levels in FGD wastewater, except when the chlorides are removed by the evaporation system. However, EPA did not select the evaporation system as BAT for FGD wastewater discharges from all existing steam electric power generating units, for the reasons explained in preamble section VIII. Thus, even if there were additional water savings associated with evaporation technology that EPA did not calculate, it would have not changed EPA's determination in this regard.

Commenter Name: Becky Hayat
Commenter Affiliation: Natural Resources Defense Council (NRDC)
Document Control Number: EPA-HQ-OW-2009-0819-4490-A1
Comment Excerpt Number: 16
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Under the effluent limitations requirement proposed in Option 4, EPA concedes that the technology basis for FGD wastewater (e.g. chemical precipitation and biological treatment) will not reduce the amount of water used unless plants recycle FGD wastewater as part of their treatment system.[29] Thus, in calculating the potential amount of reductions in water use with respect to the technology basis for treating FGD wastewater amongst the regulatory options, EPA had to operate under the assumption that plants would be both capable and willing to recycle their FGD wastewater. Moreover, the cost of the FGD treatment system is strongly influenced by the volume of the wastestream to be treated (i.e., gpm); hence, EPA stated that for these high flow plants (defined as plants with a FGD discharge flow rate greater than 1,000 gpm), it would be more cost efficient for them to implement additional recycle with the FGD system[30] because those FGD systems with large flow rates could incorporate some degree (or some additional degree) of water recycle within the FGD system as a means for reducing the purge flow sent to treatment, and thereby reducing the capital and O&M costs of the treatment system. Lastly, recycling FGD wastewater increases the level of chlorides in the FGD system, but because there is a maximum allowable concentration for chloride in the FGD system, only plants that have a sufficient margin between the operating chloride concentration and the maximum allowable concentration will be able to implement additional recycling of the ir FGD wastewater.[31]

[29] ELGs at 34,522.

[30] Incremental Costs and Pollutants Removals at 4-13.

[31] EPA used data from the Steam Electric Survey to identify the FGD systems with the potential capability to recycle their FGD wastewater and the amount of recycle that can be accommodated. For all "high flow" plants without some level of treatment in place, EPA compared each FGD system's current operating chlorides level to the specified maximum design chlorides limit provided in Part B Section 4 (Flue Gas Desulfurization Systems– Wet FGD System Information). Based on site visit discussions and data from the industry, EPA determined that plants can operate up to 80 percent of the maximum design chlorides level without significant corrosion concerns. As a result, EPA identified any system operating below 80 percent of the maximum design threshold as having the potential to recycle some FGD wastewater. FGD systems that already operate at or near the maximum chlorides design concentration would not be able to increase their level of recycle without potentially corroding the FGD scrubber system. Five of the 12 high flow plants were identified as having the potential to implement some level of FGD wastewater recycle. See id. at 4-13 – 4-14.

Comment Response:

For more information regarding flow minimization, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 102.

Commenter Name: Thomas Cmar
Commenter Affiliation: Earthjustice, et al.
Document Control Number: EPA-HQ-OW-2009-0819-4684-A1
Comment Excerpt Number: 88

External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

C. CHEMICAL PRECIPITATION IS NOT BAT FOR FGD WASTE.

EPA has proposed, under Option 1, to establish effluent limits based on chemical precipitation of FGD wastewater. However, EPA properly has not identified Option 1 as a preferred option, because the record does not support a conclusion that chemical precipitation is BAT for FGD wastewater. BAT-based numeric effluent limits "shall require the elimination of discharges of all pollutants if the Administrator finds, on the basis of information available to him ... that such elimination is technologically and economically achievable."[342] As the record shows, chemical precipitation "is not effective at removing many of the pollutants of concern in FGD wastewater, including selenium, nitrogen compounds, and certain metals that contribute to high concentrations of total dissolved solids in FGD wastewater (e.g., bromides, boron)."[343] As described above, *supra* Section I, selenium is highly toxic to aquatic organisms. Nitrates in drinking water are especially dangerous for children under the age of six, and are the cause of methemoglobinemia, or "blue baby syndrome."[344] Chemical precipitation does nothing to address either of these pollutants. Even for the pollutants that chemical precipitation can treat, such as mercury and arsenic, adding biological treatment achieves even greater reduction.[345]

---

[342] 33 U.S.C. § 1311(b)(2)(A) (emphasis added).

[343] 78 Fed. Reg. at 34,473.

[344] *See* U.S. EPA, Basic Information about Nitrate in Drinking Water, http://water.epa.gov/drink/contaminants/basicinformation/nitrate.cfm (last viewed Sept. 19, 2013).

[345] *Id.*

Comment Response:

EPA agrees with the commenter that "chemical precipitation is not BAT for FGD [wastewater]." See preamble section VIII for additional details on the selected BAT bases for FGD wastewater and EPA's rationale.

Commenter Name: Thomas Cmar
Commenter Affiliation: Earthjustice, et al.
Document Control Number: EPA-HQ-OW-2009-0819-4684-A1
Comment Excerpt Number: 7

External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

EPA Must Reject Options that Allow BAT for FGD Wastewater to Be Determined Case-by-Case. Options 3a and 3b (for plants with less than 2,000 MW wet-scrubbed capacity) would leave effluent limits to be set on a case-by-case basis. Not only is this inconsistent with the Clean Water Act, it would be disastrous for water quality, wildlife, and public health based on the states' failing record at making BAT determinations. The Clean Water Act requires EPA to establish BAT for all categories of point sources. The Clean Water Act's provision for case-by-case BAT determinations is meant as a stop-gap measure where EPA has not yet addressed a particular pollutant discharged by an industry, not as an alternative to establishing ELGs where, as here, there are adequate data and available technology to set comprehensive BAT limits. Not only do states lack the resources, expertise, and political will to make meaningful BAT determinations on a permit-by-permit basis, but requiring states to do so is inefficient not only for the states themselves but also for permit applicants, local communities, environmental organizations, and other stakeholders who participate in the permitting process. Because under-resourced communities are less able to participate in a case-by-case permitting process, allowing BAT determinations to continue to be made in that process has profound environmental justice implications.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4383-A1, Excerpt Number 6 in Comment Code 6.j.i.

Commenter Name: Thomas Cmar
Commenter Affiliation: Earthjustice, et al.
Document Control Number: EPA-HQ-OW-2009-0819-4684-A1
Comment Excerpt Number: 69
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

B. CHEMICAL PRECIPITATION PLUS BIOLOGICAL TREATMENT IS A SECOND-BEST ALTERNATIVE FOR FGD.

EPA's technology basis for Options 2, 4, 4a, and 4 is chemical precipitation followed by biological treatment. This combination of technology achieves substantial reductions in discharges of toxic mercury and arsenic—through the chemical precipitation process—and reductions in selenium and nitrate/nitrate levels through the biological treatment system. While it does not address bromides, boron, or TDS, it achieves the best removal, second to mechanical evaporation. We will sometimes refer to this treatment technology as simply "biological treatment."

None of the BAT factors rules out this combination of technologies and, indeed, compel them if there is some legitimate basis for rejecting mechanical evaporation that EPA has yet to identify. Chemical precipitation plus biological treatment is technologically available and economically achievable for FGD wastewaters. As discussed below, it is also technologically available and economically achievable for treatment of coal combustion landfill leachate, which is similar in character to FGD wastewater.[264]

---

[264] TDD at 7-39.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4684-A1, Excerpt Numbers 53 and 80.

EPA disagrees with the commenter that "[chemical precipitation plus biological treatment] is BAT for treatment of coal combustion landfill leachate," See preamble section VIII for a description of EPA's rationale for the selection of BAT for combustion residual leachate.

Commenter Name: Thomas Cmar
Commenter Affiliation: Earthjustice, et al.
Document Control Number: EPA-HQ-OW-2009-0819-4684-A1
Comment Excerpt Number: 5
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

EPA Must Determine That Vapor Compression Evaporation is Best Available Technology ("BAT") to Treat Flue Gas Desulfurization ("FGD") Wastewater. The leading technology for treatment of FGD wastewater—and the only one that will push the industry towards the national goal of zero liquid discharge as soon as possible—is chemical precipitation followed by mechanical evaporation (which EPA incorporated into Option 5). Mechanical evaporation is also the only technology evaluated by EPA that addresses all pollutants present in the FGD waste stream, including boron, bromides, and total dissolved solids, as EPA itself acknowledges. The record in this rulemaking establishes that mechanical evaporation is both technologically available and economically achievable, even as EPA has used inflated assumptions about the cost of mechanical evaporation for this proposed rule and fails to account for all of the health benefits of eliminating pollution from FGD wastewater, including bromide discharges that have been associated with the formation of dangerous disinfection byproducts in downstream public drinking water systems.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4684-A1, Excerpt Number 53.

EPA disagrees with the commenter that "EPA has used inflated assumptions about the cost of mechanical evaporation." EPA has used a reasonable approach to estimate the costs to the industry. In response to public comments, EPA revised its cost estimates for the final rule. See response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 106.

EPA acknowledges that it was unable to account for the potential benefits associated with bromide removal in the evaporation system because it did not have sufficient information regarding the potential bromide discharge reductions.

Commenter Name: Thomas Cmar
Commenter Affiliation: Earthjustice, et al.
Document Control Number: EPA-HQ-OW-2009-0819-4684-A1
Comment Excerpt Number: 6
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Chemical Precipitation Plus Biological Treatment is a Second-Best Alternative BAT for FGD Wastewater. Chemical precipitation followed by biological treatment (which EPA incorporated into Options 4, 4a, 3, 3b (for units with wet-scrubbed capacity greater than 2000MW) and Option 2)) achieves substantial reductions in discharges of toxic mercury and arsenic—through the chemical precipitation process—and reductions in selenium and nitrate/nitrate levels through the biological treatment system. While it does not address bromides, boron, or TDS, it achieves the best removal, second to mechanical evaporation. If there is some legitimate reason for rejecting mechanical evaporation as BAT for FGD wastewater that EPA has yet to identify, then EPA must select biological treatment as BAT for FGD wastewater. Biological treatment is a well-established, affordable technology that is indisputably superior to chemical precipitation alone (which EPA incorporated into Option 1) as a treatment for FGD wastewaters.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4684-A1, Excerpt Number 69.

Commenter Name: Shellie Chard-McClary
Commenter Affiliation: Association of Clean Water Administrators (ACWA)
Document Control Number: EPA-HQ-OW-2009-0819-4535-A2

Comment Excerpt Number: 4
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Some of EPA's proposed options for FGD Wastewater include the requirement of using Chemical Precipitation and Biological Treatment for treating the wastestream. The Average Effluent Pollutant Concentrations for One-Stage Chemical Precipitation Systems with Biological Treatment, presented in Table 10-5 of the Technical Development Document, appear to be reasonable treatment targets. However, states are uncertain as to whether Biological Treatment, in addition to Chemical Precipitation, rises to the level of being a standard for a well-operated facility, which would justify inclusion in a BAT standard. If EPA's analysis and supporting information show that Biological Treatment should be included in the BAT standard for FGD, the final rule should clearly provide that analysis and supporting information. Otherwise, the BAT standard for FGD should be limited to Chemical Precipitation.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4181-A2, Excerpt Number 3 in Comment Code 10.a.

Commenter Name: Thomas Cmar
Commenter Affiliation: Earthjustice, et al.
Document Control Number: EPA-HQ-OW-2009-0819-4684-A1
Comment Excerpt Number: 77
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

even if cost-effectiveness were the correct test, EPA must conclude that a biological treatment standard for FGD waste water is cost-effective. The cost of this treatment option is only $60 per TWPE removed, which is in the middle of the range for technology options that EPA considered to be preferred.[307] This is also well within the cost-effectiveness values for BAT options selected by EPA in previous rulemakings.[308] Although we do not agree that cost-effectiveness should be given significant weight in the BAT determination or that EPA's preferred range of dollars per TWPE removed is appropriate, biological treatment of FGD wastewater is clearly cost-effective applying EPA's preferred methodology.

---

[307] TDD at 8-34.

[308] *See* RIA at D-8.

Comment Response:

EPA agrees with the commenter that "cost-effectiveness should [not] be given significant weight in the BAT determination" because it is not required by the CWA and it is not a statutory factor for the BAT determination.

Regarding cost effectiveness see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 105.

Commenter Name: Beth L. McGee
Commenter Affiliation: Chesapeake Bay Foundation
Document Control Number: EPA-HQ-OW-2009-0819-4513-A2
Comment Excerpt Number: 3
External Review Flag: Envr Assess
External Review Incorporated into Response: No

Comment Excerpt:

EPA is considering several options in this rulemaking and has identified four preferred alternatives for regulation of discharges from existing sources. The fifth option, that differed from Option 4 by requiring evaporation instead of biological treatment of FGD wastewater, was not considered a "preferred alternative." It is our understanding, however, that concerns have been raised about the quantification of benefits associated with the various alternatives and that the benefits of Option 5, particularly with regard to treatment of drinking water, may have been underestimated. Because of the uncertainty, CBF would support either Option 4 or Option 5 for new and existing sources.

Comment Response:

Regarding the BAT determination, see preamble section VIII and response to DCN EPA-HQ-OW-2009-0819-4684-A1, Excerpt Number 53.

Regarding the quantification of benefits associate with the evaporation system, see response to DCN EPA-HQ-OW-2009-0819-4684-A1, Excerpt Number 5.

Regarding the NSPS determination, EPA has selected the evaporation system as the technology basis for NSPS for FGD wastewater. See preamble section VIII for additional details regarding EPA's rationale.

Commenter Name: Becky Hayat
Commenter Affiliation: Natural Resources Defense Council (NRDC)
Document Control Number: EPA-HQ-OW-2009-0819-4490-A1
Comment Excerpt Number: 15
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

With respect to FGD wastewater, Option 5 will yield the greatest reductions in water use.

The water savings associated with FGD wastewater under Option 4 is insignificant for the following reasons: 1) reductions in water use would result only if plants recycle their FGD wastewater; 2) only for plants with a FGD wastewater discharge flow rate greater than 1,000 gpm is it actually cost efficient to implement additional recycle within the FGD system; and 3) plants can recycle only if they operate at relatively low chloride levels compared to the maximum allowable chloride concentration.

Comment Response:

EPA agrees with the commenter that the evaporation system "will yield the greatest reductions in water use [for FGD wastewater]" See response to DCN EPA-HQ-OW-2009-0819-4490-A1, Excerpt Number 17.

Commenter Name: Thomas Cmar
Commenter Affiliation: Earthjustice, et al.
Document Control Number: EPA-HQ-OW-2009-0819-4684-A1
Comment Excerpt Number: 90
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

chemical precipitation is not BAT. As explained above, the record evidence considered by EPA establishes that mechanical evaporation is BAT, and biological treatment is an available, affordable technology that is indisputably superior to chemical precipitation alone as a treatment for FGD wastewaters.

Comment Response:

See responses to DCN EPA-HQ-OW-2009-0819-4684-A1, Excerpt Numbers 53 and 88.

Commenter Name: B. and J. Bailey
Commenter Affiliation: Private Citizen
Document Control Number: EPA-HQ-OW-2009-0819-4492
Comment Excerpt Number: 3
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

We urge the EPA to enact the strongest effluent limitation guidelines possible and to update the rules and standards regarding the discharge of wastewater into the waters of Belews Creek and to require evaporation treatments for sludge waste from the power plant scrubbers.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4684-A1, Excerpt Number 53.

Commenter Name: Thomas Cmar
Commenter Affiliation: Earthjustice, et al.
Document Control Number: EPA-HQ-OW-2009-0819-4684-A1
Comment Excerpt Number: 62
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Thus, none of the statutory BAT factors demonstrate that mechanical evaporation is not technologically or economically achievable.

Comment Response:

See preamble section VIII for information regarding why EPA has not selected the evaporation system as the basis for the BAT limitations for all steam electric generating units.

Commenter Name: Raven Power Holdings, LLC
Commenter Affiliation: Raven Power Holdings, LLC
Document Control Number: EPA-HQ-OW-2009-0819-4467-A1
Comment Excerpt Number: 20
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Raven Power supports BAT limitations based upon optimized chemical precipitation.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4487-A1, Excerpt Number 113.

Commenter Name: Bruce W. Ramme
Commenter Affiliation: We Energies
Document Control Number: EPA-HQ-OW-2009-0819-4475-A1
Comment Excerpt Number: 33
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

EPA Should Consider Making Chemical Precipitation BAT for Treating FGD Wastewater.

Chemical precipitation is listed as the BAT option under proposed Regulatory Option 1, but it is not listed as BAT under any of the preferred regulatory options. We Energies believes chemical precipitation using predictable inorganic chemical reactions should be chosen as BAT for treating FGD wastewater.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4633-A1, Excerpt Number 32 in Comment Code 9.

Commenter Name: Bruce W. Ramme
Commenter Affiliation: We Energies
Document Control Number: EPA-HQ-OW-2009-0819-4475-A1
Comment Excerpt Number: 38
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Based on the economic and operational drawbacks to both biological treatment and VCE, and the lack of cost-effectiveness when compared to thresholds EPA has established for past effluent limitations guidelines rulemakings, We Energies believes that the best available technology economically achievable for FGD wastewater is chemical precipitation.

Comment Response:

Regarding the selection of chemical precipitation alone as BAT, see response to DCN EPA-HQ-OW-2009-0819-4633-A1, Excerpt Number 32 in Comment Code 9.

Regarding the "operational drawbacks to both biological treatment and VCE," see responses to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Numbers 107 in Comment Code 10.a and 108 in Comment Code 11.a.

Regarding cost effectiveness see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 105.

Commenter Name: Cari Boyce
Commenter Affiliation: Duke Energy
Document Control Number: EPA-HQ-OW-2009-0819-4305-A3
Comment Excerpt Number: 62
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Flow Minimization Requirement Needs to be Removed

EPA proposes to include a flow minimization requirement for plants with FGD flows greater than 1000 gpm.[13] Duke Energy does not support this requirement which is included in all proposed options for the reasons included below.

EPA "incorporates the use of flow minimization for plants with high FGD discharge flow rates (i.e., greater than 1,000 gpm) and FGD system metallurgy and operating practices that can accommodate an increase in chlorides (e.g., scrubber systems constructed of non-metallic materials or corrosion resistant metal alloys, or systems operating with absorber chloride concentrations substantially below the design chloride limit). The flow minimization at these plants would be achieved by either reducing the FGD purge rate or recycling a portion of their FGD wastewater."[14]

The EPA does not, however, offer specific criteria outlining chloride limits for different alloy materials. It is difficult to conceive how such criteria would be set across the industry. Numerous stations throughout the industry are experiencing high corrosion in their FGD Scrubbers. Given the potentially aggressive corrosive conditions present in FGD systems, dew point, acidity, ORP, pH, high temperature, concentrations of chlorides and fluorides, wet-dry cycles and gas velocity all affect a metal alloy's corrosion resistance.

---

[13] 78 Fed. Reg. at 34459

[14] *Id.*

Comment Response:

Regarding flow minimization methodology, see responses to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 102 and EPA-HQ-OW-2009-0819-4305-A3, Excerpt Number 64.

8.c. FGD – Wastewater Characterization

Commenter Name: David Y. Chung
Commenter Affiliation: Homer City Generation, L.P
Document Control Number: EPA-HQ-OW-2009-0819-5552-A2
Comment Excerpt Number: 4
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

A. Errors In EPA's Sampling And Data

EPA's data set for calculating BAT for FGD wastewater consists of a limited number of samples collected from only seven power plants. For each of those plants, EPA relied only on data from a four-day sampling event, as well as one-day samples over a four-month period. *See* EPA-HQ-OW-2009-0819-1953 (Memorandum from C. Schroeder, U.S. EPA, to R. Jordan, U.S. EPA, "Effluent Limitations for FGD Wastewater, Gasification Wastewater, and Combustion Residual Leachate for the Proposed Effluent Limitations Guidelines and Standards for the Steam Electric Rulemaking (Oct. 2012)). EPA then supplemented this sparse sampling data with selfmonitoring data from a few stations. The data set relied on by EPA is not representative of how FGD wastewater varies across the industry given the variability among FGD treatment systems, as well as the quality and quantity of water throughout a given power station. Wastewater composition varies across the industry depending on the type of coal and sorbent used, how FGD systems are operated, the materials of construction in the system, levels of recycle within the absorber, and air pollution control systems operated upstream of the FGD system.[1]

EPA also fails to explain why it excluded data that it obtained from certain stations, including the Homer City Generating Station. EPA should not issue BAT limits for FGD technology until it compiles a more robust data set that better captures not only variability of FGD wastewater across the industry, including, but not limited to, seasonal variability, differences in treatment systems, water quality and quantity variability, and changes in operations and processes.

---

[1] In particular, the materials of construction and FGD system operations can affect the concentration of pollutants in the FGD wastewater because they affect the amount of recycle within the system, which in turn, affects the rate at which FGD wastewater is generated.

Comment Response:

In response to the commenter's general statements about EPA's use of a "limited" or "sparse" dataset for calculating limitations, EPA notes that Best Available Technology Economically Achievable is to reflect the performance of "the single best performing plant," and it can rely on data from a single plant, pilot projects, foreign plants, or technology transfer. *See, e.g., Ass'n of Pac. Fisheries v. EPA*, 615 F.2d 794, 816 (9th Cir. 1980) ("The legislative history of the 1983 regulations indicates that regulations establishing [BAT] can be based on statistics from a single plant."); *Chemical Mfrs. Ass'n v. EPA*, 870 F.2d 177, 226, 235 (5th Cir. 1989) ("Congress intended [BAT] limitations to be based on the performance of the single best performing plant in an industrial field."); *Am. Meat Inst.*, 526 F.2d 442, 462-463 (7th Cir. 1975); *Kennecott Copper v. EPA*, 780 F.2d 445, 447 (4th Cir. 1985); *Weyerhaeuser Co. v. Costle*, 590 F.2d 1011, 1054 n.70 (D.C. Cir. 1978); *Am. Frozen Food Inst. v. Train*, 539 F.2d 197, 140 (D.C. Cir. 1976); *Reynolds Metals Co. v. EPA*, 760 F.2d 549, 562 (4th Cir. 1985); *Cal. & Hawaiian Sugar Co. v. EPA*, 553 F.2d 280, 287 (2d Cir. 1977).

EPA does not agree that the data used to calculate effluent limitations for FGD wastewater is not representative of the potential variability present in FGD wastewater and its characteristics. Over the course of the rulemaking, as documented in the record, EPA compiled information about FGD wastewater generation and composition, as well as its treatability by different wastewater treatment processes. EPA evaluated the factors mentioned by the commenter to assess how they may (or may not) affect FGD wastewater characteristics (both pollutant concentrations and flow rate) and treatability, and it determined that none of these factors would prevent a well-operated treatment system (i.e., one that represents the BAT/NSPS level of control) from being able to meet the limitations established by the final rule.

The data used to calculate the effluent limitations are reflective of the variability that can be present in untreated FGD wastewater and the BAT/NSPS technologies clearly demonstrate the efficacy of pollutant removal. Where it was available, EPA used data for plants that were obtained over a number of years of operation and at different times of year. Because of this, the data reflect different types of coals, periods when plants changed to different sources or types of coals, changes in generating unit electricity generation (e.g., cycling and periods of high and low capacity utilization), periodic unit and/or plant startup and shutdown events, changes in the plant's air pollution control operations, and other factors. However, even in the cases where such long-term data were not available, EPA determined that the data used to characterize untreated wastewater and calculate the effluent limitations were appropriate and sufficient for their intended purpose. Commenters did not identify nor provide any additional data for use in calculating the effluent limitations for FGD wastewater based on evaporation (the same is true for effluent limitations for gasification wastewater). See the TDD and the Statistical Support Document: Effluent Limitations for FGD Wastewater, Gasification Wastewater, and Combustion Residual Leachate for the Final Steam Electric Power Generating Effluent Limitations Guidelines and Standards ("Statistical Support Document for Effluent Limitations"). The factors noted by the commenter would be addressed by a well-operated treatment system as plant operators monitor effluent quality, influent characteristics, and various treatment system process control parameters (e.g., pH, flow, turbidity, ORP, nitrates). EPA notes that the commenter provided no data to support the assertion that the data used by EPA were not sufficiently representative. See the response to DCN EPA-HQ-OW-2009-0819-5552-A2, Excerpt Number 2.

See also response to DCN EPA-HQ-OW-2009-0819-4655-A2, Excerpt Number 20. In addition, see Section 13 of the TDD for a discussion of EPA's data selection criteria.

EPA did not use the sampling data for FGD wastewater collected during the detailed study for the four plants (including Homer City Generating Station) for development of the final limitations and standards because of the analytical issues associated with the data for FGD wastewater. Upon completion of the detailed study, EPA worked with analytical laboratories and laboratory equipment vendors to develop laboratory standard operating practices (SOPs) that provide guidance to laboratory analysts on steps they should consider and/or take to mitigate analytical interferences that could otherwise produce biased resulted for FGD wastewater, particularly for the concentration of selenium present in the wastewater. EPA's effort to develop SOPs for this purpose was successful and the analytical issues that adversely affected the FGD wastewater data collected during the detailed study were resolved prior to EPA conducting sampling episodes to collect data that were used to calculate the effluent limitations and standards in the ELGs. See response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 48 in comment code 8.d for more discussion.

Commenter Name: Quinlan J. Shea III
Commenter Affiliation: Edison Electric Institute (EEI)
Document Control Number: EPA-HQ-OW-2009-0819-4487-A1
Comment Excerpt Number: 36
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

EPA should not derive limits for any FGD technology – including chemical precipitation – without a more robust set of data. EPA's limited data in the record for this rulemaking do not represent the variability of FGD wastewater across the industry.

During its development of the proposed rule, EPA obtained data from only 13 facilities with FGD wastewater treatment systems. EPA's resulting data do not adequately characterize the industry. For example, EPA needed to obtain data associated with facilities burning diverse types of coal. However, only one of the sampled plants (Pleasant Prairie) burns Powder River Basin (PRB) coal; another (Hatfield's Ferry) burns a blend of PRB and Eastern bituminous, and the rest burn only Eastern bituminous. According to EPA, out of 117 plants discharging FGD wastewater, 15-20 burn subbituminous (i.e., PRB) coal and 23-28 burn a blend of coals. 2013 TDD at 6-5, Table 6-2. Using only one plant to represent each of those fuel types is inadequate, and cannot possibly capture the variability of FGD wastewater discharges for PRB and blended coal plants. Additionally, the plants selected for sampling are not geographically diverse, a factor that could affect several variables including treatment efficiency. There are no New England or Southwest plants, and just one Midwest plant (Miami Fort). Three of the sampled plants are in Pennsylvania.

To characterize FGD wastewater and FGD wastewater treatment through chemical precipitation, chemical precipitation plus biological treatment, and vapor-compression evaporation, EPA used only select facility data from the already limited data set. For example,
although it had data from seven plants with chemical precipitation systems, EPA chose only three to characterize chemical precipitation treatment levels. See 2013 TDD at 10-9 to 10-10,

Table 10-4 at 10-10. The three plants selected by EPA have the highest pollutant loadings of the plants sampled by EPA. Therefore, they have the highest annual TWPE removals. EPA should have sampled more plants to calculate more representative pollutant reductions. In another example, EPA's assessment of biological treatment is based on only two plants, Allen and Belews Creek. There are several similarities between the Belews Creek and Allen plants, however. For instance, they burn a similar mix of coals, and both plants' influent to the FGD treatment system is low in total dissolved solids (TDS) and chlorides and therefore relatively easy to treat. Other plants with influents higher in TDS and chlorides will present more challenges for the treatment system.

Comment Response:

EPA does not agree that the data used to calculate effluent limitations for FGD wastewater is not representative of the potential variability present in FGD wastewater and its characteristics. See response to DCN EPA-HQ-OW-2009-0819-4655-A2, Excerpt Number 20 and DCN EPA-HQ-OW-2009-0819-5552-A2, Excerpt Number 4 regarding the potential variability of FGD wastewater associated with various factors, including coal type.

EPA does not agree that the data used to characterize untreated FGD wastewater or to calculate the effluent limitations are not sufficiently representative of the industry, including the types of coal burned or factors that may affect treatment system efficacy. EPA notes that the commenter and other industry stakeholders are the operators of the very plants that are subject to the ELGs. As such, if there were other data that the commenter or other stakeholders believed EPA should have taken into account in establishing the ELGs, they could easily have collected additional treatment system performance data during the 106-day public comment period and provided the data for consideration by EPA as part of their comments on the proposed rule. However, they did not do so. (In fact, EPA notes that a pre-publication version of the proposed rule was posted on EPA's website in April, a full 5 months prior to the end of the public comment period, affording stakeholders ample opportunity to collect data.) See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 124 in Comment Code 4.b regarding the representativeness of the FGD wastewater data.

See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 81 regarding the impacts of geographic diversity on FGD wastewater characteristics.

See response to DCN EPA-HQ-OW-2009-0819-4470-A1, Excerpt Number 3 regarding the commenter's statement about plants with the "highest pollutant loadings."

Commenter Name: Elizabeth E. Aldridge, Hunton & Williams
Commenter Affiliation: UWAG
Document Control Number: EPA-HQ-OW-2009-0819-4655
Comment Excerpt Number: 81
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

B. **EPA's Sampling Program for FGD Wastewater**

The data for FGD wastewater are more extensive than for bottom ash. Nevertheless, EPA should not derive limits for any FGD technology – including chemical precipitation – without a more robust set of data. Its limited data do not represent the variability of FGD wastewater across the industry.

During its development of the proposed rule, EPA sampled 11 facilities with FGD wastewater treatment systems. The 11 facilities represented some differences in terms of type of coal, type of scrubber, and type of treatment system, as summarized in the table below. For seven of the facilities, EPA conducted a four-day sampling event and then had each facility collect one-day samples over a four-month period, as noted in the table below.

Plant/State	Coal Type	Coal Region or State	FGD System	FGD Wastewater Treatment System	Sampling Dates
Widows Creek (AL)	E. Bit	CO and Illinois Basin	Limestone forced oxidation (LSFO)	Settling ponds	September 2007
Homer City (PA)	E. Bit	Northern App.	LSFO/formic acid additive	Chemical precipitation	August 2007
Mitchell (WV)	E. Bit	WV	LSFO	Chemical precipitation	October 2007
Big Bend (FL)	E. Bit	Illinois Basin	LSFO/dibasic acid additive	Chemical precipitation	July 2007
Belews Creek (NC)	E. Bit	Central App. and 80:20 Northern App./Central App. Blend	LSFO	Chemical precipitation + biological	4 days: June 2010 1-day: Oct-Dec. 2010, Jan. 2011
Miami Fort (OH)	E. Bit	Northern App. and Illinois Basin	Mag Enhanced LSFO	Chemical precipitation	4-days: July 2010 1 day: Sept. 2010, Nov. 2010, Dec. 2010, Jan. 2011
Allen (NC)	E. Bit	Central App.	LSFO	Chemical precipitation + biological	4 days: Aug. 2010 1 day: Oct.-Dec. 2010, Jan. 2011
Dickerson (MD)	E. Bit	PA and WV	LSFO	Chemical precipitation + biological	4 days: Aug. 2010 1 day: Sept. 2010, Nov.

Plant/State	Coal Type	Coal Region or State	FGD System	FGD Wastewater Treatment System	Sampling Dates
					2010, Dec. 2010, Jan. 2011
Keystone (PA)	E. Bit	Western PA	LSFO/no additives	Chemical precipitation	4 days: Sept. 2010 1 day: Oct.-Dec. 2010, Jan. 2011
Hatfield's Ferry (PA)	Sub Bit/ E. Bit Blend	E. Bit and PRB (WY)	LSFO	Chemical precipitation	4 days: Dec. 2010 1 day: Oct. 2010, Dec. 2010, Jan. 2011, Feb. 2011
Pleasant Prairie (WI)	Sub Bit	PRB/WY	LSFO	Chemical precipitation	4 days: June 2010 1 day: Oct.-Dec. 2010, Jan 2011

Despite this sampling effort, EPA's universe of data does not adequately characterize the industry, for the following reasons:

- The type of coal burned makes a difference. However, only one of the sampled plants (Pleasant Prairie) burns Powder River Basin (PRB) coal; Hatfield's Ferry burns a blend of PRB and Eastern bituminous, and the rest burn only Eastern bituminous. According to EPA, out of 117 plants discharging FGD wastewater, 15-20 burn subbituminous (*i.e.*, PRB) coal and 23-28 burn a blend of coals. 2013 TDD at 6-5, Table 6-2. Using only one plant to represent each of those fuel types is inadequate and cannot possibly capture the variability of FGD wastewater discharges for PRB and blended coal plants.

- The plants selected are not geographically diverse, a factor that could affect several variables including treatment efficiency. There are no New England or Southwest plants and just one mid-west plant (Miami Fort). Three of the sampled plants are in Pennsylvania.

In addition to data from its sampling program, EPA collected self-monitoring data from Belews Creek and Allen and also from the Roxboro Steam Electric Plant in North Carolina. 2013 TDD at 6-5. Roxboro also burns Eastern bituminous coal. Finally, EPA visited Italy and sampled the Enel Brindisi Station to characterize treatment by vapor-compression evaporation systems (a zero liquid discharge system or ZLD). With Roxboro and Brindisi, EPA had data from 13 facilities to characterize FGD wastewater and FGD wastewater treatment by chemical precipitation, chemical precipitation plus biological treatment, and vapor-compression evaporation.

To characterize FGD wastewater treatment *influent*, EPA used data from eight facilities: Belews Creek, Allen, Miami Fort, Keystone, Hatfield's Ferry, Dickerson, Pleasant Prairie, and

Roxboro. Except for Roxboro, EPA sampled a line from the hydroclone overflow to the equalization tank from each plant to characterize the influent to the FGD treatment system.

To characterize FGD *effluent* from the various technology options, EPA used data as indicated in the following table (2013 TDD at 10-6):

Plant Name	Source of Data Set	Wastestream Represented
Miami Fort	EPA sampling; 308 sampling	Chemical precipitation effluent
Keystone	EPA sampling; 308 sampling	Chemical precipitation effluent
Hatfield's Ferry	EPA sampling; 308 sampling	Chemical precipitation effluent
Belews Creek	EPA sampling; 308 sampling; self-monitoring data	Biological treatment effluent (after chemical precipitation)
Allen	EPA sampling; 308 sampling; self-monitoring data	Biological treatment effluent (after chemical precipitation)
Enel Brindisi	EPA sampling	Vapor-compression evaporation effluent (ZLD)

Comment Response:

EPA does not agree that the data used to calculate effluent limitations for FGD wastewater is not representative of the potential variability present in FGD wastewater and its characteristics. EPA also does not agree that the data used to characterize untreated FGD wastewater or to calculate the effluent limitations are not sufficiently representative of the industry, including the types of coal burned or factors that may affect treatment system efficacy.

See response to DCN EPA-HQ-OW-2009-0819-4655-A2, Excerpt Number 20 and DCN EPA-HQ-OW-2009-0819-5552-A2, Excerpt Number 4 regarding the potential variability of FGD wastewater associated with various factors, including coal type.

See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 124 in Comment Code 4.b regarding the representativeness for the FGD wastewater data across the industry.

EPA disagrees that the geographic location of power plants could affect the treatment efficiency of FGD wastewater, if properly managed. See response to DCN EPA-HQ-OW-2009-0819-4593-A1, Excerpt Number 2 regarding EPA's determination that the BAT system selected for the final rule is able to handle potential variability in the FGD wastewater. For the biological treatment system, the treatment efficacy related to geographic location can be controlled through temperature control (e.g., heat exchangers in warm climates, buildings in cold climates), which are accounted for in EPA's cost estimates. Additionally, see Section 5.2.2 of the TDD for additional information regarding EPA's evaluation factors including geographic location, and the determination that establishing different effluent limitations based on location was not warranted. EPA similarly concluded for the proposed ELGs that establishing different effluent limitations based on location was not warranted, and received no substantive data in public comments that demonstrated otherwise.

Commenter Name: Raven Power Holdings, LLC
Commenter Affiliation: Raven Power Holdings, LLC
Document Control Number: EPA-HQ-OW-2009-0819-4467-A1
Comment Excerpt Number: 24
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

EPA attempts to characterize FGD wastewater in identifying BAT using a one-size-fits-all approach. EPA did not fully take into account the variability of FGD wastewater chemistry/composition, which is influenced to varying degrees by, but not limited to:

- Type of fuel burned (bituminous, sub-bituminous, lignite, coke)
- Cycling of units, including seasonal operations
- Regional variations in fuels
- Boiler and system design to accept various fuels (Ash, chloride and sulfur content)
- Absorber design
- Absorber operation
- Production of varying quality gypsum for beneficial reuse
- Use and impact of additives to meet various air emission requirements
- Make-up water source (e.g., grey water) and chemistry
- Type and source of scrubber reagents

EPA calculated an average chloride concentration of 7,740 mg/l and TDS concentration of 28,600 mg/l for FGD wastewaters.[2] This chloride concentration is well below the 30,000 mg/l chloride design basis for the Brandon Shores absorber. Depending on the chloride concentration a specific absorber is designed to and the type of reagent used, TDS concentrations can easily exceed double EPA's calculated average. EPA's own data shows that TDS can range much higher than the calculated average.[3] As such, the TWPE removal of any treatment system is highly dependent on the site specific influent concentration of the various constituents.

[2] TDD Section 6.1, Table 6-3, pages 6-5 and 6-6 [EPA-921-R-13-002]

[3] USEPA, Steam Electric Generating Point Source Category: Final Detailed Study Report, Section 4.5, Table 4-8, page 4-63 [EPA-821-R-09-008] October 29, 2009

Comment Response:

EPA does not agree that the data used to calculate effluent limitations for FGD wastewater is not representative of the potential variability present in FGD wastewater and its characteristics. EPA also does not agree that the data used to characterize untreated FGD wastewater or to calculate the effluent limitations are not sufficiently representative of the industry, including the types of coal burned or factors that may affect treatment system efficacy.

See response to DCN EPA-HQ-OW-2009-0819-4655-A2, Excerpt Number 20 and DCN EPA-HQ-OW-2009-0819-5552-A2, Excerpt Number 4 regarding the potential variability of FGD wastewater associated with various factors, including coal type.

See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 124 in Comment Code 4.b, regarding the representativeness for the FGD wastewater data across the industry.

Although chemical precipitation systems are typically not designed to remove chlorides from FGD wastewater, EPA's record demonstrates that the anoxic/anaerobic bioreactor systems are capable of handling chloride levels of up to at least 35,000 ppm and could certainly be higher. Additionally, the chemical precipitation systems that represent the BAT model technologies are designed to remove pollutants to a specific effluent concentration (e.g., the long-term average for the BAT/NSPS technology), once optimized for the appropriate chemical dosages. As for the biological treatment system, see response to DCN EPA-HQ-OW-2009-0819-4593-A1, Excerpt Number 2, and EPA-HQ-OW-2009-0819-4655, Excerpt Number 107, regarding design and operation of the BAT technology to treat FGD wastewater to the level necessary to meet the final limitations and standards. For more information see Section 8.3.1 of the TDD.

Commenter Name: Thomas N. Effinger
Commenter Affiliation: South Carolina Electric & Gas (SCE&G)
Document Control Number: EPA-HQ-OW-2009-0819-4593-A1
Comment Excerpt Number: 2
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Variability of FGD Wastewater

We have been monitoring wastewater streams at our Wateree Station for the last year in an effort to define the water quality of those streams. In addition, we have initiated a pilot treatment program to evaluate the treatment of FGD wastewater. Our results indicate that the EPA has not fully defined the variability of FGD wastewater water quality that will impact both chemical and biological treatment processes.

SCE&G's Wateree Station has also operated a wet FGD scrubber for the last three years. We have observed that the water quality characteristics of the FGD wastewater constantly changes. The variability of the wastewater generated from wet-limestone, forced-oxidation scrubbers can be caused by many factors including: number of generating units in service (i.e., the flow of exhaust gas), type and blend of coal used, and scrubber operation.

The most important parameter that influences FGD water treatability is the ORP (oxidation reduction potential). The ORP is a measure of the oxidation state of the limestone slurry and the

FGD wastewater. Chart 1 shows that higher exhaust gas flows cause the FGD wastewater to have a higher ORP. Thus, the FGD wastewater quality characteristics will change as a function of the number of generating units in service. It is not clear that the EPA's use of data from only two FGD wastewater biological treatment systems has taken this variability into account. We urge the EPA to step back and consider data from a broader set of FGD wastewater systems, using a variety of coals, multiple operating conditions and other variables, when developing a new ELG.

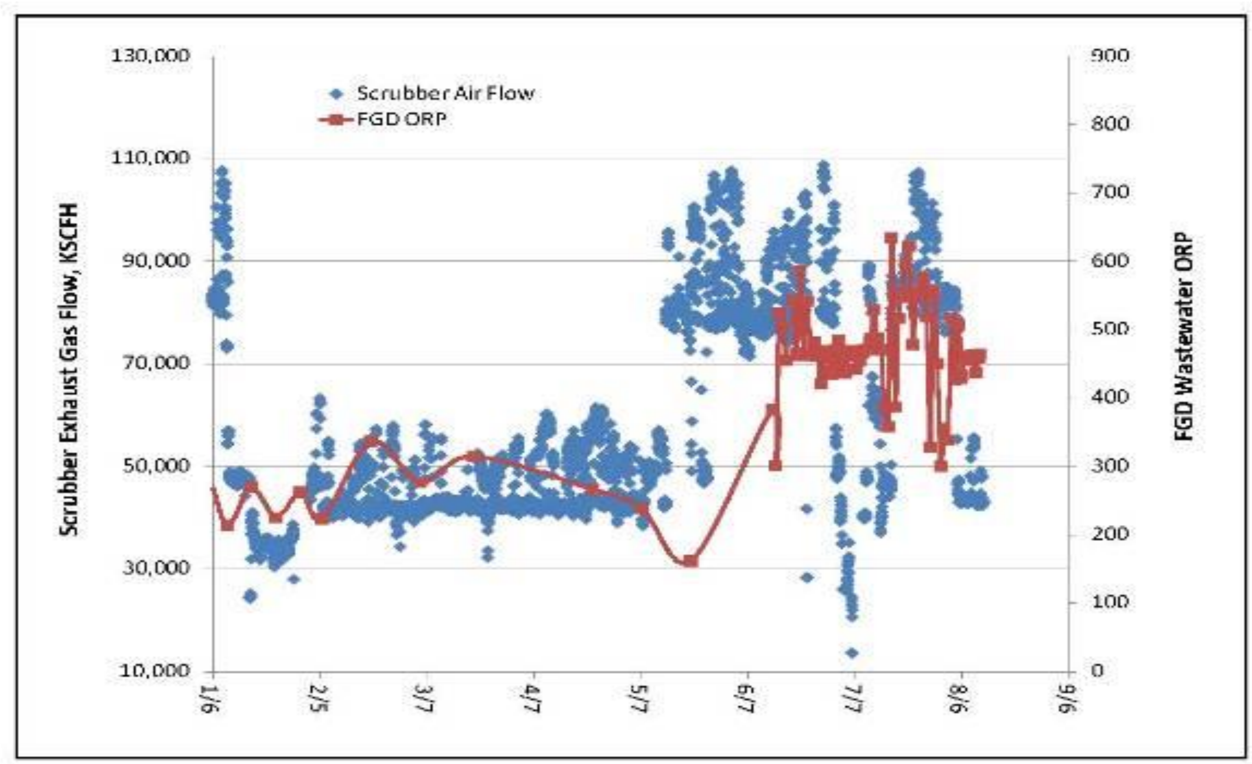


Chart 1: ORP versus exhaust gas flow

The ORP of the scrubber solution will impact the pH as well as the selenium, nitrate, and arsenic concentrations of FGD wastewater.

Recent research has shown that strong oxidizers, such as persulfate ($S_2O_8^{2-}$) are formed in the scrubber. Over time, the persulfate can oxidize chlorides in FGD wastewater to hypochlorous acid as follows (July 1, 2013 (POWER) "ORP as a Predictor of WFGD Chemistry and Wastewater Treatment", By S.R. Brown, R.F. DeVault, and D.B. Johnson, Babcock & Wilcox Power Generation Group Inc.):

$$2Cl^- + S_2O_8^{2-} \rightarrow Cl_2 + 2SO_4^{2-}$$

The Cl_2 reacts with water to form hypochlorous acid as follows:

$$Cl_2 + H_2O \rightleftarrows HOCl + H^+ + Cl^- \rightleftarrows 2H^+ + Cl^- + OCl^-$$

FGD wastewater has essentially no alkalinity; therefore, even small amounts of hypochlorous acid generated can quickly lower the pH of the FGD wastewater. Presented in Chart 2 is a graph showing the variation in FGD wastewater pH and ORP over time.

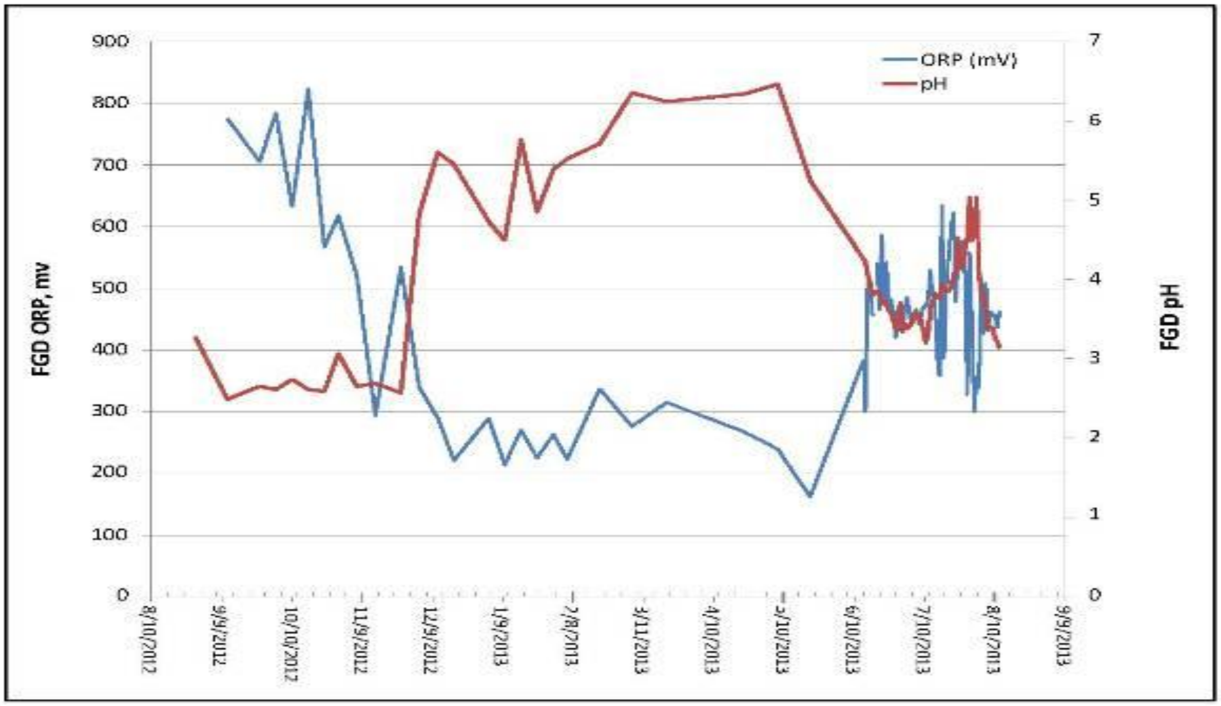


Chart 2: Wastewater pH and ORP variability over time

The variability in ORP and pH can also make it difficult to remove nitrates from FGD wastewater, a necessary step prior to treatment for selenium removal.

Denitrification rates are very pH sensitive. The EPA **Nitrogen Control Manual** (EPA/625/R-93/010, September 1993) shows that biological denitrification is significantly impacted by pH. Figure 4-2 of the EPA document (provided below) shows a reduction of 20% to 65% in the denitrification rate at a pH of 6.0, and the denitrification rate also drops above a pH of 7.0.

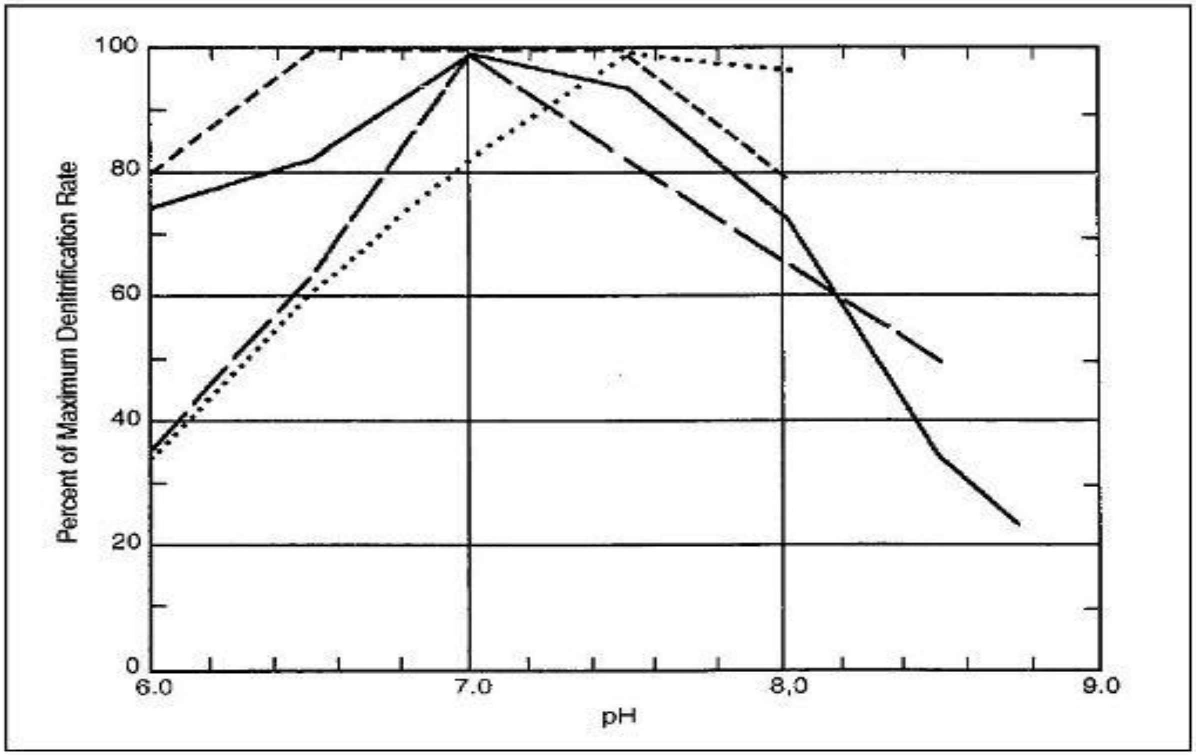


Figure 4.2 from EPA Nitrogen Control Manual (EPA/625/R-93/010, September 1993)

Changes in nitrate concentrations will impact the biological treatment processes, requiring more carbon source, and may result in ELG nitrate excursions. Chart 3 shows FGD wastewater nitrate variation over time. The nitrate (NO3-N) concentration has fluctuated from around 18 mg/L to over 115 mg/L, an over six-fold increase.

Nitrate concentrations can vary in the FGD wastewater due to changes in the operation of the selective catalytic reduction (SCR) process over time. Increased ammonia slip caused by SCR aging, or simple adjustments in ammonia feed can cause significant changes to the nitrate concentrations in the FGD wastewater. SCE&G recommends that the EPA remove nitrate/nitrite limits from the proposed ELG Rule. Total nitrogen should be addressed as a nutrient issue with NPDES limits, not in the ELG Rule.

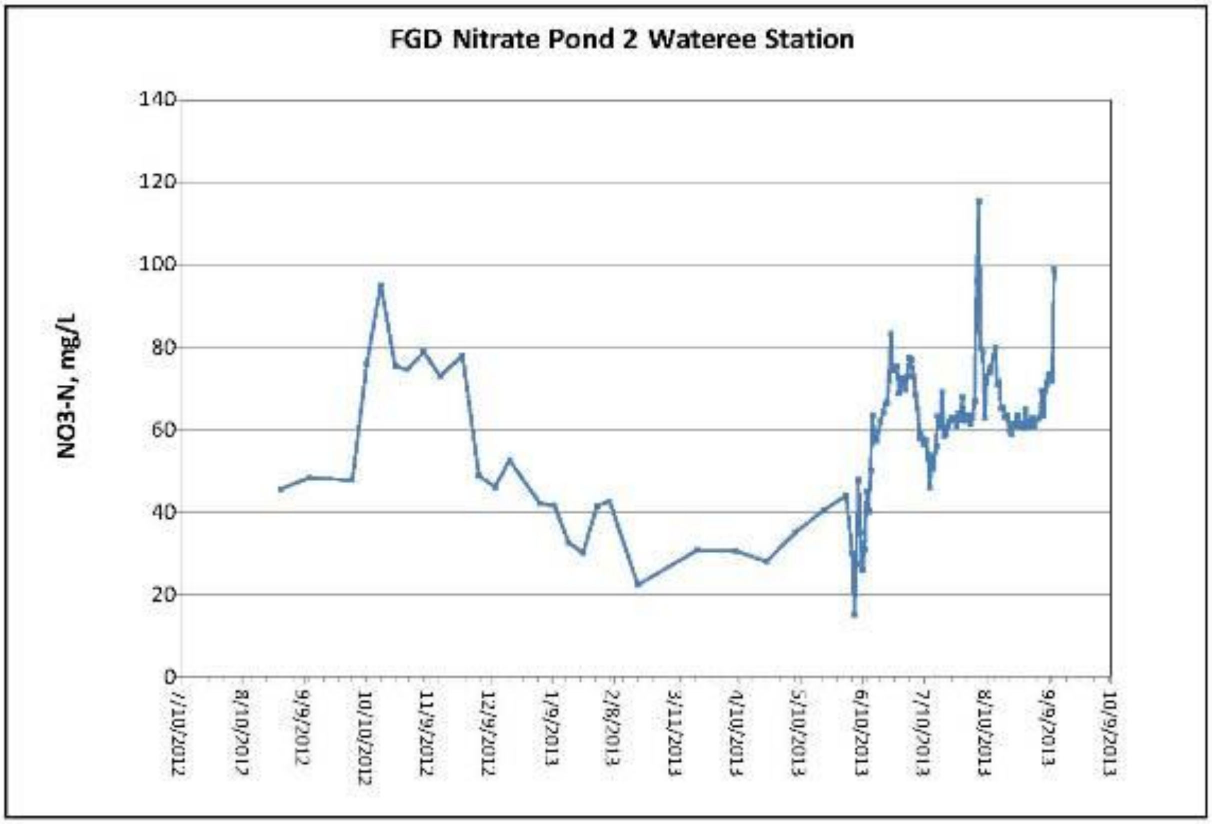


Chart 3: FGD wastewater nitrate variation over time

As mentioned previously, nitrate must be removed before selenium can be removed. Presented below in Chart 4 are selenium concentrations in the Wateree FGD wastewater, which range from around 600 µg/L to over 3300 µg/L, a range of 550%. If a discharge limit of 10 µg/L is set by the ELG, it would require a reduction of 99.7% to remove enough selenium from a concentration of 3300 µg/L.

Selenium concentration changes in the FGD wastewater will impact the ability of biological treatment systems to meet the very low proposed ELG limits. We also note that selenium concentrations can change fairly rapidly, resulting in the requirement of the bacteria to quickly respond to the changes. This variability in selenium will make it difficult to meet the very low proposed ELG limits.

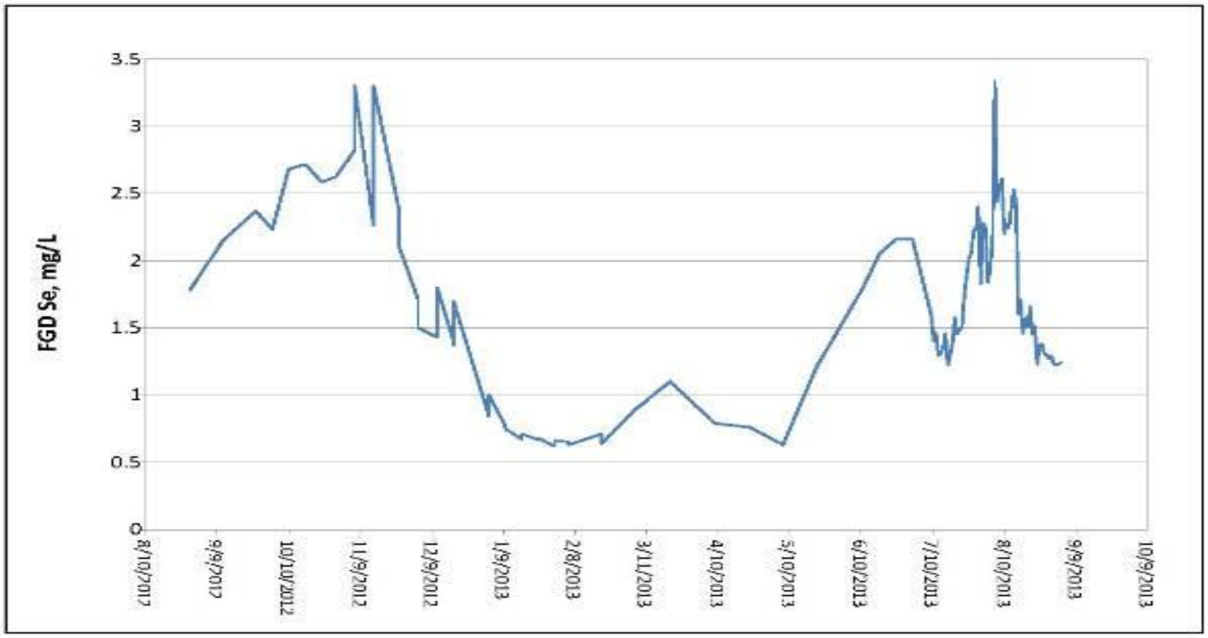


Chart 4: Selenium concentrations in the Wateree FGD wastewater

Based on data collected at Wateree Station, nitrate and selenium concentrations seem to vary in concert. The concurrent changes in selenium and nitrate concentrations could significantly hamper the biological treatment processes, since the same organisms that remove selenium from wastewater must first react and remove nitrates. Presented in Chart 5 are the nitrate and selenium concentrations in FGD wastewater over time. Due to the limited data set which the EPA used to characterize FGD wastewater, it is not possible to adequately address the fluctuations in the FGD wastewater that occur during normal operation of a power plant.

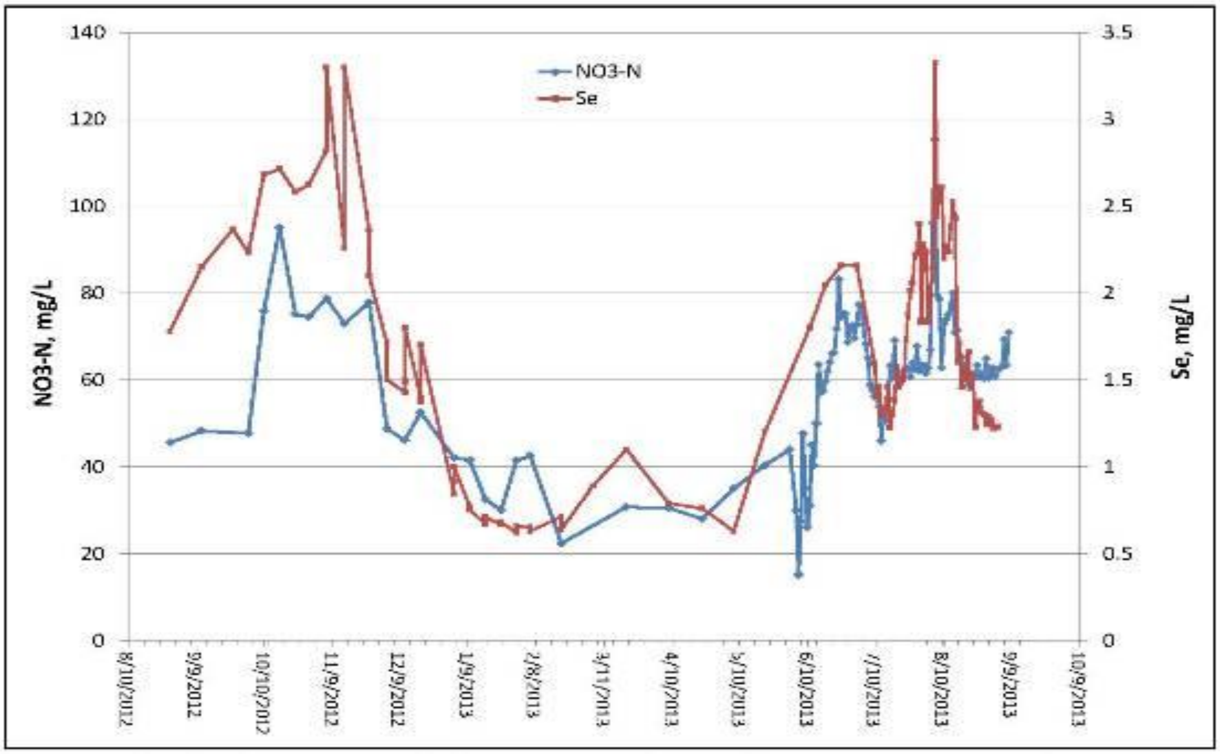


Chart 5: Nitrate and selenium concentrations in FGD wastewater over time

The concentration of mercury in the FGD wastewater also changes over time. Mercury, selenium, and nitrate concentrations in FGD wastewater all appear to be influenced by the ORP and the number of generating units in service. Chart 6 presents the mercury concentrations in the FGD wastewater over time. These variations in mercury concentration will impact the treatment processes and result in possible treatment inefficiencies and ELG limit excursions.

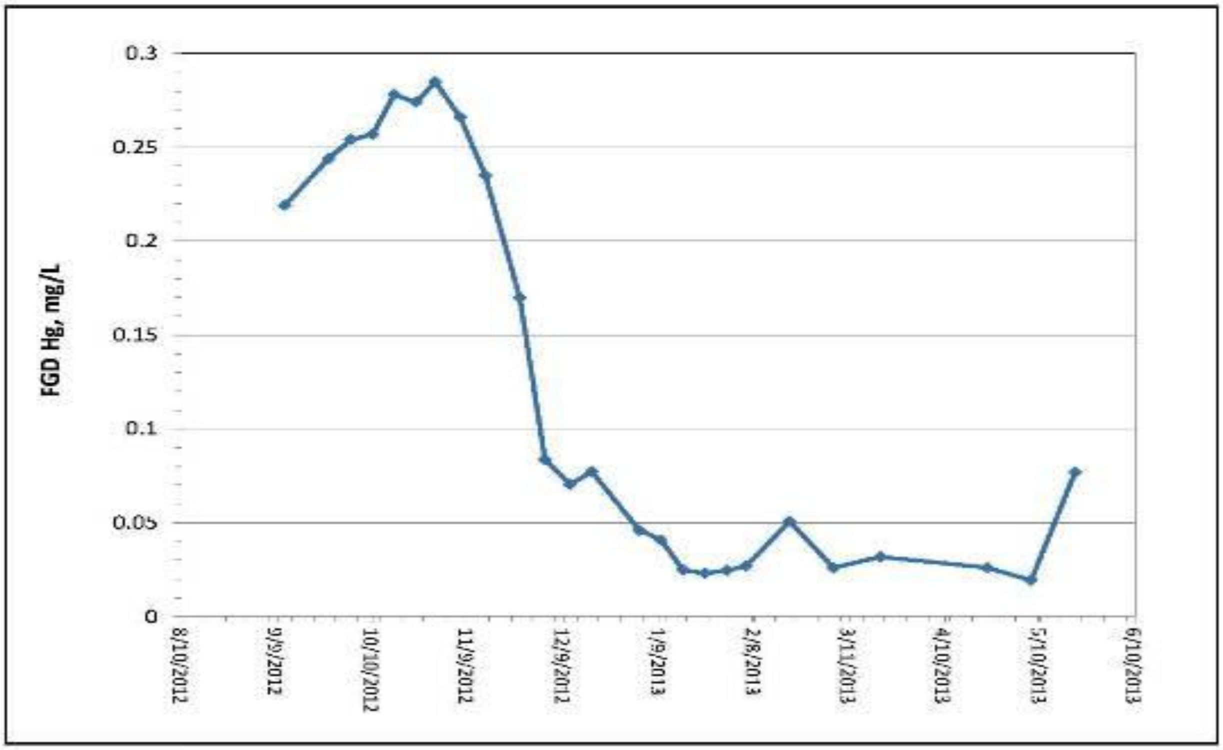


Chart 6: Mercury concentration in the FGD wastewater over time

In summary, the EPA failed to consider the implications of FGD wastewater quality fluctuations when it developed the proposed BAT limits. Our data have shown that the parameters that impact FGD treatment technologies are highly variable. None of the variations presented above could have been observed during the four days of testing and four monthly grab samples that EPA collected to define FGD wastewater quality. Selenium, mercury, and nitrate concentrations change significantly due to the number of generating units in service, the variability of the coal combusted, and operation of the SCR and FGD scrubber. In addition, the variation of ORP, pH, and concentration of oxidants will impact both biological and chemical treatment processes. These water quality parameters will impact any treatment process and likely result in exceedances of the proposed limits.

Clearly, the data that the EPA collected are not representative of FGD wastewater that is and will continue to be produced across the country. Because the definition of BAT limitations requires representative sampling, it is not possible for the EPA to establish appropriate limits with the limited data they have collected. This is especially true for the sampling the EPA did at the two biological treatment facilities, Allen Station and Belews Creek Station. We believe it is inappropriate and incorrect for the EPA to propose BAT limits for FGD treatment on the entire industry based on only two facilities that could not possibly represent the variability of coal-fired generating units across the United States.

Comment Response:

EPA does not agree that the data used to calculate effluent limitations for FGD wastewater is not representative of the variability present in FGD wastewater and its characteristics. EPA also does not agree that the data used to characterize untreated FGD wastewater or to calculate the effluent limitations are not sufficiently representative of the industry, including the types of coal burned or factors that may affect treatment system efficacy. EPA is well aware that the characteristics of untreated FGD wastewater can vary over time and from one plant to another. EPA has collected extensive data on this very topic over the course of the rulemaking. Equally important if not more so, however, is that EPA's analyses demonstrate that the BAT/NSPS technology bases for the final rule are highly effective at pollutant removal even with variable influent wastewater characteristics. The information in the record shows that the data used to calculate the effluent limitations are representative of FGD wastewater and that plants that properly operate BAT/NSPS-level treatment technology will be able to comply with the effluent limitations. EPA has closely evaluated the factors and wastewater characteristics noted by the commenter, such as pH and ORP, and determined that these characteristics can be monitored and controlled as necessary to prevent adversely impacting treatment system efficacy. EPA notes that, in response to comments on the proposed rule, EPA expanded the dataset used to develop the effluent limitations; as a result, the effluent limitations for some parameters were revised. See the TDD and the Statistical Support Document for Effluent Limitations (DCN SE05733). Also see responses to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 124 in Comment Code 4.b, and DCN EPA-HQ-OW-2009-0819-4655-A2, Excerpt Number 20.

EPA notes that the pilot testing conducted at the Wateree Station was initially evaluating the treatment of the FGD wastewater only in biological treatment systems and did not include an upstream chemical precipitation system, as is included in EPA's BAT chemical precipitation plus biological treatment technology option for FGD wastewater. Furthermore, the information in the record for the final rule shows that the validity of the pilot test for purposes of evaluating treatment technology efficacy was compromised by abnormal operation of the FGD scrubber which affected the characteristics of the untreated wastewater, but even more importantly by the failure of personnel conducting the pilot test to recognize the abnormal conditions and the resulting effect on the wastewater characteristics – which if properly assessed, could have been mitigated by proper pretreatment, including pH adjustment, chemical precipitation, and sodium bisulfite addition at the level necessary to remove free oxidants prior to the pilot treatment technologies. Proper operation of BAT/NSPS level of technology includes monitoring characteristics of influent wastewater (e.g., pH, ORP), monitoring treatment process control parameters, and adjusting chemical dosages and nutrient feed as necessary to reflect changes in wastewater characteristics. EPA notes that the chemical precipitation system is an integral part of the chemical precipitation plus biological treatment BAT basis because it is capable of handling much of the variability that is inherent in the FGD wastewater. This is supported by many commenters operating chemical precipitation systems to treat FGD wastewater:

- Raven Power Holdings, LLC (DCN EPA-HQ-OW-2009-0819-4467-A1, Excerpt Number 21 in Comment Code 9.a): "Chemical precipitation treatment systems are a reliable, proven technology that have been implemented across diverse geographical regions and operating conditions. Chemical precipitation is an active treatment system that can effectively respond to variable water conditions typical of FGD operations…. These systems have been supplied by a number of vendors, under varying configurations to meet site specific requirements."

- Duke Energy (DCN EPA-HQ-OW-2009-0819-4305-A3, Excerpt Number 38 in Comment Code 9.a): "Chemical precipitation systems, as included in Option 1, are a cost-effective reliable technology that can be employed across all geographical regions and under different operating scenarios. Specifically, these systems can be designed, and are proven, to operate over a wide range of fuel types, fuel additives, operating temperatures, and chloride concentrations."
- We Energies (DCN EPA-HQ-OW-2009-0819-4475-A1, Excerpt Number 34 in Comment Code 9.a): "Chemical precipitation using an alkali-sulfide process has a number of advantages including its ability to adjust chemical dosages to treat various influent concentrations and the predictability of the chemical reactions to treat the influent's metals concentrations."
- Alabama Power Company (DCN EPA-HQ-OW-2009-0819-4489-A1, Excerpt Number 11 in Comment Code 8): "The physical/chemical system [chemical precipitation] may be an available, proven, effective, and operationally efficient technology in some instances. This treatment system is used by power plants around the country, and has been relied upon by those using FGD systems to treat FGD wastewater."
- Public Service Company of New Hampshire (DCN EPA-HQ-OW-2009-0819-4633-A1, Excerpt Number 32 in Comment Code 9): "chemical precipitation… has proven to be effective at treating FGD waste water to levels satisfactory of water quality standards."

EPA has determined that issues that the commenter raises related to the operation of the BAT chemical precipitation plus biological treatment technology basis and meeting the effluent limitations and standards can be addressed by having a well-operated chemical precipitation system upstream of the biological treatment system and actively managing the system.

Regarding the variability in ORP, EPA's cost estimates include costs for an ORP monitor to be installed prior to the equalization tank for the chemical precipitation system. Based on the ORP present in the wastewater, the plant can actively manage the ORP levels by adding reducing agents to the wastewater to reduce the ORP and remove any free oxidants that may be present. Additionally, many plants monitor the ORP in the FGD scrubber to mitigate potential corrosion. Reducing agents can also be added to the FGD system to reduce the ORP.

Regarding variations in the pH making it "difficult to remove nitrate from FGD wastewater," EPA notes that the chemical precipitation system is designed to increase the pH to precipitate out the solids and then lower the pH to the optimal pH for the biological treatment system. Therefore, the proper active management of the chemical precipitation system will control the pH of the FGD wastewater for nitrates removal.

Regarding changes in mercury concentrations over time, the sulfide addition used in the chemical precipitation system is designed mainly for the removal of mercury and other metals. The dosage of the sulfide chemicals can be adjusted based on changes in mercury concentrations. EPA's cost estimates include the cost for a mercury analyzer so plants can actively monitor the mercury concentrations in the effluent from the system to evaluate whether they are meeting the limits and to recycle the wastewater back for additional treatment, if necessary.

Regarding changes in nitrate concentrations due to changes in the operation of the SCR, EPA notes that as good operating practice, plants should actively be monitoring for ammonia slip and adjusting their operations to prevent slippage, for economic reasons along with other environmental reasons. As such, a properly maintained and operated SCR system should not be the cause of extreme excursions in the nitrate concentrations. Regardless, the nitrate concentrations can also be controlled in several other ways as well. For plants with concentrations over 100 ppm nitrate/nitrite as N, EPA has included costs for a separate denitrification system to reduce the nitrate/nitrite concentrations prior to the wastewater entering the anoxic/anaerobic biological treatment stage. Additionally, a well-designed system will be sized to treat the maximum loading of nitrate/nitrite and selenium that may be observed at the plant. EPA disagrees with the commenter that EPA should not establish effluent limitations for nitrate/nitrite as N. See response to DCN EPA-HQ-OW-2009-0819-4183-A2, Excerpt Number 20 in Comment Code 26.f.

Regarding the commenters assertion that the "selenium concentrations can change fairly rapidly, resulting in the requirement of the bacteria to quickly respond to the changes," EPA notes that the BAT chemical precipitation plus biological treatment system basis used to estimate compliance costs accounts for an equalization tank that has a 24-hour residence time. As such, any rapid changes in concentration will be mitigated in the equalization tank as well as through the chemical precipitation system. Therefore, the bacteria will only see a gradual increase in the selenium concentrations over time, even if there is a large fluctuation in the FGD purge wastestream. The data used to calculate effluent limitations for selenium reflect samples collected by the plants over years of operation. These data show that the biological treatment technology effectively removes selenium even when present at high concentrations in the untreated wastewater, including times when the influent concentrations increase substantially over a short period of time. See the Statistical Support Document for the Effluent Limitations (DCN SE05733).

Commenter Name: Kim Mireles
Commenter Affiliation: Luminant
Document Control Number: EPA-HQ-OW-2009-0819-4614-A1
Comment Excerpt Number: 18
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

EPA has not accounted for fuel and scrubber variability in its assessment of TWPE removals. Differences in scrubber technology type, fuel characteristics, and source water all would impact the presence or removal of pollutants.

EPA's TWPE removals assume that all plants will be able to achieve the proposed numeric limits for FGD wastewater. In fact, untreated FGD wastewater varies significantly depending on coal type, scrubber chemistry and operation, site water balance and other factors. EPA's choice of

BAT treatment technologies will not be able to achieve the proposed numeric limits at certain plants, particularly those that burn sub-bituminous coals like PRB coal or blends containing PRB.

The effectiveness of the BAT for lignite, which is a basic fuel in the Texas fleet, is unknown since no testing or evaluation was conducted by the agency for this proposed regulation. Because the type of coal dictates the composition of the effluent, a one size fits all approach is simply not appropriate or technically justified. EPA should allow for, as it has in its air regulations, consideration of fuel types in development of these proposed regulations, and provide for provisions to eliminate requirements where they are not appropriate for a particular fuel characterization.

Comment Response:

EPA disagrees with the commenter that the "BAT treatment technologies will not be able to achieve" the final numeric limits at certain plants, "particularly those that burn sub-bituminous coals like PRB coal or blends containing PRB." Based on public comments, EPA supplemented its effluent limitations and standards development for FGD wastewater to include data from the Pleasant Prairie Power Plant, which burns subbituminous coal. Additionally, the Hatfield's Ferry plant, which burns a PRB blend coal, was already included in the development of the limitations and standards at proposal, and continues to be for the final rule. As such, these types of plants are included in EPA's analysis and EPA's data used for the limitations is representative of the industry. The data in the record does not show that the characteristics of FGD wastewater that result from a plant burning lignite coal differ substantially from FGD wastewater resulting from plants that burn bituminous coal, subbituminous coal, or coal blends, nor that any differences in wastewater characteristics would result in a lignite plant being unable to meet the effluent limitations in the ELGs. The commenter provided no data to the contrary. See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 124 in Comment Code 4.b for additional information about the representativeness of the data and lignite coal considerations.

Commenter Name: Stephen M. Frank
Commenter Affiliation: NRG Energy, Inc.
Document Control Number: EPA-HQ-OW-2009-0819-4510-A2
Comment Excerpt Number: 4
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Materials of Construction and FGD System Operations Affect Pollutant Concentration

As recognized in the Technical Development Document for the Proposed Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source (April 2013 TDD), the pollutant concentrations in FGD wastewater vary from plant to plant depending on:

- Coal type
- Sorbent used (e.g., limestone)
- Materials of construction in the FGD system
- FGD system operation
- Level of recycle within the absorber
- Air pollution control systems operated upstream of the FGD system.

The fuel is the source of most of the pollutants that are present in the FGD wastewater. The type and source of the sorbent (e.g., limestone) used also affect the pollutant concentrations in the FGD wastewater.

The materials of construction and the other FGD system operations affect the concentration of pollutants in the FGD wastewater because they affect the amount of recycle within the system, which in turn, affects the rate at which the FGD wastewater is generated. Purge rate is typically controlled by chloride concentrations. Many NRG FGD systems have been designed to operate with chloride concentrations between 10,000 and 20,000 mg/l (relatively high compared to the two EPA model plants that are more than half this concentration). This mode of operation minimizes the purge rates and allows for relatively smaller capacity FGD WWTP overall.

Comment Response:

EPA determined that the data used to calculate effluent limitations for FGD wastewater is representative of the variability present in FGD wastewater and its characteristics. EPA also determined that the data used to characterize untreated FGD wastewater and to calculate the effluent limitations are representative of the industry, including the types of coal burned or factors that may affect treatment system efficacy. EPA is well aware that FGD wastewater characteristics can vary from one plant to another and has evaluated this extensively for the ELG rulemaking and taken it into account in establishing the effluent limitations for the final rule. See Section 6 of the TDD for more information on the impacts of these variables on FGD wastewater. Specifically for chlorides, the chemical precipitation systems are typically not able to remove chlorides from FGD wastewater, but EPA's record demonstrates that the anoxic/anaerobic biological treatment system is capable of handling chloride levels of higher concentration than noted by the commenter. For more information see Section 8.3.1 of the TDD.

EPA generally agrees with the commenter that the "fuel is the source of most of the pollutants that are present in FGD wastewater." Based on public comments, EPA supplemented its effluent limitations and standards development for FGD wastewater to include data from the Pleasant Prairie Power Plant, which burns subbituminous coal. Additionally, the Hatfield's Ferry plant, which burns a PRB blend coal, was already included in the development of the limitations and standards at proposal, and continues to be for the final rule. As such, these types of plants are included in EPA's analysis and EPA's data used for the limitations is representative of the industry. See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 124, in Comment Code 4.b for additional information about the representativeness of the data used in the development of the final rule. Also see the response to DCN EPA-HQ-OW-2009-0819-4593-A1, Excerpt Number 2.

Commenter Name: John W. Myers
Commenter Affiliation: Tennessee Valley Authority (TVA)
Document Control Number: EPA-HQ-OW-2009-0819-4607-A1
Comment Excerpt Number: 6
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

c. Differences in FGD Wastewater Chemistry and Treatability were Not Considered by EPA for Once-Through versus Recycle FGDs

In addition to the apparent undocumented costs identified previously, the requirement to recycle flow adds complexity to the ability to effectively treat FGD effluents. Neither physical/chemical treatment nor biological treatment appreciably reduces chloride concentrations. Elevation of chlorides (and other dissolved constituents) increases wastewater treatment complexity. There is substantial variability in untreated effluents from FGDs, and it is widely recognized that there is no "typical" FGD wastewater according to a summary of EPRI-funded research. Based on data collected by EPA on FGD scrubber wastewater at TVA's Widows Creek Plant as well as current Bull Run FGD system, chloride target levels are approximately 3,000 ppm chlorides. Recycle FGDs allow chlorides to reach 20,000 ppm (or higher) without adverse effect to the FGD components as these systems have incorporated corrosion-resistant metallurgy or non-metallic components into their design. A significant concern is that the potential presence of higher chlorides and/or other dissolved constituents in wastewaters associated with recycle scrubbers may interfere with chemical precipitation reactions and other wastewater treatment techniques; thus, effluent from recycle scrubbers may be inherently less amenable to treatment.

Comment Response:

EPA notes that the final rule does not include a requirement for plants to recycle their flow. The flow minimization discussed in the final rule is a process change that EPA expects some plants might employ to reduce the costs associated with the BAT treatment technology. Of course, the final rule does not require the use of any particular technology or practice, and plants are free to meet the final limitations and standards applicable to discharges of pollutants in FGD wastewater in any manner they choose.

EPA disagrees with the commenter's statement that the "presence of higher chlorides and/or other dissolved constituents in wastewaters associated with recycle scrubbers may interfere with chemical precipitation reactions and other wastewater treatment techniques." EPA disagrees because the plants EPA included in its development of the final effluent limitations were all recycle plants and the treatment systems at those plants were capable of achieving significant reductions in the pollutants for which EPA is establishing final numeric limitations and standards applicable to FGD wastewater. EPA also evaluated the pollutant characteristics for FGD wastewater from once-through scrubbers and determined that they are similar to the wastewater characteristics for recycle scrubbers; therefore, the BAT/NSPS technology will effectively treat the FGD wastewater from both once-through and recycle scrubbers, and thus the final rule requires plants operating either type of scrubber to comply with the final effluent limitations.

Commenter Name: Dennis Leonard
Commenter Affiliation: DTE Energy Company
Document Control Number: EPA-HQ-OW-2009-0819-4517-A2
Comment Excerpt Number: 5
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Fuel Flexing at the Monroe Power Plant

The Monroe Power Plant consists for four, roughly 800 MW units. 2 units are scrubbed today and 2 additional units will be scrubbed by the end of 2014. The plant was designed to burn bituminous coal, but on any given day will burn either; 100% western subbituminous coal, a blend of subbituminous and bituminous coal or a blend of the above with pet coke. Pet Coke, a very low chloride, but high sulfur fuel will also be burned at Monroe in small quantities and subject to its limited availability. Fuel flexing is important to understand because fuel flexing causes extreme variability in the blowdown flow, the Oxidation Reduction Potential (ORP) of the blowdown and the nitrate concentration of the blowdown. Flow, ORP and Nitrate levels all impact the effectiveness of biological treatment and extreme variations in all 3 variables will drastically reduce the effectiveness of biological treatment.

Fuel Flexing Can Occur Unexpectedly

The Monroe Plant will burn a 100%, lower-heating-value, subbituminous coal, even though doing so derates the plant's generating capacity, in order to be dispatched more economically during periods of low power demand. In the new, competitive power generation market and with the advent of inexpensive natural gas, many coal fired units that burn more expensive bituminous coal will not be dispatched and will stand idle when demand and power prices are low. In order to keep running at such times, the Monroe Power Plant must burn less expensive subbituminous coal even though the plant's output is curtailed. When prices and demand are higher, the Monroe Plant will burn a blend of bituminous and sub bituminous coal because a derate must be avoided at such times. The blend is designed to allow the unit to operate at full capacity using some fraction of the more expensive eastern bituminous coal.

While power prices can be stable over a several week long period- for instance high prices during extended heat or cold; power prices can fluctuate widely in just one day. Fluctuating prices are caused, for instance, by the unexpected loss of a large unit during a period of otherwise low power demand. In such situations the plant might quickly switch from a 100% subbituminous fuel to a blend containing bituminous coal. Fluctuating power prices can also occur when a strong cold front quickly puts an end to high air conditioning loads. In such situations the plant might quickly switch from a blend to 100% subbituminous coal.

Significance of Fuel Flexing for Wastewater Treatability

The above has a great deal of significance for the treatment of FGD blowdown. When the Monroe plant is burning 100% subbituminous coal (or pet coke), there is little to no FGD blowdown to the wastewater treatment plant. The wastewater treatment system has operated for one and a half days without any discharge during such periods. During such period the liquor is continually recirculated in the scrubber without any need for a blowdown and the nitrate concentration continually increases. The ORP of the liquor is high (above 500mVs.), necessitating the eventual addition of more organo-sulfide when the physical chemical system is later called upon to treat the blowdown. Organo-sulfide is added to the physical chemical system to precipitate mercury and otherwise allow for optimum treatment.

Much less organo-sulfide is added when the plant burns a blend containing bituminous coal. Bituminous coal causes the ORP to be lower (less than 300mVs), the blowdown rate to increase and the nitrate concentration to fall from 250 to 130 mg/I, as a result of less recirculation.

Comment Response:

EPA recognizes that changing the type of coal burned (or petroleum coke) can affect the FGD wastewater characteristics in some cases, although often the effects from a change can be undiscernible from the variation in wastewater characteristics that routinely occurs even when there is no change in fuel. The effluent limitations for the final rule are based on data from different plants burning different fuels, and the data also reflect changes over time in the fuel burned at the plants themselves. Thus, the effluent limitations already reflect the treatment efficacy associated with different fuels and changes in fuel.

The commenter claims that "Fuel Flexing Can Occur Unexpectedly." EPA recognizes that a plant may decide to change the fuel it is burning and that the decision to change the fuel could be spurred by several factors; however, with good communication among plant staff there is no reason it should be "unexpected." First, the plant cannot switch to a different fuel unless it has already purchased it and received it onsite. Thus, the plant's coal buyers and coal pile operators (and probably other plant staff) are aware that this different coal (or pet coke) is present at the plant. Then, the coal pile operator must be directed to switch to the different coal, which the boiler operators are likely to be aware of. With effective communication, the treatment system operators will be aware of the fuel switch and monitor process control parameters for any significant change. Even in the absence of such communication, the BAT basis includes pH and ORP monitors that would alert the treatment system operators of any notable changes (many plants also monitor scrubber ORP). It would typically take at least a day for any fuel switch to begin affecting influent wastewater characteristics; however, even if the change were immediate, the BAT basis includes an equalization tank with 24 hours hydraulic residence time. Furthermore, it can take another 1-3 days for the wastewater to pass through the chemical precipitation stage and enter the bioreactor. Thus, treatment system operators will have ample notification of changes (or potential changes) in the wastewater characteristics and the chemical precipitation system chemical dosages can be adjusted to account for such variation. As discussed in the TDD, there are steps plants can take to manage the ORP of the FGD wastewater, as well as the ORP within the scrubber. See also response to DCN EPA-HQ-OW-2009-0819-4593-A1, Excerpt Number 2.

Commenter Name: Raymond L. Evans
Commenter Affiliation: FirstEnergy Corp.
Document Control Number: EPA-HQ-OW-2009-0819-4677-A2
Comment Excerpt Number: 3
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

For emphasis, FirstEnergy would like to reiterate some of the concerns raised in the UWAG's comments regarding the EPA's evaluation of FGD wastewater and its conclusions on availability and effectiveness of treatment technologies for achieving proposed limits for this wastewater stream. Based on UW AG' s review of EPA's FGD data, influent FGD wastewater streams at Duke Energy's Belews Creek and Allen power stations differ significantly in total dissolved and suspended solids (TDS & TSS) concentration when compared to concentrations observed at some of the other power stations that were sampled (Hatfield's Ferry, Miami Fort, and Keystone). Furthermore, nitrate-nitrite levels observed at Belews Creek and Allen were significantly lower than what was observed at most of the other sampled power stations. This biased the removal projections for biological treatment higher, falsely supporting biological treatment as an economically achievable technology for the entire industry.

FirstEnergy's experience is that FGD wastewater streams are extremely variable, not only within the industry, but within a facility. Samples collected by the EPA and Allegheny Energy Supply Company, LLC (a FirstEnergy subsidiary) from our Hatfield's Feny Power Station FGD system in 2010 indicated that influent arsenic levels were very close to the recently proposed arsenic limits for FGD wastewater. More recent data indicates a significant increase in arsenic levels. Investigations have failed to identify a cause for this increase. Magnitude changes in effluent quality such as these without obvious operational or analytical issues supports the concerns raised with the EPA's limited data set for this wastewater stream.

Comment Response:

See Section VIII.C of the preamble regarding pretreatment options for FGD wastewater containing higher levels of nitrates, among other commonly observed variations in FGD wastewater characteristics. EPA's record demonstrates that proper pretreatment prior to biological treatment and proper monitoring in both the chemical precipitation and biological treatment systems can address the wastewater variability issues presented in the comments. See response to DCN EPA-HQ-OW-2009-0819-4655-A2, Excerpt Number 20 regarding the variability of FGD wastewater and EPA's available data set. Because the plants are capable of meeting the final effluent limitations and standards, EPA disagrees with the commenter that the estimated pollutants removals are biased high.

After proposal, to address comments related to the FGD wastewater analytical data set, EPA obtained additional data from the Hatfield's Ferry plant. After reviewing the data, EPA had several discussions with company personnel and discussed the observed higher arsenic levels in the "more recent data" mentioned by the commenter. From the discussions, it was noted that the "significant increase in arsenic levels" also coincided with a change in the plant's analytical laboratory used for analysis. EPA's review of the data associated with the new laboratory determined that the extremely large fluctuations in the reported data (both high and low concentrations) were due to analytical measurement issues and these data were not used to develop the effluent limitations.

EPA did use data from Hatfield's Ferry in developing the effluent limitations. Although most observations in the datasets used to calculate the effluent limitations, including the Hatfield's Ferry data, were below the limits there were some observations above the limits. As explained in DCN SE05733, it is reasonable for this situation to arise in datasets used to calculate limits for the rule and there are specific steps that the plants can take that would enable them to improve treatment system performance so that effluent concentrations would be in compliance with the limits at all times. Although EPA selected these plants as representing the "best available" technology and they provide the best available data for establishing arsenic and mercury effluent limits that reflect BAT/NSPS level of treatment for FGD wastewater, it does not necessarily mean that the plants have the systems fully optimized, especially since the NPDES permits for these plants either do not include limits for arsenic and mercury for their discharges of FGD wastewater or because their NPDES permit limits are well above what the system is achieving. This is supported by Duke Energy's comments on the proposed effluent guidelines, which state that the "performance of the chemical precipitation treatment systems from which EPA's data relies were optimized to meet current facility NPDES permit requirements and may not reflect the system's maximum performance."

EPA determined that all power plants discharging FGD wastewater should be able to meet the effluent limits in the ELGs. Based on its engineering judgment developed over years of evaluating wastewater treatment processes for power plants and other industrial sectors, EPA determined that the combination of additional monitoring, closer operator attention, and optimizing treatment system performance to target the effluent concentrations at the technology option long-term averages will result in lower effluent concentrations that would be in compliance with the effluent limits. See the Statistical Support Document for Effluent Limitations (DCN SE05733).

Commenter Name: Elizabeth E. Aldridge, Hunton & Williams
Commenter Affiliation: UWAG
Document Control Number: EPA-HQ-OW-2009-0819-4655-A2
Comment Excerpt Number: 21

External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

FGD Wastewater

Our review of the US EPA evaluation of flue-gas desulfurization (FGD) wastewater identified two key issues. The first is that the approach to estimating flow rates most likely overestimates total flow and the second is that the treatment efficiency assigned to impoundment may underestimate selenium removal.

Flow Rate Estimates

The calculation presented on p. 6-4 of the TDD shows that US EPA estimated industry-wide annual flow rates for FGD wastewater based on a 365-day operation. Daily flow rates were based on a 24-hour average design flow rate (US EPA, 2013g, pg. 4-2). However, some plants with FGD are "load following" facilities, which operate depending on the daily demand. The US EPA approach, therefore, likely overestimates the industry's total pollutant loading from FGD.

US EPA should normalize the FGD wastewater discharge flow rates to the number of operational days in a year, similar to the methodology used for estimating ash transport flow rates, as noted below (US EPA, 2013b, pg. 10-22).

Because most generating units/ash handling systems do not operate 365 days per year, EPA normalized the ash impoundment discharge flow rates. To do this, EPA calculated the amount of ash transport water transferred to each ash impoundment per year by multiplying the flow rate by the number of days the ash transport water is generated or transferred to the impoundment, depending on which source is being used. EPA divided this yearly ash transport water flow by 365 days per year to calculate a flow rate in gallons per day (gpd) for use in loadings calculations.

Comment Response:

EPA disagrees with the commenter's assertion that the methodology for estimating FGD wastewater discharge volumes most likely overestimates total flow. In response to the steam electric survey, plants reported the operational days per year specific to a steam electric generating unit. Because multiple generating units can be serviced by a single FGD system, the shutdown of one generating unit does not necessarily dictate the shutdown of the overall FGD system or influence FGD wastewater discharge volumes. EPA therefore continues to consider the approach used at proposal to be appropriate and did not make the change suggested by the commenter for the final rule. Nonetheless, EPA notes that it did evaluate how the commenter's suggested approach might affect the pollutant removal estimates and determined that they would change by less than 5 percent.

In reviewing the public comments on the proposed rule, EPA identified one public comment submitted by We Energies requesting revision of the FGD wastewater flow rates based on their operational days per year; see DCN EPA-HQ-OW-2009-0819-4475-A1, Excerpt Number 43 in Comment Code 7. No additional comments were submitted to correct for FGD wastewater flow rates. Due to the lack of specific comments correcting EPA's calculation for specific plants, EPA used FGD wastewater flow rates as reported in the Steam Electric Survey at the system level. Furthermore, EPA based calculations for pollutant loadings and incremental compliance costs using the same flow rate for FGD wastewater; therefore, if the flows were normalized based on operational days per year, which EPA determined would not be appropriate, it would result in evaluating compliance costs for a lower capacity system than EPA should.

Additionally, EPA disagrees with the commenter's assertion that FGD wastewater flow rates should be calculated the same way ash transport water flow rates are calculated. EPA normalized ash transport flow rates based on the number of operational days per year because the flow rate for ash transport water is specifically linked to the generating unit (i.e., if the generating unit is not operating, then there is no ash generated thus no ash transport water for that unit). EPA used ash transport water flow rates in calculating pollutant loadings for fly ash and bottom ash; however, EPA used the ash tonnage generated in calculating costs. For more information on EPA's overall pollutant loadings and cost methodology, see the *Incremental Costs and Pollutant Removals for the Final Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category* (Cost & Loads Report) (DCN SE05831/SE05832).

Commenter Name: Dean Ellis
Commenter Affiliation: Dynegy Inc.
Document Control Number: EPA-HQ-OW-2009-0819-4491-A1
Comment Excerpt Number: 17
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

FGD wastewaters are typically very alkaline (contain high concentrations of calcium). Therefore, merely allowing the FGD wastewaters to clarify through settling may be sufficient to treat metals. If the settling were to occur in open impoundments with long retention times, algae may uptake the nitrogen and further reduce the metals.

Comment Response:

EPA did not select surface impoundments as the BAT basis for control of FGD wastewater discharges from all existing steam electric power generating units for the reasons stated in section VIII.C.1 of the preamble. However, the regulations do not require that facilities implement specific technologies, and plants are free to choose any technology or practice they wish to meet the limitations and standards in the final rule.

Commenter Name: Ron Shipman
Commenter Affiliation: Georgia Power Company
Document Control Number: EPA-HQ-OW-2009-0819-4447-A1
Comment Excerpt Number: 20
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

EPA's Evaluation Of FGD Wastewater Is Flawed.

EPA's evaluation of FGD wastewater is flawed because EPA limited its evaluation to two plants (Duke's Belews Creek and Allen facilities), both of which have similar influent characteristics, burn similar coals, and operate identical treatment systems. Basing industry-wide FGD wastewater effluent limits on data from two similar plants is a mischaracterization of this wastestream. The selenium and nitrate/nitrite-N data that EPA collected from these two plants are not representative of the entire coal-fired industry. Indeed, all of the other plants that EPA sampled have different influents with higher TSS, TDS and nitrates/nitrites. The influents for these other plants are much harder to treat than the influents from the two plants that EPA evaluated. Accordingly, coal-fired plants with higher TSS, TDS, and nitrates/nitrites will have difficulty meeting EPA's proposed FGD limits. Therefore, EPA's evaluation of FGD wastewater is flawed because it is based on influent from two plants that are not representative of the entire coal-fired industry.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4655-A2 Excerpt Number 20 regarding the representativeness of the data for FGD wastewater.

See response to DCN EPA-HQ-OW-2009-0819-4593-A1, Excerpt Number 2 regarding the treatment of variable wastewater and the use of the chemical precipitation system to accommodate the variability in the FGD wastewater.

Commenter Name: Thomas N. Effinger
Commenter Affiliation: South Carolina Electric & Gas (SCE&G)
Document Control Number: EPA-HQ-OW-2009-0819-4593-A1
Comment Excerpt Number: 9
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

We have shown that there is a large degree of water quality variability in the FGD wastewater. This variability, including ORP, oxidants, pH, as well as varying concentrations of selenium, mercury, arsenic, and nitrate were not adequately studied by EPA during the rulemaking. The resulting low limits proposed for these pollutants will likely not be attainable using the proposed treatment technologies. This will likely lead to exceedances of the proposed limits. We therefore recommend that the EPA continue to use the current ELG guidelines for the power industry while it conducts further studies of the FGD wastewater.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4593-A1, Excerpt Number 2.

Commenter Name: Pamela F. Faggert
Commenter Affiliation: Dominion Resources, Inc.
Document Control Number: EPA-HQ-OW-2009-0819-4631-A1
Comment Excerpt Number: 10
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Second, the data sampled and collected for FGD wastewater is limited and does not appear to representative of industry effluents in a manner needed to support the establishment of national FGD treatment technology standards. We also believe the analysis of pollutant removals contains some inconsistencies which appear to alter the costs considered by EPA in the proposal. Further data collection and analysis would appear to be necessary to gather support for advanced FGD treatment technologies such as chemical precipitation or biological treatment.

Comment Response:

EPA does not agree that the data used to characterize the untreated wastewater and calculate the effluent limitations do not adequately represent the characteristics of FGD wastewater. See response to DCN EPA-HQ-OW-2009-0819-4655-A2, Excerpt Number 20 regarding variability of FGD wastewater and EPA's use of available data to evaluate treatability of the wastewater by the BAT basis.

See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 124 in Comment Code 4.b regarding the representativeness of the FGD wastewater used in EPA's analysis.

See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 95 in Comment Code 10.c regarding the pollutant removal inconsistencies referred by the commenter.

Commenter Name: Chris M. Hobson
Commenter Affiliation: Southern Company
Document Control Number: EPA-HQ-OW-2009-0819-4379-A1
Comment Excerpt Number: 55
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Only one of the sampled plants (Pleasant Prairie) burns Powder River Basin (PRB) coal; Hatfield's Ferry burns a blend of PRB and Eastern bituminous, and the rest burn only Eastern bituminous. According to EPA, out of 117 plants discharging FGD wastewater, 15-20 burn subbituminous (*i.e.*, PRB) coal and 23-28 burn a blend of coals. 2013 TDD at 6-5, Table 6-2. Using only one plant to represent each of those fuel types is inadequate, and cannot possibly capture the variability of FGD wastewater discharges for PRB and blended coal plants.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 81.

Commenter Name: Patrick O'Loughlin
Commenter Affiliation: Buckeye Power, Inc.
Document Control Number: EPA-HQ-OW-2009-0819-4183-A2
Comment Excerpt Number: 5
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Removal of the minute concentrations of mercury and selenium found in FGD wastewater is a complex challenge. Different FGD designs, variations in limestone composition, different types of coal, coal blending and switching, and variations in water composition at the various facilities interact to influence mercury and selenium chemistry and impact the success of treatment.

Comment Response:

The data EPA has collected and used for the final steam electric rule adequately represents the variability of the untreated wastewater and the information in the record demonstrates that the final effluent limitations and standards can be met. See response to DCN EPA-HQ-OW-2009-0819-4655-A2, Excerpt Number 20 regarding variability of FGD wastewater and EPA's use of available data to evaluate treatability of the wastewater by the BAT system.

See response to DCN EPA-HQ-OW-2009-0819-4593-A1, Excerpt Number 2 regarding operations practices to control and mitigate issues affecting treatment performance.

See response to DCN EPA-HQ-OW-2009-0819-4517-A2, Excerpt Number 5 regarding coal switching/fuel flexing.

Commenter Name: Paul Chu
Commenter Affiliation: Electric Power Research Institute (EPRI)
Document Control Number: EPA-HQ-OW-2009-0819-4499-A1
Comment Excerpt Number: 51
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

FGD wastewater chemistry is not understood enough well to be able to predict changes in metal concentrations, as well as the speciation and the ratio of dissolved and particulate metals. This is critical, as these wastewater characteristics will likely impact treatment performance.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4593-A1, Excerpt Number 2 regarding EPA's determination that the BAT basis is capable of handling the variability of the FGD wastewater.

Additionally, EPA's record demonstrates that the chemical precipitation treatment portion of the BAT basis is capable of treating both dissolved and particulate metals. Additionally, the biological treatment portion of the BAT basis targets both dissolved and particulate selenium, as well as both selenate and selenite species of selenium.

Commenter Name: Douglas J. Fulle
Commenter Affiliation: Oglethorpe Power Corporation
Document Control Number: EPA-HQ-OW-2009-0819-4449-A1
Comment Excerpt Number: 3
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

EPA has failed to collect and analyze representative samples of FGD wastewater across the industry, and also failed to properly account for the sensitivity of biological treatment methods to variations in several parameters across different plants.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4655-A2, Excerpt Number 20 and DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 124 in Comment Code 4.b regarding the representativeness of the FGD wastewater data used for the final rule.

See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107 in Comment Code 10.a regarding "the sensitivity of biological treatment method to variations in several parameters."

Commenter Name: Elizabeth E. Aldridge, Hunton & Williams
Commenter Affiliation: UWAG
Document Control Number: EPA-HQ-OW-2009-0819-4655
Comment Excerpt Number: 78
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

EPA's evaluation of FGD wastewater, and the possible technologies available to address FGD wastewater, is not representative of the wide variations in coal types, scrubbers, and operational patterns in the industry.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4655-A2, Excerpt Number 20 and DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 124 in Comment Code 4.b regarding the representativeness of FGD wastewater data used for the final rule.

Commenter Name: Kim Mireles
Commenter Affiliation: Luminant
Document Control Number: EPA-HQ-OW-2009-0819-4614-A1
Comment Excerpt Number: 7
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

- EPA has not accounted for fuel and scrubber variability in its assessment of toxic weighted pound-equivalents (TWPE) removal.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4655-A2, Excerpt Number 20 and DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 124 in Comment Code 4.b regarding the variability of FGD wastewater and the representativeness of the FGD wastewater data used for the final rule.

Commenter Name: Raven Power Holdings, LLC
Commenter Affiliation: Raven Power Holdings, LLC
Document Control Number: EPA-HQ-OW-2009-0819-4467-A1
Comment Excerpt Number: 8
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

EPA used unrepresentative data to characterize FGD wastewater across the industry.

Comment Response:

EPA does not agree the data are unrepresentative. See response to DCN EPA-HQ-OW-2009-0819-4655-A2, Excerpt Number 20 and DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 124 in Comment Code 4.b regarding the representativeness of the FGD wastewater data used for the final rule.

Commenter Name: JoAnne Rau
Commenter Affiliation: Dayton Power & Light Company (DP&L)
Document Control Number: EPA-HQ-OW-2009-0819-4470-A1
Comment Excerpt Number: 3
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

USEPA Used Limited Data to Develop FGD BAT

USEPA's evaluation of FGD wastewater, and the possible technologies available to address FGD wastewater, is not sufficiently representative of the wide variations in coal types, FGD systems, and FGD operations utilized by the industry. Limits for any FGD technology including chemical precipitation should not be derived based on a less than robust set of data.

During its development of the proposed rule, DP&L understands that USEPA sampled 11 facilities with FGD wastewater treatment systems. The 11 facilities represent some differences in terms of type of coal, type of scrubber, and type of wastewater treatment system. For seven of the facilities, USEPA conducted a four-day sampling event, and then had each facility collect one-day samples over a four-month period.

In addition to data from its own sampling program, USEPA collected self-monitoring data from three stations (Belews Creek, Allen and Roxboro Steam Electric Plant in North Carolina). DP&L understands that USEPA also visited and sampled the Enel Brindisi Station in Italy to characterize treatment through vapor-compression evaporation systems (a zero liquid discharge system, or ZLD). With the addition of these stations, USEPA had data from 13 facilities to characterize FGD wastewater and FGD wastewater treatment through chemical precipitation, chemical precipitation plus biological treatment, and vapor-compression evaporation.

Despite this sampling effort, DP&L believes USEPA's universe of data does not adequately characterize the industry, for the following reasons:

- The type of coal burned makes a difference. The majority of the stations used for providing FGD wastewater treatment data bum Eastern bituminous coal and therefore do not represent the wide variety of coals utilized by steam electric power plants;

- The plants selected are not geographically diverse, a factor that could affect several variables including treatment efficiency. There is just a single Midwest plant and there are no New England or Southwest plants.

To characterize FGD wastewater treatment *influent*, USEPA used data from eight facilities: Belews Creek, Allen, Miami Fort, Keystone, Hatfield's Ferry, Dickerson, Pleasant Prairie, and Roxboro.

To characterize FGD *effluent* from the various technology options, USEPA used data from the following facilities: Miami Fort (chemical precipitation effluent), Keystone (chemical precipitation effluent), Hatfield's Ferry (chemical precipitation effluent), Belews Creek (biological treatment effluent after chemical precipitation), Allen (biological treatment effluent after chemical precipitation), Enel Brindisi (vapor-compression evaporation effluent (ZLD)).

Although it had data from several plants with chemical precipitation systems, USEPA chose only three to characterize chemical precipitation treatment levels: Miami Fort, Keystone, and Hatfield's Ferry. The three plants selected by USEPA have the highest pollutant loadings of the plants sampled by the agency. Therefore, they have the highest annual toxic-weighted pounds-equivalent (TWPE) removals.

Finally, USEPA's assessment of biological treatment is based on only two plants, Allen and Belews Creek. Those two facilities burn the same coal and have FGD wastewater treatment plants . The Belews Creek wastewater treatment system (completed in 2008) was used to build the same type of treatment system (with some improvements) at Allen and as a result, there are several similarities between the stations. For instance, both plants' influent to the FGD treatment system is low in Total Suspended Solids (TSS), total dissolved solids (TDS), and chlorides, and therefore is relatively easy to treat. Other plants with influents higher in TSS, TDS, and chlorides will present more challenges for the treatment system.

DP&L believes more plants more plants should have been sampled in order to calculate more representative pollutant reductions. Industry effluent limitations for biological treatment of FGD wastewater should not be based on the performance of only two plants which are very similar in design and operation. In addition, USEPA should collect more data, particularly for arsenic and mercury, from other facilities that operate chemical precipitation wastewater treatment systems. According to USEPA, there are 42 plants currently operating chemical precipitation systems for FGD wastewater treatment. The variability of more than two treatment systems should be evaluated.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4655-A2, Excerpt Number 20 regarding the variability of FGD wastewater caused by various factors, including coal type.

See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 124 in Comment Code 4.b regarding the representativeness for the FGD wastewater data.

See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 81 in Comment Code 10.c regarding the impacts of geographic diversity on FGD wastewater characteristics.

Regarding EPA's selection of plants with the "highest pollutant loadings," EPA notes that these plants were not selected for use in the loadings and limits development based on their loadings, but rather, based on the operation of the FGD wastewater treatment system. EPA determined that these plants were well-operated systems that operated using the specifications of the BAT chemical precipitation technology.

Commenter Name: Elizabeth E. Aldridge, Hunton & Williams
Commenter Affiliation: UWAG
Document Control Number: EPA-HQ-OW-2009-0819-4655-A2
Comment Excerpt Number: 20
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

In general, US EPA's developed their estimates of industry-wide pollutant loadings based on a dataset they describe as follows (US EPA, 2013b, pg. 3-8):

EPA conducted a sampling program at 17 different steam electric power plants in the United States and Italy to collect wastewater characterization data and/or treatment performance data associated with FGD wastewater, fly ash and bottom ash wastewater, and wastewater from *gasification and carbon capture processes. EPA also obtained sampling data for surface impoundment and landfill leachate collection and treatment systems at 39 plants, as required by Part G of the Steam Electric Survey.*

Example shortcomings of this development approach are as follows:

- US EPA conducted two to four day sampling events at seven US plants to "…obtain the following: 1) wastewater characterization data and 2) wastewater treatment technology performance data" (US EPA, 2013b, pg. 3-8), and in some cases collected 24-hour composite samples (US EPA, 2013b, pg. 3-12). US EPA has identified 1,179 facilities that would be subject to the proposed regulations (US EPA, 2013b, pg. 4-5). Among those 1,179 facilities, US EPA estimates that there will be approximately 145 plants generating FGD wastewater from wet FGD systems (US EPA, 2013b, pg. 4-5). The 7 facilities characterized by US EPA for FGD wastewater therefore constitute 5% of all facilities generating FGD wastewater. The post- compliance loadings values for chemical precipitation, biological treatment, and vapor- compression evaporation technologies were determined using data from even fewer facilities,
  only 1 to 3, depending on the technology. Similarly, pollutant loadings from was tewater generated from ash transport and coal combustion residual leachate was calculated using fewer than 10% of all facilities. Additional data is readily available. For example, US EPA's report on Incremental Costs and Pollutant Removals for the Proposed Effluent Limitations Guidelines (US EPA, 2013g, Table 10-5) includes FGD blowdown data from seven facilities, reported in a 2006 EPRI report (EPRI, 2006). Similarly, the responses to the questionnaire sent to Steam Electric Power Generating Effluent Guidelines (US EPA, 2010a) included FGD monitoring data (for untreated FGD scrubbed sludge) from 18 facilities. Therefore, US EPA should either incorporate additional readily available data or explain why they omitted that data.
- US EPA acknowledges that "a number of variables can affect the composition of combustion wastewater, including fuel composition, type of combustion process, air pollution control technologies implemented, and management techniques used to dispose of combustion wastewater" (US EPA, 2013c, pg. 3-3). These variables can results in significant variability in metal concentrations in wastewater at steam electric power plants. For example, FGD monitoring data obtained from the questionnaire (US EPA, 2010a) showed that selenium concentrations in untreated FGD scrubber sludge ranged from 0.36 to 14,800 µg/L, based on data from 18 facilities. Even within a given facility, significant variability is observed. For example, selenium concentration in the influent to the settling pond at the Progress Energy Roxboro facility ranged from 847 µg/L to 21,700 µg/L. Given this wide range of variation, increasing the number of data points for the calculation of industry-wide average reduces the uncertainties in the estimation of pollutant loadings.

Comment Response:

EPA disagrees that the plants used to evaluate the BAT chemical precipitation, biological treatment, and evaporation system technologies do not represent the industry. See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 124 in Comment Code 4.b. EPA notes that the commenter compares the number of plants EPA sampled for FGD wastewater to the number of plants the generate FGD wastewater, however, not all of the plants that generate FGD wastewater discharge that wastewater and, therefore, those plants would not be subject to the final FGD wastewater limitations and standards unless and until they discharge. It is not necessary to use data from every plant that generates FGD wastewater. The data EPA used are representative of FGD wastewater.

The BAT basis for FGD wastewater (i.e., chemical precipitation with hydroxide and sulfide addition and iron coprecipitation followed by anoxic/anaerobic biological treatment) is designed to treat wastewater to a targeted effluent concentration, not a targeted percentage removal. EPA identified plants that were operating treatment systems that represented operation of the BAT and obtained data from these plants to estimate baseline loadings for these plants, and thus pollutant removals) associated with the BAT basis, and to calculate effluent limitations. EPA determined that these plants were sufficiently representative of the industry for establishing ELGs based on those technologies. EPA notes that the industry did not provide any effluent characterization data for other plants operating the BAT technology.

EPA used FGD purge data from seven plants to characterize FGD wastewater; however, the data were not used to establish effluent limits. In EPA's review of the plants that discharge FGD wastewater, EPA determined that the plants operated at a minimum a surface impoundment system (or similar treatment system). In EPA's estimation of pollutant loadings, EPA evaluated baseline loadings for these plants based on a surface impoundment system. EPA evaluated available FGD blowdown (and FGD purge) data to estimate effluent concentrations for surface impoundments, which are the concentrations used to evaluate baseline loadings for plants operating surface impoundments for FGD wastewater under baseline conditions. EPA did not use the survey-submitted FGD blowdown data because insufficient data components were provided for EPA to calculate the settling pond effluent values (i.e., total metals, dissolved metals, and TSS concentrations are required for the calculation). While some plants may have provided all of these components for one of two pollutants, EPA determined it was not appropriate to include data from a small subset of plants for only one or two pollutants in the pollutant loadings analysis. Additionally, EPA did not use the EPRI data from the *Flue Gas Desulfurization (FGD) Wastewater Characterization: Screening Study* because EPA does not know the identity of the plants and, therefore, is unable to determine whether the data should be combined into the dataset of one of the existing plants or whether the data are associated with an entirely new plant not already accounted for in EPA's dataset. See Chapters 3 and 11 of the *Incremental Costs and Pollutant Removals for the Final Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category* (Cost & Loads Report) (DCN SE05831/SE05832) for the data sources used and the calculation methodology for surface impoundment effluent concentrations.

EPA recognizes that FGD wastewater characteristics can vary from one plant to another based on a number of variables. EPA's data take such variability into account Since proposal, both through and as a result of public comments, EPA received FGD data over a three-year period for plants operating BAT chemical precipitation technology option and BAT biological treatment technology option to use for calculating effluent limitations and estimating pollutant loadings/removals. These additional data were in some cases used to supplement EPA's dataset and further address the variability in FGD wastewater that the commenter noted. See preamble section V.F and Section 3 of the TDD for additional information on the data sources used in the development of the final rule.

- Regarding the ash transport water, EPA disagrees with the commenter that the data EPA used for the final rule is not sufficient for its intended purposes. For further details on EPA's data collection activities, see Section 3 of the TDD. Regarding issues related to the use of the 1982 TDD data, see the response to response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 72 in Comment Code 15.d. Also see the responses to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 38 in Comment Code 4.b; DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 33 in Comment Code 4.b; DCN EPA-HQ-OW-2009-0819-4305-A3, Excerpt Number 75; DCN EPA-HQ-OW-2009-0819-4379-A1, Excerpt Number 24 in Comment Code 4.b.

Regarding the landfill leachate data, the data used in the analysis is based on the data EPA received in response to the steam electric industry survey. EPA notes that the survey only required a subset of plants to respond. EPA notes that no other plants provided EPA with leachate data. Therefore, EPA used the best data available.

Commenter Name: Chris M. Hobson
Commenter Affiliation: Southern Company
Document Control Number: EPA-HQ-OW-2009-0819-4379-A1
Comment Excerpt Number: 54
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

EPA should not derive limits for any FGD technology under consideration – including chemical precipitation – without a more robust set of data and a better understanding of treatment performance. Its limited data do not represent the variability of FGD wastewater across the industry. UWAG's comments describe the EPA sampling program in detail.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 81.

Commenter Name: Michael G. Cashin
Commenter Affiliation: Minnesota Power (ALLETE)
Document Control Number: EPA-HQ-OW-2009-0819-4768-A2
Comment Excerpt Number: 3

External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

2. FGD Treatment Technology. MP comments that EPA's technology based treatment methods for Flue Gas Desulfurization (FGD) wastewaters are unproven due to the lack of commercial demonstration of treatment equipment performance at the operating capacity and under the field conditions typical of electric generating units. FGD wastewaters should be managed by Best Professional Judgment (BPJ). If EPA includes Chemical Precipitation and Biological Treatment as required FGD treatment methods in the final rule, then MP notes that EPA's proposed exclusion under regulatory option 3b for FGD wastewaters for facilities with less than 2,000 MW of wet-scrubbed capacity (FR page 34436), becomes essential for supporting compliance from most electric generating units.

Comment Response:

EPA disagrees with the commenter that FGD wastewater should be managed by BPJ. See preamble Section VIII.C.1 and responses to comments in Comment Code 6.j.i.

See response to DCN EPA-HQ-OW-2009-0819-4477-A1, Excerpt Number 15 in Comment Code 5.c regarding EPA's evaluation of the 2,000 MW wet-scrubber capacity threshold.

Commenter Name: Dean Ellis
Commenter Affiliation: Dynegy Inc.
Document Control Number: EPA-HQ-OW-2009-0819-4491-A1
Comment Excerpt Number: 14
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

As detailed in UWAG's comments, EPA's evaluation of FGD wastewater and the possible technologies available to address it is not adequately representative of the wide variations in coal types, scrubbers, and operational patterns within the industry.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4655-A2, Excerpt Number 20 and DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 124 in Comment Code 4.b regarding the representativeness of FGD wastewater.

Commenter Name: Michael G. Cashin
Commenter Affiliation: Minnesota Power (ALLETE)
Document Control Number: EPA-HQ-OW-2009-0819-4768-A2
Comment Excerpt Number: 19
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

The performance of FGD wastewater treatment systems is unique for each wet-scrubbed unit given numerous affective variables including coal type, boiler characteristics, climate, etc.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4655-A2, Excerpt Number 20 and DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 124 in Comment Code 4.b regarding the representativeness of FGD wastewater.

8.d. FGD – Calculation of Baseline Loads

Commenter Name: Elizabeth E. Aldridge, Hunton & Williams
Commenter Affiliation: UWAG
Document Control Number: EPA-HQ-OW-2009-0819-4655
Comment Excerpt Number: 87
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

2. Typical Problems in Calculating Percent Removal Are Relevant to EPA's Sampling Program

Other considerations may apply to a system exhibiting an apparent "incidental" removal:

- The retention time of the system is a major factor when pairing influent/effluent data, and this comparison can be complex.
- Many large outdoor treatment systems have an inherent, though minor, dilution of the wastewater during the treatment process due to weather precipitation events, or from multiple recycling of treatment stages.

When EPA develops ELGs, it typically lacks sufficient data, especially continuous data, from both the influent and effluent of a treatment system, which are needed to properly calculate an accurate percent removal. EPA therefore calculates an *apparent* daily percent removal using a limited amount of "paired data." In doing this, EPA frequently resorts to simplifications that can lead to misleading interpretations of the data.

For example, EPA often disregards the retention time in the treatment system and simply compares the measurements of the influent and effluent taken on the same day. This leads to error when the influent concentration is not constant during the period when the data are measured. Some days will show exaggerated "removal," while others will seem to have negative removal.

In developing other industries' ELGs, EPA has often used only the *positive* percent removals calculated for each day, while adjusting negative percent removals to zero (reasoning that "negative removal" is not possible, so the results must be faulty for that day). But this is a false assumption when influent concentrations change significantly from day to day and there is a significant retention time to the treatment, and it introduces a large high bias to the calculated percent removals. The apparent negative removals are in fact compensation for other imperfectly paired data points where the percent removal is erroneously high; thenegative values must be retained in order to more accurately calculate the "true" percent removal. EPA was correct, therefore, in using both the positive and negative removals in the TWPE calculations for FGD wastewater treatment.

To our knowledge, EPA has never accounted for diffusion and mixing at intermittent stages of the treatment system. Whenever the influent concentration varies significantly, the differences in concentration at downstream treatment sampling points are modulated, because at least some mixing will occur inside equalization basins and/or treatment tanks within the treatment system. A spike in the influent concentration will seem to show an apparent removal at a downstream treatment point because the concentration spike will have been "equalized." This is particularly a problem if the influent "sample" is collected differently from the composite sample used at other sample locations in the system. The section below describes the complications associated with mixing within the treatment system stages.

3. EPA's Data Are Inadequate to Characterize the Performance of Technologies Because of Complications Caused by Mixing

Even matching the retention time does not give a perfect influent/effluent pair, however, because there are additional complications due to mixing within the treatment system. It is not possible to obtain "perfect" sets of paired influent/effluent data. First, the sample data are mostly available only in 24-hour composites, whereas the retention times in the system will not likely be in increments of exactly 24 hours. Second, there is another complication in obtaining optimally "paired" influent and effluent data, and that is the mixing or diffusion characteristics within various treatment stages.

The water from the influent is not a fixed quantity that moves uniformly as a block through the system. As the water enters the tanks in the various stages of the treatment, it is constantly mixing – rapidly if the tank is actively mixed and more slowly by diffusion in settling tanks that are mostly quiescent. If the influent remains constant, the concentrations of the measured parameters at various sampling points throughout the treatment system change very little over time.

However, when the influent is changeable, "slugs" of high-concentration and low-concentration water enter the system at different times. These slugs are constantly diffusing into the existing wastewater in the system while moving through it. The impact on the measured concentrations at any downstream sampling point over time is to mediate the change in concentration. The peak concentrations will not be as high, the low concentrations will not be as low, and the overall "slug" will broaden and take longer to pass an individual sampling point.

The effect is similar to a peak on a gas chromatograph column. When the column is operated at a high temperature, the peak is sharp and narrow, and the time it takes to pass the detector (the sampling point) is relatively short. At a lower temperature, the peak is lower but broader, taking longer to pass the sampling point. However, when the areas under each peak are integrated, they should come out about the same.

Therefore, the most accurate method of determining percent removals during treatment stages (and the *only* method that allows any certainty when the observed percent removals are small), is to measure representative (composite) samples every day and to continue this for a period of time that encompasses several high and low influent slugs that flow completely through the system.[36]

For systems like Allen and Belews Creek, where the retention time is 88 and 63 hours, respectively, this would mean at least a month (and preferably several months) of continuous daily composite sampling at all three sample locations (and the locations would have to be appropriate). If a system like Allen's demonstrates a continued history of relatively rapid changes in concentration, longer periods may be necessary.

Also, skipping sampling on random days during this period would not be acceptable at a system like Allen's, because the sampling could miss different stages of a change in concentrations, which would skew the apparent percent removals. Percent removals over this time could be calculated from averages over the time period, with the average results adjusted for the retention time in the treatment system. (This would mean eliminating a few daily data points from the average calculations.) Such an ideal data set would still require that a limit be set for effective removal, consistent with the guidelines established by EPA for the CWT treatment systems described above.

4. Percent Removal Across a Complex Treatment System Is Difficult to Calculate Accurately

There are several reasons why there must be some minimum level of percent removal demonstrated before crediting a treatment system with successful treatment. The first is analytical. The typical quality control standard for reproducibility at an environmental lab is 20% relative percent difference (RPD) for most inorganic analyses. That is, when a lab runs duplicate analyses on the same sample, results that are within 20% of each other are normally considered acceptable by most NELAC-certified environmental laboratories. Therefore, it is also possible that a percent removal calculated from a single pair of influent and effluent results from the same treatment system that differ by 20% or less is within the acceptability limits of a duplicate sample and therefore not a reliable removal value. Of course, increasing the number of sample pairs can increase the reliability of the measured removal, if the removal results remain consistent.

The locations and methods of sampling are also important. Flow-proportional composite sampling is generally considered most representative for a given sampling point, but not if the sample location does not represent the true influent to or effluent from the treatment system.

Also, it is unlikely that any two "paired" influent/effluent samples will match up exactly. The retention time and mixing characteristics in the treatment system virtually guarantee that the samples will not be an exact match, so that small percentage differences between samples, and a subsequently calculated small percentage of removal, can be simply an artifact of the pairing.

All these problems are magnified when a treatment system has a variable influent, which appears to be the case for the Allen site based on both the EPA and the self-monitoring data.

Based on general wastewater engineering practice, percent removals across wastewater treatment systems of less than 30% are considered poor. They may be no more than incidental removal that could be due to the uncertainties between influent and effluent measurements, especially when the influent concentration is variable. Even 50% removal is often considered only marginal performance.

5. EPA Precedent for Calculations of Cost-Effectiveness in Recent ELGs

For past ELGs, EPA typically adopted an acceptable minimum average removal value across a technology option as part of the criteria used to determine which parameters might be assigned a regulatory limit. For the CWT ELG (finalized in 2000, 65 Fed. Reg. 81,241 (Dec. 22, 2000)), EPA adopted a minimum removal of 50% for inorganic parameters such as metals (removed by chemical precipitation) and a 30% removal for trace organic parameters. *See* CWT 2000 Development Document.

The more recent MP&M rule set a limit for effective removal of 20%. However, in that rule, the 20% removal was an aggregate estimate over baseline, where many of the existing (baseline) sites were already given credit for chemical precipitation removal. If the removal across a model technology option was less than these values, EPA considered the treatment technology ineffective for that parameter, and that parameter would not be considered for regulation.

In the CWT Cost-Effectiveness Analysis, EPA issued additional guidelines as to which parameter removals would not be applicable to the calculations of TWPEs:

- the pollutant was not effectively treated by the option technology (the pollutant level increased across the technology),
- the pollutant was not detected at treatable levels in the influent streams at the facilities forming the basis for the options limitations and standards,
- the pollutant is pervasive in the environment as a mineral and is relatively nontoxic (for example, calcium),
- the pollutant is often used as a treatment chemical, and
- the pollutant's TWF is zero.

CWT Cost-Effectiveness Analysis at 2-2. These conditions would eliminate magnesium (for example) from consideration as a TWPE in the steam electric rulemaking, since it is the other ubiquitous hardness cation, second in prevalence only to calcium, and it also has an exceedingly low TWF.

EPA further modified these qualifications for boron removal across treatment technologies (such as chemical precipitation) where the treatment mechanism does not effectively target that pollutant. In the CWT 2000 Development Document, EPA stated: "EPA also eliminated those pollutants for which the treatment technology forming the basis of the option is not a standard method of treatment. For example, chemical precipitation systems are not designed to remove BOD_5." *Id.* at. 7-25.

Table 7-11 in the CWT 1998 Development Document for the proposed rule included boron as a parameter that was not effectively treated by chemical precipitation, and EPA concluded that any *apparent* boron removal across this technology was "incidental." The removals that EPA may have calculated for boron and magnesium do not meet EPA's criteria at the Allen and Belews Creek FGD wastewater treatment systems, as discussed in the section below.

---

[36] The use of Belews Creek and Allen self-monitoring data does not solve this problem. The self-monitoring data was not collected on a daily basis and the frequency was not consistent.

Comment Response:

The commenter disagrees with EPA's approach, for purposes of the pollutant loadings and removals analysis, in calculating the percent of pollutant removals across the FGD wastewater treatment system due to "imperfectly paired data" and "mixing or diffusion" within the treatment system. EPA agrees with the commenter that having an analytical data set that represents uninterrupted daily composite samples would be ideal for this calculation. However, EPA must often operate in a world with imperfect data. EPA requested self-monitoring data from all the plants identified as operating treatment systems that are consistent with the BAT bases for FGD wastewater and that are used in the loadings analysis, and none of the plants were able to provide such data to EPA. However, the plants did provide EPA with additional self-monitoring data, in some cases spanning a three-year period, which EPA incorporated into its analyses. Therefore, EPA is using the best available data for its analyses.

The commenter also states that there should be a "minimum level of percent removal demonstrated before crediting a treatment system with successful treatment" and that "removals that EPA may have calculated for boron and magnesium do not meet EPA's criteria at the Allen and Belews Creek FGD wastewater treatment systems." EPA agrees that pollutant removals should be included in the estimates when the data show that the pollutant is actually being removed. In consideration of the pollutant removals of the BAT basis of chemical precipitation plus biological treatment for FGD wastewater, EPA also reviewed the treatment effectiveness of each technology option (i.e., chemical precipitation, biological treatment) for removing specific pollutants. For EPA's evaluation of treatment effectiveness, EPA did not calculate percent removals on a daily basis, but rather, calculated an overall percent removal for each pollutant based on the average influent concentration and the average effluent concentration for each plant. EPA used this calculated percent removal to evaluate whether the individual plant's systems demonstrated treatment across the different portions of the system. EPA's data set demonstrates that the BAT basis of chemical precipitation plus biological treatment effectively treats the pollutants for which EPA is establishing numeric limitations and standards for the discharge of pollutants in FGD wastewater (i.e., arsenic, mercury, selenium, and nitrate/nitrite as N). Regarding boron, EPA determined that there is removal of boron across the chemical precipitation system but not the biological treatment system. Therefore, EPA's removal estimates do account for some removal of boron across the entire BAT basis of chemical precipitation plus biological treatment. Regarding magnesium, EPA determined that magnesium is not removed across the chemical precipitation or biological treatment system and, therefore, EPA's removal estimates do not account for any removals of magnesium across the entire treatment system.

See Section 11.1.5 of the *Incremental Costs and Pollutant Removals for the Final Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category* (Cost & Loads Report) (DCN SE05831/SE05832) for more information on EPA's methodology for evaluating pollutant removals by the treatment system representing the BAT basis of chemical precipitation plus biological treatment.

Commenter Name: Paul Chu
Commenter Affiliation: Electric Power Research Institute (EPRI)
Document Control Number: EPA-HQ-OW-2009-0819-4499-A1
Comment Excerpt Number: 48
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Both EPA and EPRI followed similar procedures and, therefore, obtained similar TWPE's for the influent and effluent streams. The following sections then describe the factors that drive the differences in the final results, namely: the inclusion of calculations for the incremental reductions of adding biological or VCE treatment to a plant with CP systems (Section 4.2), and the importance of using influent and effluent data from the same source and test runs when calculating TWPE reductions (Section 4.3).

4.1 Pollutant removals calculated by EPA for chemical precipitation, biological, and CP + VCE treatment are substantially greater than those calculated by EPRI.

EPA's calculated pollutant removals are significantly greater than EPRI's calculated pollutant removals. EPA's calculated benefits are 2 times greater for chemical precipitation (CP), 8 times greater for incremental biological treatment, 3 times greater for CP + biological, and approximately 2 times greater for incremental vapor compression evaporation (VCE) and CP + VCE (Table 4-1).

Table 4-1
Comparison of EPA and EPRI Calculated Industry Benefits of Treating FGD Wastewater

Treatment	EPA[a] (TWPE per year)	EPRI (TWPE per year)
CP	1,533,000	851,000
Incremental Biological	1,087,000[b]	136,000
CP + Biological	2,620,000	987,000
Incremental VCE	1,457,000[c]	752,000
CP + VCE	2,990,000	1,603,000

[a] EPA, 2013, page 10-25
[b] The Incremental Biological treatment benefit was not directly provided by EPA. This was calculated by subtracting the CP benefit from the CP + Biological benefit.
[c] The Incremental VCE treatment benefit was not directly provided by EPA. This was calculated by subtracting the CP benefit from the CP + VCE benefit.
TWPE = toxic-weighted pounds-equivalent

EPRI attempted to recreate EPA's wastewater quality (concentration of trace metals and other parameters) for each treatment stream, with the exception of CP + VCE. Although the wastewater qualities were similar, EPRI was unable to replicate EPA's values, as shown in Figure 4-1. To help clarify the impact of differences in water quality estimates, the concentration of each constituent was multiplied by its toxic weighting factor (TWF). For example, a large difference in estimates of water quality for a constituent with a very small TWF will have little impact on the difference between pollutant removal values calculated by EPRI and EPA. EPA's water quality values are from the TDD [EPA, 2013], Table 10-3 for settled data, Table 10-4 for chemical precipitation treatment effluent data, Table 10-5 for chemical precipitation with biological treatment effluent data, and Table 10-6 for chemical precipitation data with vapor-compression evaporation effluent data. EPRI used TWF values from T*echnical Support Document for the Annual Review of Existing Effluent Guidelines and Identification of Potential New Point Source Categories* [EPA, 2009a]. Part of the discrepancy could stem from EPA's use of non-detect and J-values. EPA treated non-detect and J-values as half of the sample quantitation limit, which would lead to higher averages (and possibly greater pollutant removals). In contrast to EPA's method, EPRI treated non-detect values as half of the sample-specific method detection level, and J-values at their reported concentrations. To duplicate EPA's benefit values, more information on methodology and data is needed.

To clarify the discrepancy between treatment pollutant removal estimates calculated by EPA and those calculated by EPRI, the assumptions used to calculate the pollutant loading reductions were evaluated by EPRI. Pollutant removals for each plant (expressed in TWPE) were calculated as a function of four variables:

- Wastewater stream quality (concentration of trace metals and other parameters)
- Toxic weighting factor (TWF) of each parameter

- Flow rate of wastewater stream
- Type of coal used in plant

The assumptions used to calculate the benefits for each plant are shown in Table 4-2. Details of EPRI's calculations are available in Appendix B.

Table 4-2
Comparison of EPA and EPRI Assumptions Used to Calculate Pollutant Removals for Each Plant

Assumptions	EPA Approach	EPRI Approach
Wastewater stream quality[a]	CP Influent = average of 8 plants' data CP Effluent = average of 3 plants' data Biological Effluent = average of 2 plants' data CP + VCE Effluent = average of 1 plant's data	CP Influent = average of 12 plants' data[b] CP Effluent = average of 4 plants' data[b] Biological Effluent = average of 2 plants' data (same as EPA) CP + VCE Effluent = assumes zero discharge
TWF	Published factors	Same as EPA
Flow rate for each plant	Data from the ICR[c] Section B5-2 Typical flow rate (gpd) x typical frequency (dpy)	Same as EPA
Benefit calculated and allocated by coal type	Not considered	Coal type ("rank") considered for each of the wastewater streams

[a] FGD wastewater constituent concentrations
[b] While the number of plants used in the calculation differed, the actual concentrations were similar to EPA's calculated concentrations.
CP = chemical precipitation
VCE = vapor-compression evaporation
TWF = toxic weighting factor
gpd = gallons per day
dpy = days per year

EPRI and EPA used data from eight plants to calculate average constituent concentrations for CP influent. These plants include:

- Mirant Mid-Atlantic LLC's Dickerson Generating Station
- Allegheny Energy's Hatfield's Ferry Power Station
- RRI Energy's Keystone Generating Station
- We Energies' Pleasant Prairie Power Plant
- Duke Energy's Belews Creek Steam Station
- Duke Energy's Allen Steam Station
- Duke Energy's Miami Fort Station
- Progress Energy's Roxboro Plant

EPRI used data from four additional plants to calculate average constituent concentrations for CP influent. These plants are the sites that EPA sampled in 2007, as follows:

- Tampa Electric Company's Big Bend Power Station
- Homer City Generation L.P.'s Homer City Generating Station
- Ohio Power Company's Mitchell Plant
- Tennessee Valley Authority's Widow's Creek Power Plant

EPA did not include the effluent data from the four plants they sampled in 2007 because different analytical methods were used at these sites; however, the influent settled data should be acceptable for inclusion. Regardless, the addition of these four sites had little effect on the overall average concentrations of FGD wastewater constituents, as shown in Figure 4-1.

EPRI and EPA used data from three plants to calculate average constituent concentrations for CP effluent. These plants were:

- Allegheny Energy's Hatfield's Ferry Power Station
- RRI Energy's Keystone Generating Station
- Duke Energy's Miami Fort Station

The one additional plant used in EPRI's FGD pollutant removal calculation for CP effluent is

- We Energies' Pleasant Prairie Power Plant

EPRI included the Pleasant Prairie data in its calculation of average constituent concentrations for CP effluent because FGD wastewater treatment at the plant meets the definition of BAT. The addition of the Pleasant Prairie data had very little effect on the average constituent concentrations, as shown in Figure 4-1.

Both EPA and EPRI used data from the following two plants to calculate the average constituent concentrations for biological effluent:

- Duke Energy's Belews Creek Steam Station
- Duke Energy's Allen Steam Station

Figure 4-2 shows water quality estimates for each constituent used by EPRI and EPA in pollutant removal calculations. When EPRI's water quality estimate is weighted, using the percent of the industry's FGD wastewater flow by each coal type, the difference between water quality estimates by EPRI and EPA is small—less than 10 percent.

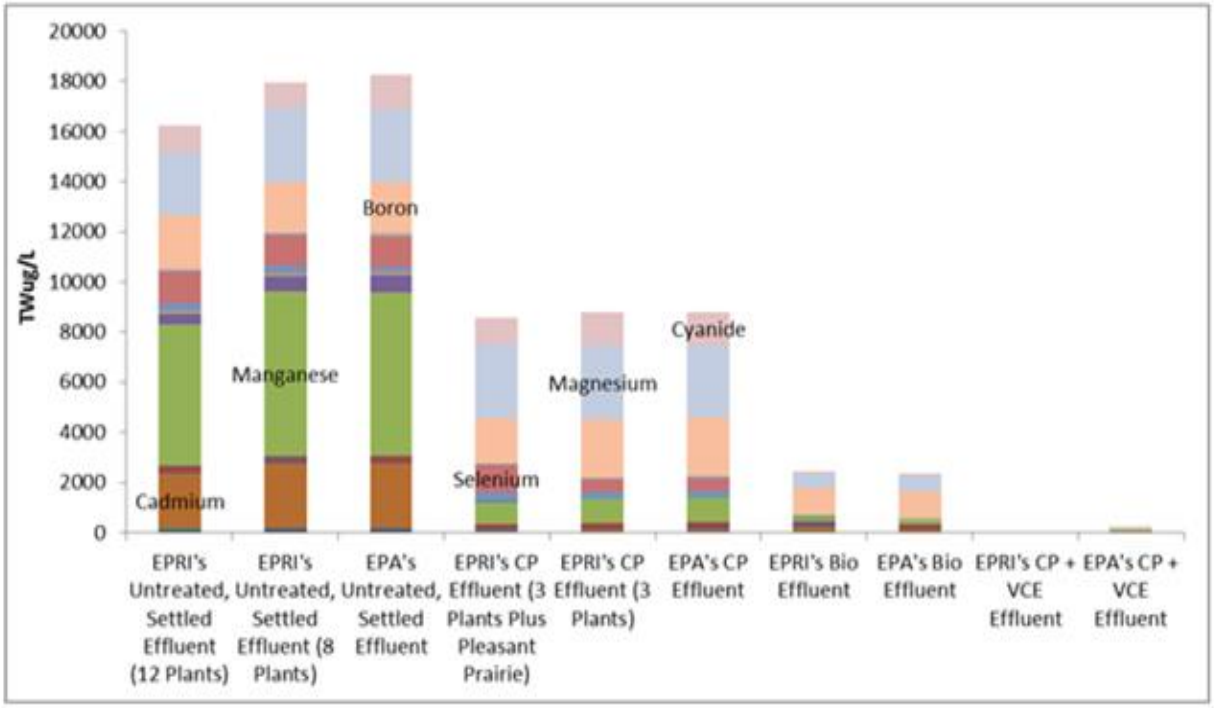


Figure 4-1
Comparison of EPRI and EPA Average Constituent Concentrations for FGD Wastewater Streams
Source: EPA, 2013, Table 10-3, Table 10-4, Table 10-5, Table 10-6; EPA, 2009b; ERG, 2008a–d; ERG, 2009; ERG, 2011a–g; ERG, 2012

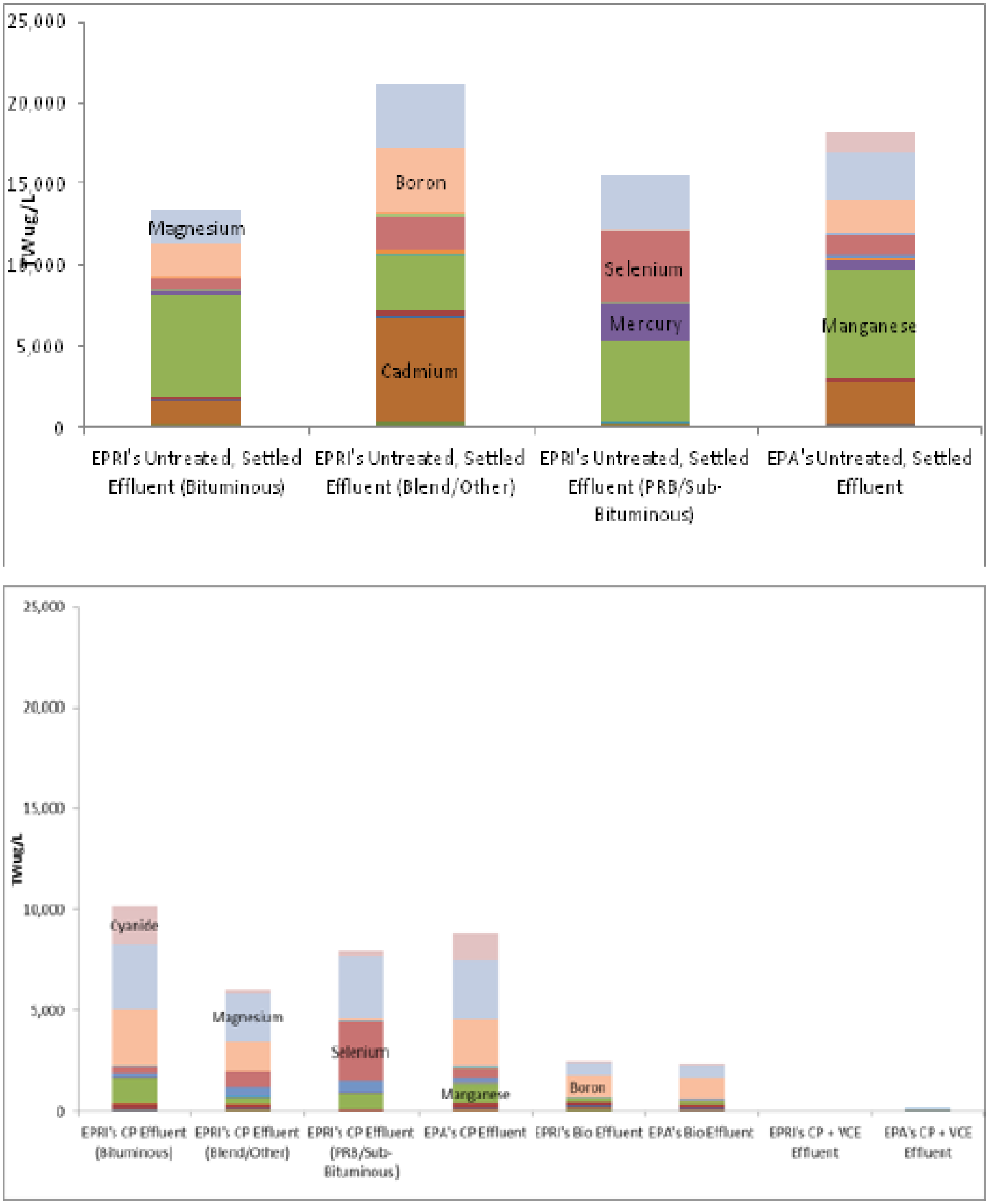


Figure 4-2
Comparison of EPA Average Water Quality Characteristics and EPRI Water Quality Characteristics Derived Using Coal Rank for FGD Wastewater Streams (top and bottom)

Source: EPA, 2013, Table 10-3, Table 10-4, Table 10-5, Table 10-6; EPA, 2009b; ERG, 2008a–d; ERG, 2009; ERG, 2011a–g; ERG, 2012

The number of plants included for each wastestream in EPA's and EPRI's pollutant removal calculation is shown in Table 4-2.

To calculate industry-wide pollutant removals, both EPA and EPRI made assumptions about the number of plants that would need treatment, as well as the credit to be given for treatment already in place (Table 4-3). EPRI incorporated the same number of plants (116) as EPA in its industry-wide calculation. EPA and EPRI both gave credit to plants with treatment systems in place now or planned for installation by 2014. As the other factors described in Table 4-3 are similar for EPA and EPRI (with the exception of using coal type), the remaining potential differences involve the actual plants that EPA included in its industry-wide pollutant removal calculation and its assignment of credit for treatment in place. As this information was redacted, EPRI was unable to complete its evaluation to clarify possible differences between the approaches taken by EPA and EPRI. Accordingly, EPRI requests additional details of EPA's methodology and supporting information that will allow a proper comparison of industry-wide pollutant removals calculated by EPA and EPRI.

Table 4-3
Differences in EPA and EPRI Assumptions Used to Calculate Industry-Wide Pollutant Removals

Assumptions	EPA Approach	EPRI Approach
Plants included in industry-wide benefits calculation	116	Same number of plants as EPA (116); unclear if identical plants included due to redacted information
Credit for treatment in place	Calculated the baseline by giving credit to plants with treatment systems in place now or by 2014	Same method as EPA; unclear if identical credit provided due to redacted information

EPRI chose to use an alternative approach for estimating water quality concentrations. Plants burning different coal types make up vastly different percentages of the total industry flow and available data appear to have different concentrations of the various constituents in FGD wastewater. For these reasons, EPRI calculated the pollutant removals of FGD wastewater treatment by developing water quality characteristics for CP Influent and CP Effluent by coal type for three coals: bituminous, sub-bituminous, and blend/other, as shown in Figure 4-2. EPRI then applied these water quality characteristics to the industry by coal rank (i.e., bituminous water quality characteristics were applied to plants burning bituminous coal, sub-bituminous water quality characteristics were applied to plants burning sub-bituminous coal, and blend/other water quality characteristics were applied to plants burning a blend of coals, lignite or petroleum coke, or whose coal type was redacted in the ICR). As there are only two data sets for biological treatment—both from facilities burning bituminous coal—EPRI did not differentiate between coal type for biological treatment effluent.

Comment Response:

EPA does not entirely agree with the commenter's characterization of EPA's approach, or with the commenter's own approach, for estimating baseline pollutant loads and removals associated with control of pollutants in discharges of FGD wastewater for the reasons discussed below.

The commenter states that "EPA treated non-detect and J-values as half of the sample quantitation limit, which would lead to higher averages" in its calculations of pollutant loadings. See *Evaluation of Alternatives for Handling Qualified Analytical Data in the Steam Electric Pollutant Loadings* (DCN SE05879) for more information on how EPA handled J-values, including a sensitivity analysis demonstrating that the effect of three alternative methodologies is minimal, including the method that commenter described: "EPRI treated non-detect values as half of the sample- specific method detection level, and J-values at their reported concentrations."

EPA disagrees with the commenter's description that "EPRI and EPA used data from eight plants to calculate average constituent concentrations for [chemical precipitation] influent." EPA used data from eight plants to calculate the estimated settling pond effluent concentrations used to approximate the baseline discharges from plants operating surface impoundments to treat FGD wastewater. These estimated concentrations do not represent the influent to the chemical precipitation system.

EPA disagrees with the commenter's approach of using certain data from four additional plants "to calculate average constituent concentrations for [chemical precipitation] influent." The commenter offers no basis for including these plants in the analysis. EPA did not use EPA's detailed sampling effluent data for the four named plants because of the analytical issues associated with the data. As the commenter points out, EPA used different analytical methods for the detailed study compared to the rulemaking sampling. Based on discussions with UWAG and EPRI related to the detailed study sampling results, EPA revised the analytical methods used in the rulemaking sampling program to account for analytical interferences and other issues. As such, EPA did not use the detailed study sampling data in any of its analyses for the final rule. And as the commenter points out, "the addition of these four sites had little effect on the overall average concentrations of FGD wastewater constituents." Therefore, EPA concludes that the exclusion of these data was appropriate. For the same reasons, EPA also disagrees with the commenter that, for these four plants, "the influent settled data should be acceptable for inclusion."

EPA agrees with the commenter that the Pleasant Prairie Power Plant data should be used in the loadings analyses and has included the data in the analysis for the final rule. See response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 53 (in comment code 9.a).

EPA notes that the population of plants discharging FGD wastewater has been updated for the final rule to account for information provided in comments, additional announced generating unit retirements, and additional evaluation of the data in response to public comments on the proposed rule. See Sections 6 and 10 of the TDD for more information regarding plants with wet FGD systems and EPA's calculation of FGD wastewater loadings. As was the case at proposal, some of the information related to plant information and costs has been claimed confidential business information (CBI) and although it is included in the record for the rule, it is not publicly releasable. EPA does not have discretion in this regard. 40 CFR Part 2 establishes specific requirements regarding the protection of confidential business informations, which EPA must adhere to. See 40 CFR Part 2 for more information.

EPA disagrees with the commenter's approach of calculating loadings based on the type of coal burned at the plant. The final rule establishes limitations and standards for the discharge of pollutants from the stream electric generating industry. The final rule does not regulate what type of coal plants may burn. Moreover, the final rule does not create subcategories within the steam electric industry based on type of coal burned. EPA determined that it would not be appropriate to subcategorize based on the type of coal burned by a generating unit because some plants are constantly changing the coal used at the plant and many plants use different blends of coals. Additionally, some plants use different coal in different generating units. Therefore, EPA determined that establishing subcategories would unnecessarily complicate the regulatory regime, make compliance and enforcement more difficult, or possibly limit the types of coals that could be burned at plants. Moreover, EPA determined that plants can achieve the final limitations and standards regardless of which coal they use. As such, EPA is not subcategorizing the industry based on the type of coal burned. Because EPA is not subcategorizing the industry based on coal type, EPA determined that it is inappropriate to calculate loadings based on the differentiation of coal type.

Commenter Name: Chris M. Hobson
Commenter Affiliation: Southern Company
Document Control Number: EPA-HQ-OW-2009-0819-4379-A1
Comment Excerpt Number: 168
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

EPA's Reasons for Selection of Cyanide Data Are Unclear
For some unknown reason, EPA did not use any of the SP-1 (influent) monthly data (i.e., CWA 308 sampling) collected from each of the seven plants. It appears EPA selected the higher concentration values from the four-consecutive-day sampling events to calculate the average influent concentrations used to calculate TWPEs. Interestingly, none of the influent data from the monthly events were used to calculate the influent average concentrations, but the effluent data from the monthly events were used to calculate average concentrations for chemical precipitation effluent SP-2 and bioreactor effluent SP-3. This selection of data results in artificial removals of cyanide.

The table below provides the influent cyanide data EPA did not include in its TWPE calculations. The results were not flagged with any qualifiers except for one nondetect. Note that the data for Hatfield's Ferry and Keystone are several orders of magnitude lower than their four-consecutive-day event data that EPA used to calculate TWPEs. The higher concentrations reported for EPA's four-consecutive-day sampling event could be a result of exceeding the holding time required by the method resulting in cyanide formation over time due to the preservative. The higher concentrations could be a result of interferences. The analysis of the solid phase of these influent samples with a method developed for liquid phase samples could have resulted in matrix interferences producing false positives.

EPA Influent (SP-1) Cyanide Data Not Used in EPA's TWPE Calculations

Plant	Sampling Point	Average Concentration, mg/L	EPA's Qualifications of Analytical Results
Hatfield's Ferry	SP-1, Monthly 1-4	0.91	1 < MDL (0.1)
Keystone	SP-1, Monthly 1-4	0.36	
Miam Fort	SP-1, Monthly 1-4	5.5	Monthly 4, 19 mg/L (data point questionable due required dilution)

Comment Response:

EPA disagrees with the commenter that its selection of data resulted in "artificial removals of cyanide." EPA did not use FGD purge data directly in the calculation of pollutant loadings. Instead, EPA used the FGD purge data to estimate the concentrations that would be present in the settling pond effluent if a surface impoundment were used for treating the FGD wastewater. These concentrations were used to represent the baseline discharges for plants operating surface impoundments to treat FGD wastewater. EPA's methodology for estimating the settling pond effluent concentrations is described in Section 11.1.1 of the *Incremental Costs and Pollutant Removals for the Final Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category* (Cost & Loads Report) (DCN SE05831/SE05832). The methodology EPA employed was primarily focused on determining the effluent concentrations for metals. As such, EPA did not develop a methodology to estimate the settling pond effluent for cyanide. Therefore, for the pollutant loadings, EPA set the settling pond effluent concentration equal to the chemical precipitation effluent concentration such that cyanide loadings would be accounted for in the baseline industry discharges, but no pollutant removals would be accounted for in the chemical precipitation system. Thus, the commenters concern that "this selection of data results in artificial removals of cyanide" has been resolved in the analysis for the final rule. See Section 11.1.5 for additional information regarding the concentrations used for each pollutant for each technology option in EPA's loadings analysis.

Commenter Name: Elizabeth E. Aldridge, Hunton & Williams
Commenter Affiliation: UWAG
Document Control Number: EPA-HQ-OW-2009-0819-4655
Comment Excerpt Number: 100

External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

8. EPA's Adjustments to High FGD Flow Rates Are Misleading

In addition to treating FGD wastewater by chemical precipitation, Options 1, 2, 3, 4a, and 4 would require flow minimization for plants with high FGD discharge flow rates. The preamble states:

As is the case for Option 1, these BAT options [2, 3b, 3, 4a and 4] the use of flow minimization for plants with high FGD discharge flow rates (i.e., greater than 1,000 gpm) and FGD system metallurgy and operating practices that can accommodate an increase in chlorides. The flow minimization at these plants would be achieved by either reducing the FGD purge rate or recycling a portion of their FGD wastewater.

78 Fed. Reg. at 34,460 col. 1. Whether or not assuming flow minimization is technically acceptable, it causes problems in the calculation of TWPEs. EPA used different flow rates to calculate the TWPEs for the baseline case (that is, TWPE removal using only a settling pond) and the proposed post-compliance options. In Table 10-9 of the TDD, EPA provides the total industry discharge flow for the baseline case as 65.4 MGD, and the total industry discharge flow for the technology options (chemical precipitation, chemical precipitation plus biological treatment, and chemical precipitation with evaporation/crystallization) as 56.8 MGD.

Apparently, EPA reduces the flows because it intends that facilities with high FGD wastewater flows (greater than 1,000 gpm) will minimize those flows as part of the compliance process. Even though flow minimization may be a goal for plants with >1,000 gpm flow, applying flow minimization creates an error when estimating TWPEs for constituents that are not removed by the post-compliance options.

The use of different flow rates creates an artificial increase in TWPEs removed from the chemical precipitation system. For example, cyanide has the same concentration in the chemical precipitation effluent (*i.e.,* after treatment in the chemical precipitation system) as in the baseline (settling pond effluent). In other words, cyanide is not removed in the chemical precipitation system. EPA explains its process for estimating cyanide and nitrate/nitrite FGD wastewater effluent as follows:

[A]lthough EPA did not develop a methodology to estimate the effluent concentrations for … cyanide, nitrate/nitrite … from a surface impoundment based on the FGD wastewater concentrations, EPA believes that these analytes are present in the effluent from the surface impoundment. Therefore, to account for these pollutants in the loadings analysis, EPA assumed that the concentrations of these pollutants were equal [to] the concentrations calculated for the one-stage chemical precipitation system effluent.

IC&PR, p. 10-9. As a result, EPA calculated 31,065 TWPEs of cyanide removed by chemical precipitation *solely because of the reduced flow rate*. Therefore, EPA should use 56.8 MGD (flow after reductions) to calculate the baseline loadings because EPA's pollutant concentrations represent plants with flow minimization.

Other examples of artificial TWPE removals calculated by EPA are nitrate/nitrite, boron, tin, and cyanide. Even though tin was not quantified in the FGD influent or chemical precipitation effluent, EPA used one-half of reporting limit (100 ug/L) for both the average influent and effluent concentrations in the TWPE calculations. The difference in flow rates between the baseline and the chemical precipitation stage resulted in 2,650 pounds, or 797 TWPE of tin removed. Again, this is a false removal. The following table provides EPA's average concentrations for FGD influent (settling pond effluent) and chemical precipitation effluent and their corresponding pounds and TWPE removals.

Pollutant	Average Influent Concentration, µg/L	Average Chemical Precipitation Effluent, µg/L	Chemical Precipitation, Pounds Removed	Chemical Precipitation, TWPE Removed
Nitrate/Nitrite[(1)]	67.3	67.3	1,458,133	4,753
Boron	243,000	279,000	1,705,730	14,229
Tin[(2)]	100	100	2,650	797
Cyanide[(1)]	1.19	1.19	27,813	31,065

[(1)] EPA calculated nitrate/nitrite and cyanide TWPE removals for chemical precipitation even though average concentrations for influent and effluent are the same.

[(2)] EPA calculated TWPE removal for tin for chemical precipitation even though EPA's tin concentration for influent and effluent are not quantified. EPA used one-half the reporting limit (100 ug/L) for tin in both the average influent and effluent concentration.

The EPA methodology results in artificial pounds and TWPE removals due to the difference in flow rates. EPA should recognize that these pollutants are not removed in the chemical precipitation treatment process and make the corresponding TWPE adjustments.

Comment Response:

EPA disagrees with the commenter that the rule "requires flow minimization." Regarding the technical feasibility of flow minimization, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 102 (in comment code 8).

Regarding the pollutant loadings associated with the plants for which EPA accounted for flow minimization, EPA agrees with the commenter that the approach that EPA used at proposal may have resulted in "artificial pounds and TWPE removals due to the difference in flow rates." For the final rule, EPA revised its calculations such that for any pollutant where the expected post-compliance concentration does not decrease from the concentration used in the settling pond effluent loadings calculation, the mass loading for those plants for which EPA accounts for flow minimization is unchanged from the baseline mass loadings.

Commenter Name: Ron Shipman
Commenter Affiliation: Georgia Power Company
Document Control Number: EPA-HQ-OW-2009-0819-4447-A1
Comment Excerpt Number: 24
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

EPA counted TWPE removals for pollutants -such as boron, magnesium, manganese, and cyanide- that are not removed by biological treatment. This makes a significant difference in TWPEs removed for biological treatment. EPA also counted TWPEs removed for all pollutants in chemical precipitation systems; this is misleading but does not make a significant difference in total TWPEs removed by chemical precipitation. Using the EPA sampling data, the TWPE reductions for boron, magnesium, manganese, and cyanide account for 87% of the TWPEs removed by biological treatment. EPA's own data show very little removal, if any, of these constituents by the biological treatment system. Georgia Power supports UWAG's conclusion that no effective removal is demonstrated by this data for magnesium or boron, for either chemical precipitation or biological treatment, and EPA should not take removal credits for these parameters when evaluating the technologies.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 95 (in comment code 10.c).

Commenter Name: Lisa C. Messinger
Commenter Affiliation: Vectren Corporation
Document Control Number: EPA-HQ-OW-2009-0819-4317-A1
Comment Excerpt Number: 5
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

The questions in Section B of t he 2010 I C R did not allow for adequate description of these unique scrubbers and therefore the resulting FGD wastewater flows used by EPA are also not in proper representation of the scrubbing system . As stated above, there is not a true FGD wastewater purge system in these types of scrubbers and instead, the water is from the wash down of the belt filters and truck bays, and generally uses the ash pond water as the source water for these washes. Although we provided numerous detailed explanations in the comment section of the ICR, EPA still equated the belt filter wash down waters to a FGD wastewater flow. This resulted in an overstatement of t he pollutant loading and caused an underestimate of the cost per TWPE (Toxic Weighted Pound Equivalent) removed by the FGD system. Additionally since the source water is recycled ash pond water, the actual discharge from the plant is very small, yet in the EPA Incremental Costs document it is treated as a continuous new addition to the effluent.

Comment Response:

In response to this comment, EPA contacted the commenter to discuss the operations at the A.B. Brown Station in more detail. Based on the conversation, EPA revised the flow rate for FGD wastewater at the A.B. Brown Station to be zero (i.e., zero discharge of FGD wastewater). Therefore, this plant was removed from EPA's estimate of compliance costs and baseline loadings for FGD wastewater.

Commenter Name: Elizabeth E. Aldridge, Hunton & Williams
Commenter Affiliation: UWAG
Document Control Number: EPA-HQ-OW-2009-0819-4655-A2
Comment Excerpt Number: 22
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Surface Impoundment Selenium Removal Effectiveness

In several pages of the TDD (pg. 6-7, 7-4, 8-5, 10-7) and in the supporting document (US EPA, 2013g), US EPA states that surface impoundments are designed to remove particulates from wastewater using gravity sedimentation, but will not remove dissolved metals from the wastewater. Although it is correct that surface impoundments are designed as settling ponds, with the primary purpose of removing particulates from the wastewater, depending on the residence times, dissolved metal concentrations are also reduced in some facilities, as illustrated in an example below:

- US EPA (2009a, pg. 4-20, 58) reported that dissolved selenium decreased from 366 μg/L to 226 μg/L, a 38% removal, for FGD wastewater retained in a surface impoundment. Total selenium concentration decreased 63% (from 652 μg/L to 236 μg/L).

In their calculation of baseline and post-compliance pollutant loadings for FGD wastewater discharged to surface impoundment, US EPA collected and analyzed the untreated FGD wastewater of seven steam electric power plants operating wet FGD systems, and used these values to calculate effluent concentrations, by assuming that "a surface impoundment will remove most of the particulate phase metals, but will not remove dissolved metals from the wastewater." Since, as discussed above, moderate to significant total and dissolved metal removals are observed in surface impoundment, US EPA's assumption overestimates the pollutant loadings. US EPA should reevaluate pollutant loading reductions from surface impoundments.

Comment Response:

EPA agrees with the commenter that the data cited from Widow's Creek in the *Steam Electric Power Generating Point Source Category: Final Detailed Study Report* do show what would be calculated as a 38% removal of dissolved selenium. However, EPA disagrees with the commenter that this should be accounted for in EPA's analysis for the settling pond effluent concentrations. As the commenter points out in DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 87, there are certain difficulties in calculating a percent removal associated with a treatment system. But, for the detailed study data, it is even more difficult because EPA collected a one-time grab for the effluent sample and a four-hour composite for the influent sample. Additionally, the detailed study samples were not paired samples, there is only one value for the plant, and there were analytical issues associated with the methods used in the detailed study, as the commenter raised to EPA at the conclusion of the detailed study sampling program. As such, EPA determined that it would be inappropriate to account for removals of dissolved selenium based only on this one sample from Widow's Creek from the detailed study.

Commenter Name: Thomas Cmar
Commenter Affiliation: Earthjustice, et al.
Document Control Number: EPA-HQ-OW-2009-0819-4702-A7
Comment Excerpt Number: 7
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Total Mercury Removal

This section will present a discussion of the Hg removal in the anaerobic biological processes utilized for Se removal. In all of the treatment options proposed by EPA for WFGD treatment, the effluent limits for Hg are based on the levels achievable by hydroxide plus polysulfide chemical precipitation systems. For the technology alternative including biological treatment, EPA did not adjust these limits to account for the additional removal of Hg that may be achieved in the bioreactor.

Under the anoxic/anaerobic conditions in the biological treatment step it is likely that Hg will form sparingly soluble mercury sulfide and elemental mercury as well as being incorporated into the biomass. Because the organisms that produce sulfides from sulfate (the sulfate reducing bacteria, SRB) (Barkay and Wagner-Döbler, 2005) can also convert inorganic Hg to the environmentally-mobile methylmercury it is necessary to control the ORP so that a significant amount of sulfate reduction does not occur. Sulfate reduction occurs at lower (more negative) ORP values than does selenate/selenite reduction, so controlling the ORP in this way will not interfere with Se removal. Harwood (2013) indicated that satisfactory Se removal by the ABMet® process took place when the anaerobic system effluent contained ≤1mg sulfide/L. The first step of the EPA-proposed "Chemical Precipitation and Biological Treatment" for WFGD wastewater is chemical co-precipitation by hydroxide and polysulfide. The effluent concentration limitations for total Hg for this technology are respectively: daily limitation = 242 ppt and monthly limitation = 119 pp (78 Fed. Reg. at 34,490, Table X-1, 2013).

The two plants (Allen and Belews Creek) that EPA used to develop the effluent limitations for this technology had a chemical precipitation step that employed only hydroxide precipitation. Because of this, EPA proposed "to establish the effluent mercury and arsenic limitations for the biological treatment technology option (which includes one-stage chemical precipitation as an initial treatment stage) based on transferring the limitations that were calculated for the chemical precipitation treatment technology option." (78 Fed. Reg. at 34,488, 2013). EPA justified this approach as follows: "This is a reasonable approach for establishing mercury and arsenic limitations for the biological treatment technology because, in doing so EPA would be setting the limitations equal to the performance that reflects the level of treatment that would be achieved by the initial treatment stage of the wastewater treatment system." (78 Fed. Reg. at 34,488, 2013).

Mercury Removal from WFGD Wastewater

Figures 7-11 show the Hg removal performances of the Allen, Belews Creek and NE USA full-scale ABMet® biological treatment systems. The combined "Chemical Precipitation and Biological Treatment" processes at all three units were able to comply readily with the proposed EPA daily maximum and monthly average total Hg limitations.

Figure 7. Allen ABMet Plant Daily Influent and Effluent Total Mercury Concentrations for Paired Data Above the DL

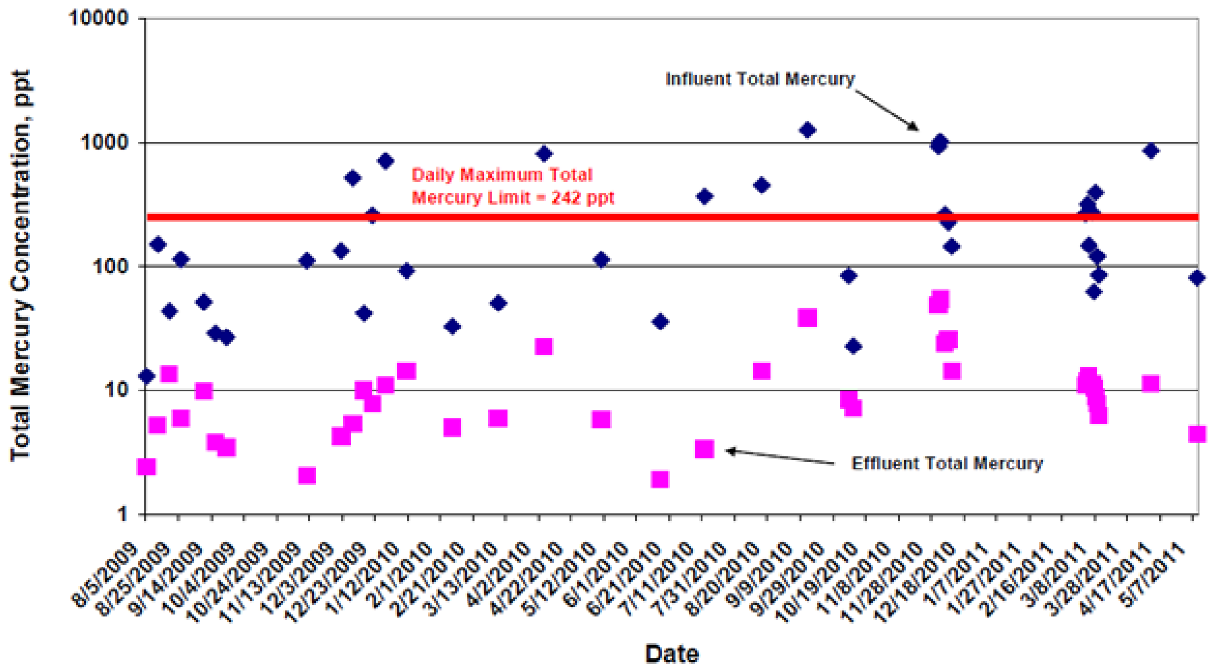


Figure 8. Allen ABMet Plant Monthly Average Influent and Effluent Total Mercury Concentrations for Paired Data Above the DL.

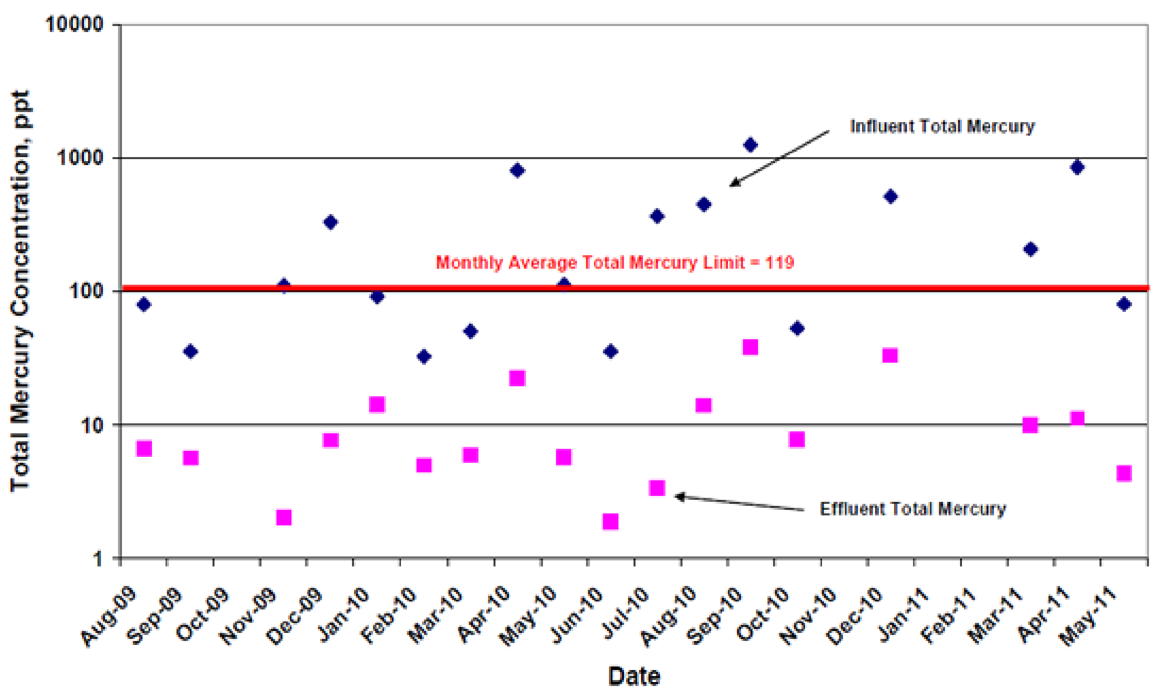


Figure 9. Belews Creek ABMet Plant Daily Influent and Effluent Total Mercury Concentrations for Paired Data Above the DL

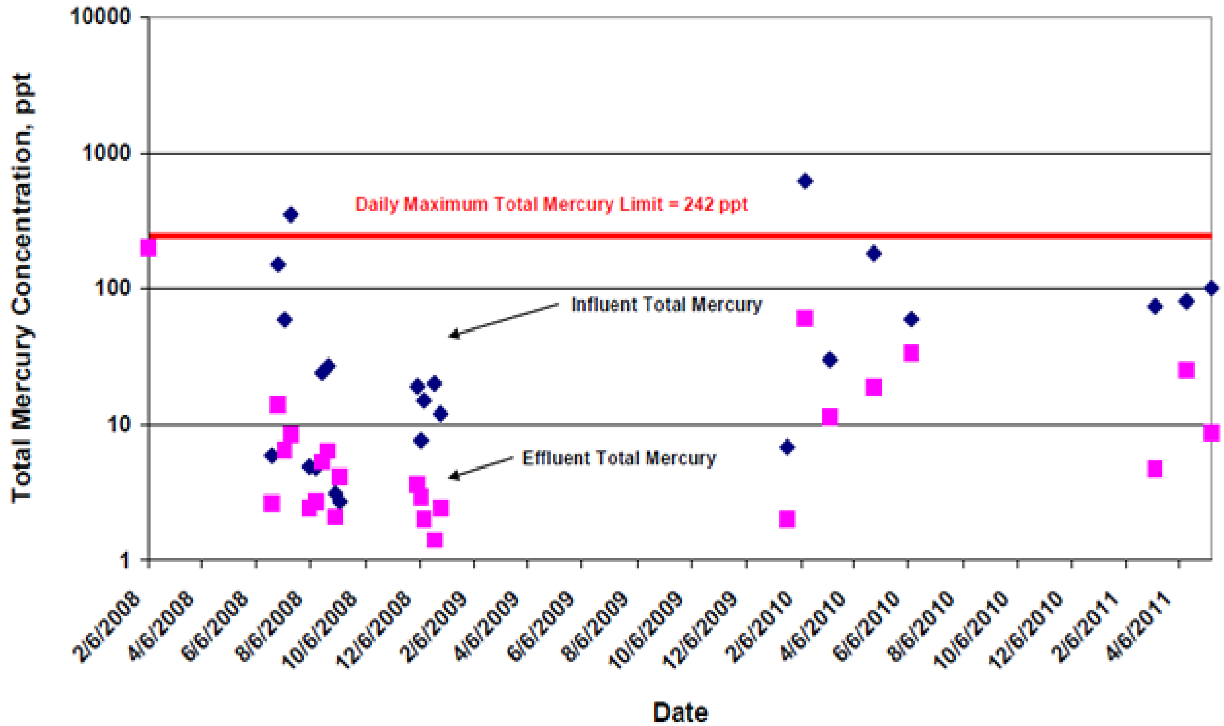


Figure 10. Belews Creek ABMet Plant Monthly Average Influent and Effluent Total Mercury Concentration for Paired Data Above the DL

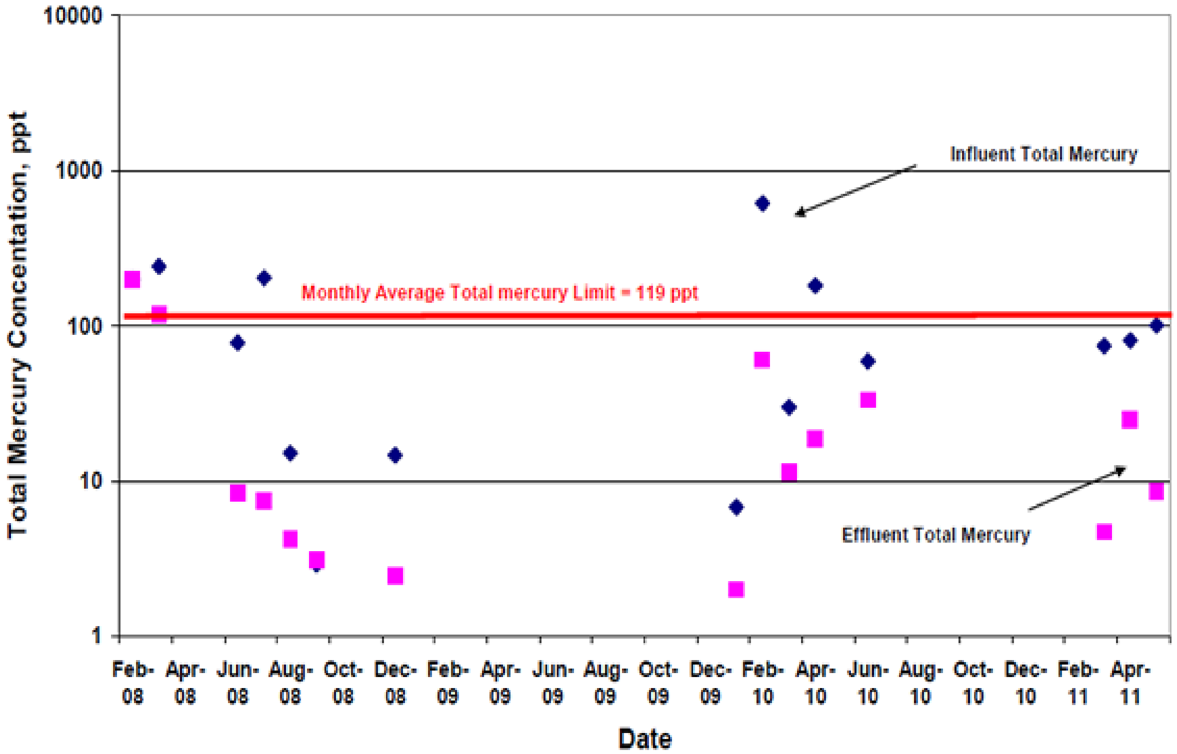
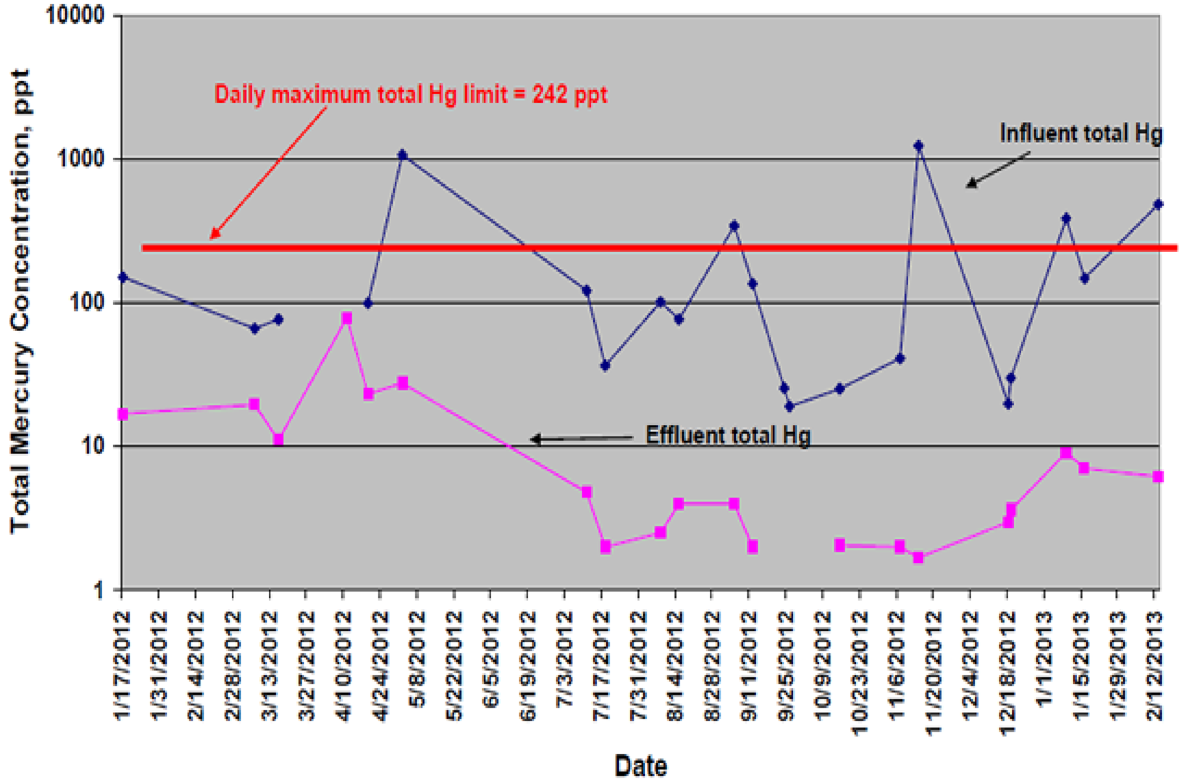


Figure 11. NE USA ABMet Plant Daily Influent and Effluent Total Mercury Concentrations (Harwood, 2012)



Furthermore, in all of the ABMet® plants evaluated the biological stage of the "Chemical Precipitation and Biological Treatment" provided additional Hg removal over that obtained by the chemical precipitation step (Figures 12-14) both when the precipitation step employed hydroxide only and when it employed hydroxide plus polysulfide. The magnitude of this additional Hg removal was investigated further by examining paired daily influent and effluent total Hg values that were above the detection limit. The additional Hg removal appeared to be a function of the biological system influent total Hg concentration (Figure 15). The anaerobic biological system effluent total Hg concentration seems to be proportional to the biological system influent total Hg over an influent total Hg range from approximately 1000 ppt to approximately 20 ppt. Below an influent total Hg concentration of approximately 20 ppt the effluent total Hg concentration does not decrease below the approximate range of 1-4 ppt.

Figure 12. Allen ABMet Plant: Relationship Between Influent and Effluent Total Mercury Concentrations for Paired Data

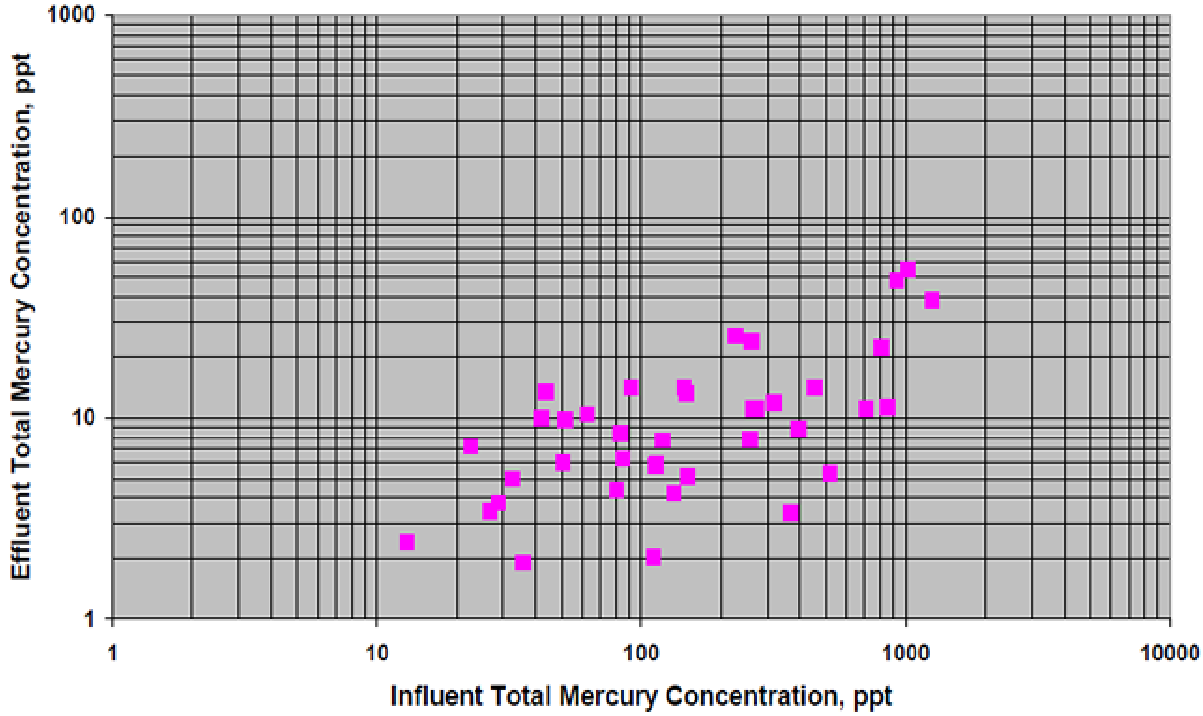
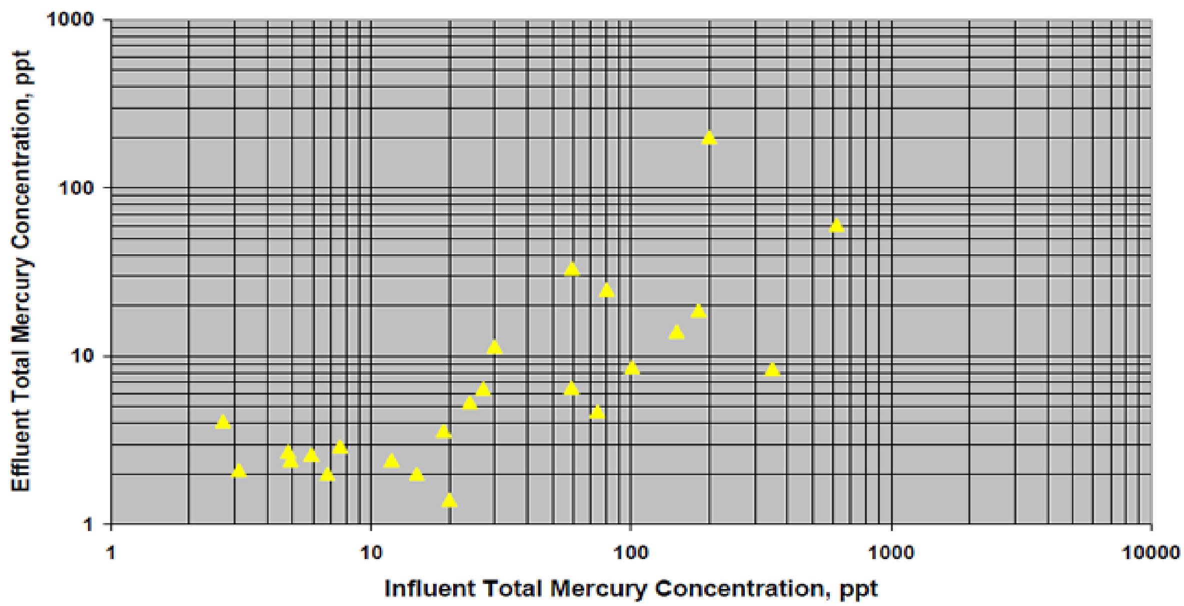


Figure 13. Belews Creek ABMet Plant: Relationship Between Influent and Effluent Total Mercury Concentrations for Paired Data



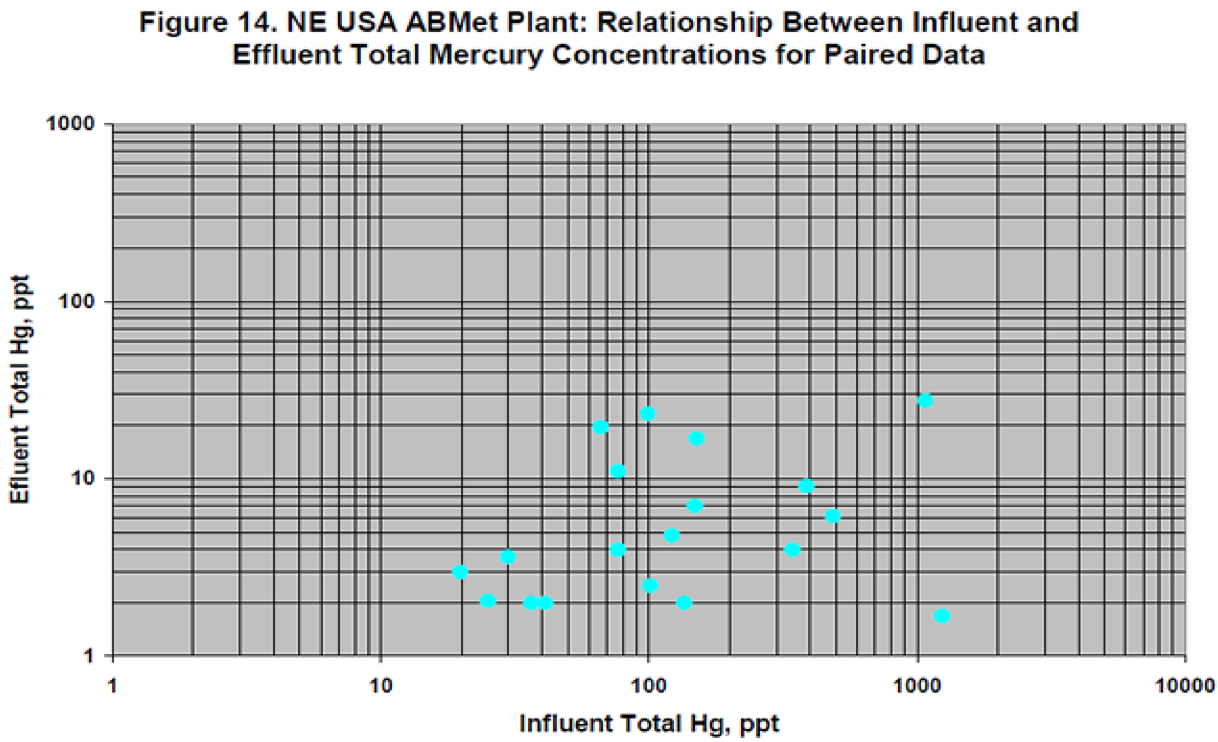


Figure 14. NE USA ABMet Plant: Relationship Between Influent and Effluent Total Mercury Concentrations for Paired Data
Effluent Total Hg, ppt
1000
100
10
1
1
10
100
1000
10000
Influent Total Hg, ppt

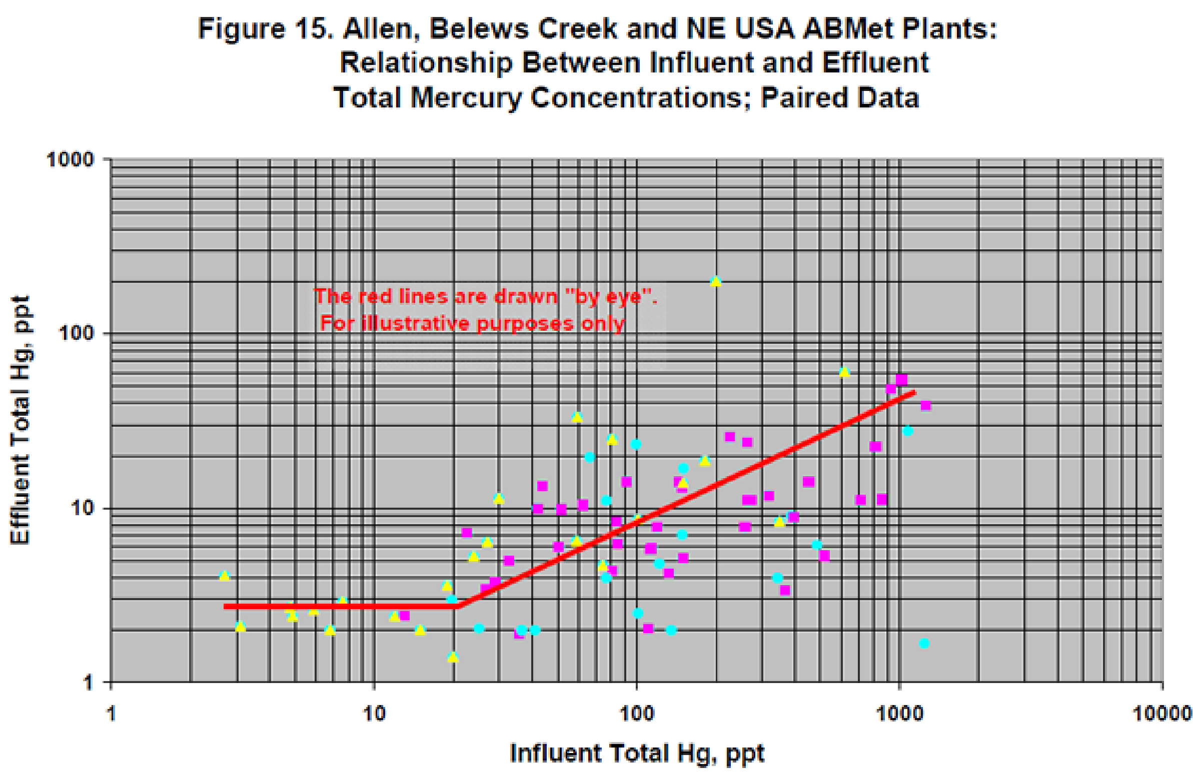


Figure 15. Allen, Belews Creek and NE USA ABMet Plants: Relationship Between Influent and Effluent Total Mercury Concentrations; Paired Data
The red lines are drawn "by eye".
For illustrative purposes only
Effluent Total Hg, ppt
1000
100
10
1
1
10
100
1000
10000
Influent Total Hg, ppt

These results demonstrate the advantage of producing as low as possible effluent total Hg levels from the chemical precipitation step (and therefore in the biological system influent). This effect is most clearly seen when the total Hg removal performances of the Belews Creek/Allen systems (with only hydroxide precipitation) and the NE USA system (with hydroxide and polysulfide precipitation) are compared. By attaining much lower biological system influent total Hg concentrations through hydroxide plus polysulfide precipitation the NE USA biological unit was able to produce much lower effluent total Hg levels than the Allen and Belews Creek systems with just hydroxide precipitation.

Comment Response:

EPA agrees with the commenter that the BAT basis of chemical precipitation plus biological treatment system does effectively treat mercury concentrations to lower levels than those observed in the effluent from the chemical precipitation technology basis alone. See Chapter 11 of the *Incremental Costs and Pollutant Removals for the Final Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category* (Cost & Loads Report) (DCN SE05831/SE05832) for more information on the effluent concentrations EPA used in estimating pollutant loadings from the chemical precipitation plus biological treatment technology basis. EPA also agrees with the commenter that use of a hydroxide plus polysulfide precipitation system can achieve greater mercury removals than use of hydroxide alone. For this reason, EPA's chemical precipitation and biological treatment technology bases include both of these steps.

Commenter Name: Paul Chu
Commenter Affiliation: Electric Power Research Institute (EPRI)
Document Control Number: EPA-HQ-OW-2009-0819-4499-A1
Comment Excerpt Number: 108
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

B.1.3.3 Summary of Data Used for the Benefits Evaluation

The benefits calculation uses data that EPA collected as part of its efforts to develop ELGs for the steam electric industry.

EPA sampled FGD wastewater at the following seven facilities with existing FGD wastewater treatment systems in 2010:

- Mirant Mid-Atlantic LLC's Dickerson Generating Station
- Allegheny Energy's Hatfield's Ferry Power Station
- RRI Energy's Keystone Generating Station
- We Energies' Pleasant Prairie Power Plant

- Duke Energy's Belews Creek Steam Station
- Duke Energy's Allen Steam Station
- Duke Energy's Miami Fort Station

Each facility uses chemical precipitation, as shown in Table B-2. Three facilities also have biological treatment plants that follow the chemical precipitation treatment. Of these three, only two (Allen and Belews Creek) have biological systems designed for selenium removal. The third biological treatment plant (Dickerson) is designed for removal of nitrogen.

Table B-2
Summary of Treatment Systems by Plant

	Chemical Precipitation					Biological Treatment	
	Equalization	Desaturation	Metals Removal (Organo-sulfide addition)	Clarification	Filtration	SBR	ABMet®
Dickerson	X	X		X		X	
Hatfield's Ferry Power Station	X	X	X	X	X		
Keystone Generating Station	X	X	X	X	X[a]		
Pleasant Prairie Power Plant	X	X	X	X			
Belews Creek Steam Station	X	X	X	X	X		X
Allen Steam Station	X	X	X	X	X		X
Miami Fort Station	Confidential						

[a] Filtration includes sand filtration followed by polishing filters containing Teflon® media
ABMet® = Advanced Biological Metals Removal Process (for selenium)
SBR = sequencing batch reactor (for nitrogen removal)

During 2010, EPA and their contractor Eastern Research Group, Inc. (ERG) collected samples over a four-day period at each of the seven facilities. The samples were analyzed for the following:

- Biochemical oxygen demand, 5-day (BOD5)
- Chemical oxygen demand (COD)
- Total suspended solids (TSS)
- Total dissolved solids (TDS)
- Sulfate
- Chloride
- Total Kjeldahl nitrogen (TKN)
- Ammonia as nitrogen
- Nitrate/nitrite as nitrogen
- Total phosphorus
- Total cyanide
- Total metals:

    - Aluminum, antimony, arsenic, barium, beryllium, boron, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, molybdenum, nickel, selenium, silver, sodium, thallium, tin, titanium, vanadium,
- Dissolved metals:
    - Same parameters as listed for total metals, plus hexavalent chromium

EPA also instructed each of the seven facilities to collect samples one day per month for four months for the same analytes except for the dissolved metals analyses. Untreated FGD wastewater and chemical precipitation effluent were collected at the seven plants. Biological system effluent (SP-3) was collected from the three plants with biological treatment systems.

The data from the four-day sampling conducted by EPA and ERG used in EPRI's evaluation can be found in the following reports by ERG:

- *Sampling Episode Report Mirant Mid-Atlantic, LLC's Dickerson Generating Station Sampling Episode 6562* (December 2011)
- *Sampling Episode Report Allegheny Energy's Hatfield's Ferry Power Station; Masontown, PA, Sampling Episode 6564* (December 2011)
- *Sampling Episode Report RRI Energy's Keystone Generating Station; Shelocta, PA, Sampling Episode 6563* (December 2011)
- *Sampling Episode Report We Energies' Pleasant Prairie Power Plant; Pleasant Prairie, WI, Sampling Episode 6569* (December 2011)
- *Sampling Episode Report Duke Energy Carolinas' Belews Creek Steam Station; Belews Creek, NC, Sampling Episode 6558* (December 2011)
- *Sampling Episode Report Duke Energy Carolinas' Allen Steam Station; Belmont, NC, Sampling Episode 6561* (December 2011)
- *Sampling Episode Report Duke Energy Miami Fort Station; North Bend, OH, Sampling Episode 6560* (December 2011)

Data for the monthly sample results were obtained from the following report by ERG:

- *Power Plant Monitoring Data Collected under Clean Water Act Section 308 Authority ("CWA 308 Monitoring Data") Sampling Episodes 6565 – 6575* (March 2012)

Belews Creek Steam Station and Allen Steam Station long-term data were obtained from ELG Docket under the following titles:

- *Industry Provided Sampling Data from Duke Energy's Belews Creek Steam Station*, EPA-HQ-OW-2009-0819-1226, DCN SE1808
- *Industry Provided Sampling Data from Duke Energy's Allen Steam Station*, EPA-HQ-OW- 2009-0819-1227, DCN SE1809

EPA also obtained long-term data from a settling pond at Roxboro. These data were obtained from ELG Docket under the following title:

- *State Provided Sampling Data from Progress Energy's Roxboro Plant,* EPA-HQ-OW-2009- 0819-1236, DCN SE1812,

When data were reported with a qualifier flag of J, meaning the result was above the method detection limit (MDL) but less than the quantitation limit, the data were used in EPRI's calculations. For the analytes that were not detected EPRI used half the method detection limit to calculate benefit.

In some cases, concentration increased through treatment. For example, the magnesium concentration in the averaged influent of chemical precipitation (effluent of the settling ponds) is greater than the magnesium concentration in the averaged CP effluent (from 2,950,000 ug/L in the chemical precipitation influent to 3,450,000 ug/L in the chemical precipitation effluent. For the purposes of this estimate, EPRI substituted "0" for all negative removals.

Each of the four monthly samples was used in EPRI's calculations. The four-day event sampling results were averaged to represent a fifth month. EPRI incorporated the long-term self-monitoring data for Allen and Belews Creek according to EPA's methodology. Per page 10-12 of the *Technical Development Document for the Proposed Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category* [EPA, 2013b]:

"In cases where an analyte was represented in the long-term self-monitoring data provided by the plant, the EPA sampling, and the CWA 308 monitoring data, EPA averaged all sample results to calculate a plant-level average concentration for each analyte. When combining the industry self-monitoring data with EPA's sampling results (both four-day EPA sampling and CWA 308 monitoring), there were some instances of overlap with two sample results occurring on the same day. In these cases, the two results were averaged together to calculate one average concentration for each day of sampling before calculating an average concentration for each analyte."

In 2007, EPA sampled FGD wastewater at the following four facilities with existing FGD wastewater treatment systems:

- Tampa Electric Company's Big Bend Station
- Homer City Generation L.P.'s Homer City Power Plant
- Ohio Power Company's Mitchell Plant
- Tennessee Valley Authority's Widow's Creek Fossil Plant

Three of these facilities use chemical precipitation and one facility uses settling ponds as shown in Table B-3. One facility also has aerobic biological treatment that follows the chemical precipitation treatment. None of these treatment technologies were considered optimized; therefore, only the untreated and settled data were used in EPRI's evaluation. The same parameters were analyzed in the 2007 sampling episode as in the 2010 sampling episodes. Different sampling methods, however, were occasionally used during the 2007 and 2010 sampling episodes. Whenever available, EPRI used 2007 sample concentrations data with the same method as in the 2010 sampling episode.

Table B-3
Summary of Treatment Systems by Plant

	Settling Pond	Chemical Precipitation					Biological Treatment		
		Equalization	Desaturation	Metals Removal (Organo-sulfide addition)	Clarification	Filtration	SBR	ABMet®	Aerobic
Big Bend		X	X		X	X			
Homer City		X	X		X	X			X
Mitchell		X	X		X				
Widow's Creek	X								

ABMet® = Advanced Biological Metals Removal Process (for selenium)
SBR = sequencing batch reactor (for nitrogen removal)

Data from these site visits were obtained from the ELG Docket under the following titles:

- *Sampling Episode Report Tampa Electric Company's Big Bend Station Apollo Beach, FL, Episode 6547*, EPA-HQ-OW-2009-0819-0820, DCN SE02103
- *Sampling Episode Report EME Homer City Generation L.P.'s Homer City Power Plant, Homer City, PA Episode 6548*, EPA-HQ-OW-2009-0819-0821, DCN SE02104
- *Sampling Episode Report Ohio Power Company's Mitchell Plant Moundsville, WV, Sampling Episode 6550*, EPA-HQ-OW-2009-0819-0823, DCN02106
- *Sampling Episode Report Tennessee Valley Authority's Widows Creek Fossil Plant Stevenson, AL, Sampling Episode 6549*, EPA-HQ-OW-2009-0819-0822, DCN SE02105

B.1.3.4 Settled FGD Wastewater

EPA only has one data point from its 2010 sampling of an actual settling pond, Roxboro, and one data point from its 2007 sampling, Widows Creek, because the remaining facilities EPA sampled didn't use a settling pond in their FGD wastewater treatment. Therefore, following EPA's methodology, EPRI estimated the characterization (mass and TWPE) of "settled FGD wastewater" to compare the incremental benefit of the three treatment alternatives with removal from settling ponds.

For metals, EPRI used the same methodology to calculate settling pond effluent as ERG did for EPA which ERG describes in its memo titled, "Technology Option Loads Calculation Analysis for Steam Electric Detailed Study" [ERG, 2009]. It was assumed that a settling pond would only remove metals present in the particulate phase of the sample, not in the dissolved phase. ERG also assumed that the settling pond would achieve an effluent TSS concentration of 30 milligrams per liter (mg/L), which is the current 30 day average effluent limit set in 40 Code of Federal Regulations (CFR) Part 423 for the best practicable control technology currently available (BPT).

The total settling pond effluent concentration for each pollutant is equal to the sum of the contribution of that pollutant from the solids present in the wastewater and the concentration of that pollutant dissolved in the wastewater. Only the four-day data were used in this calculation because this method requires both the total and the dissolved concentrations in the wastewater, and dissolved data were not collected as part of monthly sampling. The following equation was used to perform this calculation:

$C_{Settling}$ (μg/L) = C_{Dry} (mg/kg) x 30 mg/L x 0.000001 kg/mg x 1,000 μg/mg + $C_{Dissolved}$ (μg/L)

Where (when C_{Dry} data was not included in the data set):

C_{Dry} (mg/kg) = {[C_{Total} (μg/L) – $C_{Dissolved}$ (μg/L)] x 1,000,000 mg/kg} / [C_{TSS} (mg/L) x 1,000 μg/mg]

C = concentration

mg/L = milligrams per liter

μg/L = micrograms per liter

μg/mg = micrograms per milligram

Settling pond effluent classical concentrations were handled following EPA's methodology as described on page 10-9 in the *Incremental Costs and Pollutant Removals for the Proposed Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category* [EPA, 2013a]. Namely, chloride did not establish removal through the settling process and was equal to the settling pond influent. Ammonia, cyanide, nitrate/nitrite, and sulfate were not calculated. However, following EPA's assumption, cyanide and nitrate/nitrite were set to equal to the calculated chemical precipitation effluent.

Comment Response:

EPA disagrees with commenter's approach, in calculating baseline pollutant loadings or pollutant removals, of the handling of the nondetect and J-values, as well as the commenter's inclusion of the detailed study sampling data, see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 48.

Commenter Name: Cari Boyce
Commenter Affiliation: Duke Energy
Document Control Number: EPA-HQ-OW-2009-0819-4305-A3
Comment Excerpt Number: 48
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

EPA did not use the complete data set available to evaluate the treatment technologies. Even though data were collected from the FGD purge during the CWA 308 Sampling event, only data collected during the EPA 4-day sampling event and data from Roxboro were used to estimate the effluent from a surface impoundment.

Comment Response:

EPA agrees with the commenter that it did not use the CWA 308 sampling data of the FGD purge in the settling pond effluent concentration estimations. EPA was not able to use that data because the methodology used to calculate the concentrations requires both the total and the dissolved concentrations in the wastewater. Dissolved concentration data were not collected as part of 308 CWA monthly sampling.

Commenter Name: Paul Chu
Commenter Affiliation: Electric Power Research Institute (EPRI)
Document Control Number: EPA-HQ-OW-2009-0819-4499-A1
Comment Excerpt Number: 107
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

B.1Flue Gas Desulfurization Wastewater Treatment Benefits

In this Appendix, pollutant removals are referred to as benefits, expressed in toxic-weighted pounds-equivalent (TWPE). The overall cost-effectiveness of pollutant removal reflects the cost per TWPE removed.

B.1.1*Summary*

The Electric Power Research Institute (EPRI) estimated the benefits (i.e., removal of pollutants) of flue gas desulfurization (FGD) wastewater treatment to the steam electric industry. This appendix includes the methodology and calculation of the estimated benefits for the treatment technologies evaluated by EPA: chemical precipitation, biological treatment, and chemical precipitation plus vapor compression evaporation. Table B-1 outlines the benefit of FGD wastewater treatment to the industry.

Table B-1
FGD Wastewater Treatment Benefits to the Industry

Treatment Type	TWPE per Year Removed
Chemical Precipitation	851,000
Incremental Biological	136,000
Chemical Precipitation + Biological	987,000
Incremental Vapor Compression Evaporation	752,000
Chemical Precipitation + Vapor Compression Evaporation	1,603,000

TWPE = toxic-weighted pounds-equivalent

B.1.2 *Introduction*

The U.S. Environmental Protection Agency (EPA) is updating the Steam Electric Power Generating ELG. As part of setting the effluent limitations guidelines (ELG), EPA conducted a comprehensive information collection request (ICR) and wastewater sampling at power plants. EPA is proposing to revise or establish Best Available Technology Economically Achievable (BAT), New Source Performance Standards (NSPS), Pretreatment Standards for Existing Sources (PSES) and Pretreatment Standards for New Sources (PSNS) that apply to discharges of pollutants found in FGD wastewater.

Under an alternative for Option 1 in the draft ELG, the rule would establish Chemical Precipitation (CP) as BAT for treatment of FGD wastewater. Under Option 3b, the rule would establish CP + Biological as BAT for treatment of FGD wastewater for plants with greater than 2,000 MW wet scrubbed capacity. Under Options 2, 3, 4a, and 4, the rule would establish CP + Biological as BAT for treatment of FGD wastewater for plants greater than 50 MW wet scrubbed capacity. Under Option 5, which is not presented as a preferred option by EPA, the rule would establish CP + Vapor Compression Evaporation (VCE) as BAT for treatment of FGD wastewater. (Page 34460, Federal Register of ELG Rule).

EPRI estimated the benefits (i.e., removal of pollutants) of three FGD wastewater treatment technologies. The treatment technologies evaluated were (1) CP, (2) biological, and (3) CP + VCE.

B.1.3 *Calculation Methodology*

A.1.3.1 Benefit Calculation Overview

For this analysis, the benefits of treatment were defined as the amount of pollutants removed from wastewater. The benefits were calculated as toxic-weighted pound equivalents (TWPE). Toxic weighting factors (TWF) are used by the EPA to express the relative toxicity of parameters. Use of TWPE provides a relative measure comparing the potential toxicity of different pollutants. EPRI used the concentration of pollutants in the water, wastewater flow, and the TWFs published by EPA to calculate TWPE. The TWFs used in this evaluation were published in *Technical Support Document for the Annual Review of Existing Effluent Guidelines and Identification of Potential New Point Source Categories* [EPA, 2009].

B.1.3.2 Defined Terms

Terms used in this evaluation are defined below:

- Untreated FGD wastewater – The FGD purge stream after primary solids separation (e.g., hydrocyclone overflow) that is transferred to the FGD chemical precipitation wastewater treatment system, prior to any commingling with other wastewaters or treatment system recycle streams. This data is used to calculate the settled FGD wastewater as described below.
- Settled FGD wastewater – To estimate the pollutant concentrations from a typical settling pond effluent, EPRI used the EPA assumption that the concentration would be equal to the sum of a portion of the concentration of the solids and the dissolved pollutants present in the untreated FGD wastewater. These calculations are described in the Summary of Available Data section below.
- Chemical precipitation removal –The amount removed (TWPE) through treatment by chemical precipitation.
- Incremental biological removal – The incremental amount removed (TWPE) across the biological treatment system only. The biological treatment influent is assumed to be the chemical precipitation effluent.
- Chemical precipitation + biological removal – The total amount removed (TWPE) across the CP and biological treatment system. This is calculated as the addition of CP removal and incremental biological removal.
- CP + VCE removal – The amount removed (TWPE) across CP + the vapor compression evaporation system.
- Incremental VCE removal – The incremental amount removed (TWPE) across the vapor compression evaporation system. This is calculated as the benefits of CP + VCE minus the benefits of CP.
- Coal Type. In EPRI's evaluation of coal type, plants were categorized as Bituminous Coal if only bituminous coal was burned. Plants considered sub-bituminous if only sub-bituminous coal was burned. All other plants were considered to be "Blend/Other," this included coals firing lignite or petroleum coke, blends of coal, or plants that redacted their coal type in the ICR.

Comment Response:

EPA disagrees with the commenter's approach of evaluating the "incremental" removals for the biological and VCE treatment technology systems, above the removals calculated for the chemical precipitation treatment technology. EPA's BAT basis for the discharge of FGD wastewater from existing steam electric power generating units (except for those units that are oil-fired or whose nameplate capacity is 50 MW or less) is chemical precipitation followed by anoxic/anaerobic biological treatment (see preamble Section VIII). Therefore, EPA evaluated the two systems as a single technology.

EPA also disagrees with the commenter's approach for evaluating the loadings based on the coal type. See response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 48.

Commenter Name: John McManus
Commenter Affiliation: American Electric Power System (AEP)
Document Control Number: EPA-HQ-OW-2009-0819-4448-A1
Comment Excerpt Number: 11
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

2. EPA needs to acknowledge agency precedent in ELG revisions and account for minimal pollutant removal rates when assessing cost effectiveness.

As noted in the comments filed by UWAG,[3] EPA has, in the past, adopted a minimum acceptable average removal rate across a technology option when determining which parameters might be assigned a regulatory limit. For the Centralized Waste Treatment (CWT) ELG finalized in 2000, 65 FR 81241)[4] EPA adopted a minimum removal of 50% for inorganic parameters such as metals (removed by chemical precipitation) and a 30% removal rate for trace organic parameters. The more recent Metal Products and Machinery rule also set a limit for effective removal of 20%. If the removal across a technology option was less than these values, EPA considered the treatment technology ineffective for that parameter.

EPA has developed guidance to use as the basis for eliminating pollutants from treatment consideration. Among these guidelines, EPA did not consider pollutants for TWPE calculations if they were, "not effectively treated by the option technology."[5] Based on this guidance, boron, cyanide, magnesium and manganese may need to be eliminated from consideration during TWPE calculations for chemical precipitation.

In following UWAG's recommendation, any pollutant with a removal rate of less than 25% should not be considered during TWPE calculations. There are several reasons why a minimum level of removal must be demonstrated before a treatment system can be credited with successful treatment. For example, analytical variability can complicate the comparison of duplicate samples. Typical quality control standards for reproducibility require that the relative percent difference between sample results be less than 20%. Therefore, it is possible that if the percent removal value calculated from a single pair of influent and effluent samples from the same treatment system is 20% or less, it could be due to simple analytical variability and not due to treatment system removal.

It is also unlikely that any two "paired" influent/effluent samples will actually represent the wastewater that was treated. The retention time and mixing pathways within a treatment system vary, making it almost impossible to collect effluent samples that perfectly match previously collected influent samples. As a result, small percentage differences between "paired" samples may be an artifact of the sampling.

Based on general wastewater engineering practice, percent removals of less than 30% are considered poor and 50% removal is often considered marginal.[6] The inclusion of pollutants whose removal has not been sufficiently verified can lower the dollars per toxic weighted pollutant equivalent ($/TWPE) removed estimates, giving the appearance of more favorable cost effectiveness than actually exists for the proposed treatment technology.

---

[3] Comments of the Utility Water Act Group (UWAG) on EPA's Proposed Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category (40 CFR Part 423) [hereinafter UWAG ELG Comments], September 20, 2013.

[4] Cost-Effectiveness Analysis of Effluent Limitation Guidelines and Standards for the Centralized Waste Treatment Industry, at 2-2, cited by UWAG http://water.epa.gov/scitech/wastetech/guide/treatment/upload/2006_12_28_guide_cwt_final_effective.pdf

[5] Id.

[6] UWAG ELG Comments, September 20, 2013, at 101.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 87.

Commenter Name: Paul Chu
Commenter Affiliation: Electric Power Research Institute (EPRI)
Document Control Number: EPA-HQ-OW-2009-0819-4499-A1
Comment Excerpt Number: 112
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

B.1.5*Calculated Benefit Estimates for Industry*

Benefits of treating FGD wastewater were estimated for the current industry. Based on information from the Questionnaire for the Steam Electric Power Generating Effluent

Guidelines, EPA identified 116 plants discharging FGD wastewater but redacted the actual list (after excluding oil-fired units and units with a capacity of 50 MW or less).

The following assumptions were used to attempt to recreate EPA's list of 116 plants since plant IDs were redacted:

- Included plants responding Yes or No Answer to Wet FGD systems in D5-2
- Excluded plants with a capacity of 50 MW or less
- Excluded plants reporting in ICR as retiring all FGD units prior to December 31, 2014
- Excluded plants reporting zero FGD wastewater discharge in current or planned industry profile
- Excluded plants that did not report a NPDES permit
- Excluded plants that reported an evaporation pond

Table B-7 lists the number of plants and the type of treatment in place.

Table B-7
Description of Treatment in Place for 116 Plants Included in Industry Extrapolation

Treatment in Place	Number of Plants
Plants with Settling Pond	71
Plants with CP (Including plants with Partial and Optimized CP)	39
Plants with Biological Treatment	5
Plant with CP + VCE	1
Total	116

Coal type data were also evaluated from the the Questionnaire for the Steam Electric Power Generating Effluent Guidelines for each of the plants included in the industry extrapolation. Any plants using more than one coal type were grouped as "blend/other" coal. Redacted coal type information, lignite, or petroleum coke, were also grouped in as blend/other coal. The breakdown of each coal type is summarized in Table B-8.

Table B-8
Industry Extrapolation by Coal Type

	Flow (GPY)	Percent of Industry
Industry	14,100,000,000	
Bituminous	7,670,000,000	54%
Blend/Other	4,940,000,000	35%
Subbituminous	1,490,000,000	11%

GPY = gallons per year

Consideration was given to which plants to include in these benefit (removal) calculations. For example, plants with optimized CP treatment already installed were not used in the calculation of the benefit of CP. The benefit for each treatment type is summarized in Table B-9.

Table B-9
Benefit for Each Treatment Type Applied in the Industry Extrapolation

Treatment in Place	CP	Incremental Biological	CP + VCE
Plants with Settling Pond	Full CP benefit	Full Biological benefit	Settling pond effluent to zero
Plants with CP (Including plants with Partial and Optimized CP)	No benefit	Full Biological benefit	CP effluent to zero
Plants with Biological Treatment	No benefit	No benefit	Biological effluent to zero
Plant with CP + VCE	No benefit	No benefit	No benefit

The total benefits from CP + Biological were then calculated by adding the CP + Incremental biological benefits. The total benefits from incremental VCE were then calculated by subtracting the CP benefits from the CP + VCE benefits.

B.1.5.1 Flow Basis

The benefit of treatment at each plant by coal type was multiplied by the flow at each plant to calculate mass removed. EPRI used the ICR responses in question B5-2 of the ICR (typical amount of FGD scrubber purge [or slurry discharge] sent to wastewater treatment or discharge [gallons per day]) for the average flow estimate, multiplied by the days per year provided in the same question. This calculation results in a unit of flow in gallons per year for each plant.

For those plants for which average flow was not provided in ICR question B5-2, flow was estimated using equation 4-1 from EPA's *Incremental Costs and Pollutant Removals for the Proposed Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category* [EPA, 2013a] relating FGD wastewater flow to the amount of coal burned.

B.1.6 ***Conclusion***

A summary of the annualized industry benefits for each FGD wastewater treatment technology is shown in Table B-10.

Table B-10
Detailed Annualized Industry Benefit (Removal of Pollutants) for FGD Wastewater Treatment

Treatment Type		Number of Plants	Total Flow Rate (BGY)	TWug/L Removed	TWPE per Year Removed (Millions)
Chemical Precipitation		73*	10.0		0.85
Bituminous Plants		40	5.65	7,279	0.34
Blend/Other Plants		21	3.24	15,730	0.43
PRB/Sub-bituminous		12	1.14	8,539	0.08
Incremental Biological		110	13.7		0.14
Bituminous Plants		64	7.32	663	0.04
Blend/Other Plants		30	4.94	1,237	0.05
PRB/Sub-bituminous		16	1.48	3,558	0.04
Chemical Precipitation + Vapor Compression Evaporation	TIP = Ponds	71	9.75		1.32
	Bituminous Plants	38	5.36	13,360	0.60
	Blend/Other Plants	21	3.24	21,216	0.57
	PRB/Sub-bituminous	12	1.14	15,560	0.15
	TIP = CP	39	4.00		0.27
	Bituminous Plants	26	1.96	10,157	0.17
	Blend/Other Plants	9	1.70	6,012	0.09

Treatment Type		Number of Plants	Total Flow Rate (BGY)	TWug/L Removed	TWPE per Year Removed (Millions)
	PRB/Subbituminous	4	0.34	7,967	0.02
	TIP = Bio	5	0.35		0.01
	Bituminous Plants	5	0.35	2,449	0.01
	Blend/Other Plants	0	0	2,449	0.00
	PRB/Sub-bituminous	0	0	2,449	0.00
	Total	115			1.6

*Includes plants which only have a settling pond treatment in place and two plants that have settling ponds followed by biological treatment.

BGY = billion gallons per year

Table B-11, presented at the beginning of this appendix as Table B-1, shows a summary of the TWPE removal to the industry for each treatment and coal type. Chemical precipitation with biological treatment is the sum of the chemical precipitation and incremental biological benefit. Incremental vapor compression evaporation is the benefit of chemical precipitation and vapor compression evaporation benefit minus the benefit of chemical precipitation.

Table B-11
Annualized Industry Benefit (Removal of Pollutants) for FGD Wastewater Treatment

Treatment Type		TWPE per Year Removed (Millions)
Chemical Precipitation	Total	851,000
Biological	Incremental	136,000
Chemical Precipitation + Biological	Total	987,000
Vapor Compression Evaporation	Incremental	752,000
Chemical Precipitation + Vapor Compression Evaporation	Total	1,603,000

Comment Response:

EPA disagrees with the commenter's approach of evaluating the "incremental" removals for the biological and VCE treatment technology systems, above the removals calculated for the chemical precipitation treatment technology. EPA's BAT basis for the discharge of FGD wastewater from existing steam electric power generating units (except for those units that are oil-fired or whose nameplate capacity is 50 MW or less) is chemical precipitation followed by anoxic/anaerobic biological treatment (see preamble Section VIII). Therefore, EPA evaluated the two systems as a single technology.

EPA also disagrees with the commenter's approach for evaluating the loadings based on the coal type. See response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 48.

Commenter Name: Raven Power Holdings, LLC
Commenter Affiliation: Raven Power Holdings, LLC
Document Control Number: EPA-HQ-OW-2009-0819-4467-A1
Comment Excerpt Number: 26
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

EPA did not consider the source water to the absorbers as a variable. Specifically, EPA did not account for facilities that utilize domestic grey water as an absorber makeup source, as is the case at Brandon Shores. This water, which would otherwise be directly discharged by the municipality, contains elevated levels of nutrients not typically found in FGD service. By recycling this water in the absorber and using it to reduce chlorides and TDS prior to biological treatment, there is a net reduction of the overall nitrogen discharge into the receiving body of water common to both the municipal sanitary treatment system and the electric power generating facility, as shown in Table 1 in the Appendix.

Table 1

2012 Reduction in Nitrogen Discharged					
	Cox Creek WRF		**MP801 (FGD wastewater)**		
	Effluent Received		**Effluent Discharged**		**Reduction in lbs**
Month	**gals**	**lbs Nitrogen**	**gals**	**lbs Nitrogen**	**Nitrogen Discharged**
Jan-12	40,894,366	3,037	9,146,951	551	2,486
Feb-12	31,529,028	2,231	7,620,522	569	1,662
Mar-12	33,157,216	2,191	8,456,078	1015	1,176
Apr-12	42,229,843	2,760	8,382,033	1144	1,616
May-12	70,096,860	5,815	13,904,538	3518	2,297
Jun-12	60,814,905	4,608	13,625,047	1360	3,248
Jul-12	78,154,168	4,838	15,982,060	1027	3,811
Aug-12	73,684,620	6,129	15,727,823	1068	5,061
Sep-12	49,796,209	3,173	11,608,408	467	2,706
Oct-12	38,674,564	3,923	8,185,546	363	3,560
Nov-12	41,876,856	2,666	7,612,420	321	2,345
Dec-12	36,230,400	2,433	6,483,496	276	2,157
Total	**597,139,035**	**43,804**	**126,734,923**	**11,679**	**32,125**
2013 Reduction in Nitrogen Discharged					
	Cox Creek WRF		**MP801 (FGD wastewater)**		
	Effluent Received		**Effluent Discharged**		**Reduction in lbs**
Month	**gals**	**lbs Nitrogen**	**gals**	**lbs Nitrogen**	**Nitrogen Discharged**
Jan-13	52,482,327	4,021	8,203,134	465	3,556
Feb-13	49,002,757	3,166	9,523,607	507	2,659
Mar-13	59,031,456	3,451	8,031,803	331	3,120
Apr-13	23,784,179	1,429	3,291,395	120	1,309
May-13	50,248,076	3,887	8,626,681	467	3,420
Jun-13	64,737,612	4,609	13,835,094	664	3,945
Jul-13	75,576,073	5,516	14,924,290	725	4,791

Aug-13	69,278,958	5,647	11,563,410	758	4,889
Sep-13					
Oct-13					
Nov-13					

Comment Response:

The commenter states that EPA failed to consider "source water to the absorbers as a variable" and "EPA did not account for facilities that utilize domestic grey water as an absorber makeup source." EPA did consider how source water might impact its analyses of pollutant loadings for FGD wastewater, but was not able to evaluate what that impact might be due to a lack of data, despite the opportunity for people like the commenter to submit such data to EPA. EPA notes that in response to the proposed rule, EPA received source water data specifically related to fly ash and bottom ash transport water samples; however, EPA did not receive source water samples. Additionally, during EPA's detailed study, UWAG collected split samples with EPA and also collected source water data from at least one of the plants, but the source water data were never provided to EPA. Therefore, EPA concluded that the source water was not a significant contributor to the FGD pollutant loadings.

While the commenter did provide certain data regarding mass loadings for total nitrogen from its Brandon Shores plant, it did not provide EPA with nitrate/nitrate as N, which is the pollutant specifically limited by the final rule. Without knowing the source water contribution of nitrate/nitrite as N, EPA cannot account for the source water in its analysis. Additionally, as demonstrated by the commenter's data, the Brandon Shores plant is already achieving significant removals of nitrogen; therefore, the plant may not need to install the biological treatment system included as part of the basis for the BAT, but rather, the plant could install a different technology that only focuses on selenium removal (e.g., zero-valent iron) as a polishing step to meet the ELGs. EPA notes that in its compliance cost analysis, EPA included costs for the plant to install a new biological treatment system, even though the plant is free to choose any means it desires to achieve the final limitations and standards.

Commenter Name: Elizabeth E. Aldridge, Hunton & Williams
Commenter Affiliation: UWAG
Document Control Number: EPA-HQ-OW-2009-0819-4655
Comment Excerpt Number: 97
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

b. EPA's Reasons for Selection of Cyanide Data Are Unclear

For some unknown reason, EPA did not use any of the SP-1 (influent) monthly data (*i.e.*, CWA 308 sampling) collected from each of the seven plants. It appears EPA selected the higher concentration values from the four-consecutive-day sampling events to generate the average influent concentrations used to calculate TWPEs. While EPA did not use the influent data from the monthly events to calculate the influent average concentrations, it did use the effluent data from the monthly events to calculate average concentrations for chemical precipitation effluent (SP-2) and bioreactor effluent (SP-3). This selection of data results in artificial removals of cyanide.

The table below provides the influent cyanide data EPA did not include in its TWPE calculations. The results were not flagged with any qualifiers except for one nondetect. The data for Hatfield's Ferry and Keystone are several orders of magnitude lower than their four-consecutive-day event data that EPA used to calculate TWPEs. The higher concentrations reported for EPA's four-consecutive-day sampling event could be a result of exceeding the holding time required by the method resulting in cyanide formation over time due to the preservative. The higher concentrations could be a result of interferences. The analysis of the solid phase of these influent samples with a method developed for liquid phase samples could have resulted in matrix interferences producing false positives.

EPA Influent (SP-1) Cyanide Data Not Used in EPA's TWPE Calculations

Plant	**Sampling Point**	**Average Concentration, mg/L**	**EPA's Qualifications of Analytical Results**
Hatfield's Ferry	SP-1, Monthly 1-4	0.91	1 <MDL (0.1)
Keystone	SP-1, Monthly 1-4	0.36	
Miami Fort	SP-1, Monthly 1-4	5.5	Monthly 4, 19 mg/L

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4379-A1, Excerpt Number 168.

Commenter Name: Cari Boyce
Commenter Affiliation: Duke Energy
Document Control Number: EPA-HQ-OW-2009-0819-4305-A3
Comment Excerpt Number: 47
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

There are, however, several flaws with EPA's methodology that create an artificially high removal estimate for several pollutants and completely misrepresents the pollutants removed for the treatment technologies evaluated.

The methodology fails to account for the variability of several constituents in the FGD purge stream. By examining the data, the concentrations of several constituents in the purge stream at Belews Creek and Allen are much lower than the concentrations at the other plants. By averaging the data from all 8 sites to calculate the baseline for surface impoundments and then only using data from Belews Creek and Allen to characterize the effluent from a chemical precipitation with biological treatment system, EPA estimated that several constituents are removed in great quantities, when in reality, these constituents are not removed at all. The appearance of removal is truly just a representation of the variability of FGD purge stream amongst the 8 sites.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 95 (in comment code 10.c).

Commenter Name: Elizabeth E. Aldridge, Hunton & Williams
Commenter Affiliation: UWAG
Document Control Number: EPA-HQ-OW-2009-0819-4655
Comment Excerpt Number: 125
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Once EPA collected its samples, it then failed to analyze and apply them correctly in the TWPE process, for the following reasons:

- EPA included cyanide data that were affected by interferences and should not have been used.
- EPA credited pollutant removals for pollutants that are *not* removed by the treatment systems, including boron, magnesium, and cyanide.
- EPA failed to follow its own precedent in treatment of pollutant removal efficiencies. EPA should have deleted any pollutant removals that were below 20% effectiveness. This is especially important in light of the problems noted above with the sampling.
- EPA erroneously calculated a reduction in FGD wastewater flows for the highest flow facilities. This assumed reductions in flows that probably are not possible for the facilities in question.

Therefore EPA's cost-effectiveness analysis is inadequate and should not be used for any purpose.

Comment Response:

Regarding the use of cyanide data, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 96 (in comment code 32).

Regarding pollutant removals for pollutants that are not removed by the treatment system, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 95 (in comment code 10.c).

Regarding pollutant removal efficiencies, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 87.

Regarding calculated reductions for the highest flow plants, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 100.

For the role of cost-effectiveness in EPA's decisions for the final rule, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 27 in Comment Code 6.h.

Commenter Name: Chris M. Hobson
Commenter Affiliation: Southern Company
Document Control Number: EPA-HQ-OW-2009-0819-4379-A1
Comment Excerpt Number: 86
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Once EPA collected its samples, it then failed to analyze and apply them correctly in the TWPE process, for the following reasons:

- EPA included cyanide data that were affected by interferences and should not have been used.

- EPA credited pollutant removals for pollutants that are *not* removed by the treatment systems, including boron, magnesium, cyanide, and manganese.

- EPA failed to follow its own precedent in treatment of pollutant removal efficiencies. EPA should have deleted any pollutant removals that were below 20% effectiveness, particularly since it did not collect paired samples.

- EPA used wrong FGD wastewater flow rates to calculate TWPE removals and costs for the treatment technology options.

Therefore, EPA's cost-effectiveness analysis is inadequate and should not be used for any purpose.

Comment Response:

Regarding the use of cyanide data, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 96 (in comment code 32).

Regarding pollutant removals for pollutants that are not removed by the treatment system, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 95 (in comment code 10.c).

Regarding pollutant removal efficiencies, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 87.

Regarding the commenter's statement that "EPA used the wrong FGD wastewater flow rates to calculate TWPE removals and costs," the commenter does explain why the flow rates used were "wrong" or identify any alternative flow rates that EPA should have used. Nevertheless, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 100, regarding calculated reductions for the highest flow plants.

For the role of cost-effectiveness in EPA's decisions for the final rule, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 27 in Comment Code 6.h.

Commenter Name: Elizabeth E. Aldridge, Hunton & Williams
Commenter Affiliation: UWAG
Document Control Number: EPA-HQ-OW-2009-0819-4655
Comment Excerpt Number: 194
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

As to FGD wastewater, EPA estimated a total industry discharge flow rate of 65.4 million gallons per day based on plant-specific flow rates for 117 plants that discharge FGD wastewater. 2013 TDD p. 10-25. UWAG estimated a total industry discharge flow rate of 33.0 million gallons per day based on the 2010 ICR data supplemented with data collected from a UWAG survey. UWAG identified plants on EPA's list of 117 plants that do *not discharge* FGD wastewater because they either have an evaporation pond, manufacture Pozzolanic material, or completely recycle wastewater. The difference in the flow rates used to calculate TWPEs explains why EPA's baseline FGD TWPEs are overestimated.

Comment Response:

The commenter states that it identified plants among 117 listed by EPA that do not discharge FGD wastewater, but it did not provide any information in its comments indicating which plants it views EPA as having estimated baseline discharges for that do not exist. Therefore, EPA cannot directly address the comment. However, based on the comment, EPA re-evaluated each of the FGD wastewater dischargers and did identify a number of plants that, for the final rule, EPA considered to be zero discharge for FGD wastewater. Additionally, EPA continued to identify additional announced generating unit retirements for the final rule. Both these zero dischargers and announced retirements were removed from the FGD wastewater compliance costs and baseline pollutant removals for the final rule.

Commenter Name: Elizabeth E. Aldridge, Hunton & Williams
Commenter Affiliation: UWAG
Document Control Number: EPA-HQ-OW-2009-0819-4655
Comment Excerpt Number: 94
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

1. EPA's TWPE Analysis for FGD Wastewater Counts Removals of Pollutants in Some Treatment Systems that Are Not Actually Removed from the Influent to those Treatment Systems

EPA's most significant error in calculating FGD TWPE removals is that it counted pollutant removals for numerous pollutants – such as boron, magnesium, manganese, and cyanide – that are *not* removed by the treatment system. This makes a significant difference in TWPEs removed for biological treatment. (EPA also counted TWPEs removed for all pollutants in chemical precipitation systems; this is misleading but does not make a significant difference in total TWPEs removed by chemical precipitation.)

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 95 (in comment code 10.c).

Commenter Name: Elizabeth E. Aldridge, Hunton & Williams
Commenter Affiliation: UWAG
Document Control Number: EPA-HQ-OW-2009-0819-4655
Comment Excerpt Number: 88
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

F. EPA's Cost-Effectiveness (TWPE) for FGD Wastewater

EPA describes its baseline (*i.e.*, influent) TWPE calculations as follows:

EPA calculated plant-specific loadings for each of the technology options considered for FGD wastewater. For baseline loadings, EPA multiplied the plant-specific FGD wastewater discharge flow rate with the average pollutant concentrations that represent the current level of treatment at the plant (i.e., surface impoundment, chemical precipitation, biological treatment, or vapor-compression evaporation).

2013 TDD at 10-23.

Comment Response:

EPA disagrees with the commenter that the baseline loadings are equivalent to the influent to a treatment system. The baseline loadings represent the current level of discharge. Therefore, for plants operating surface impoundments, the baseline loading is estimated to be the settling pond effluent concentration times the FGD wastewater flow. For plants operating a chemical precipitation under baseline conditions, the baseline discharge loadings is estimated to be the chemical precipitation effluent times the FGD wastewater flow. And so forth. The baseline is not equivalent to the treatment system influent.

Commenter Name: Chris M. Hobson
Commenter Affiliation: Southern Company
Document Control Number: EPA-HQ-OW-2009-0819-4379-A1
Comment Excerpt Number: 59
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

EPA's Cost-Effectiveness Analysis for FGD Wastewater

EPA describes its baseline (*i.e.*, influent) TWPE calculations as follows:

EPA calculated plant-specific loadings for each of the technology options considered for FGD wastewater. For baseline loadings EPA multiplied the plant-specific FGD wastewater discharge flow rate with the average pollutant concentrations that represent the current level of treatment at the plant (i.e., surface impoundment, chemical precipitation, biological treatment, or vapor-compression evaporation). 2013 TDD at 10-23.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 88.

Commenter Name: Theresa Pugh
Commenter Affiliation: American Public Power Association (APPA)
Document Control Number: EPA-HQ-OW-2009-0819-5140-A2
Comment Excerpt Number: 58
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Major Flaw in EPA's TWPE Analysis for FGD Wastewater

EPA's most significant error in calculating FGD TWPE removals is that it counted pollutant removals for numerous pollutants – such as boron, magnesium, manganese, and cyanide – that are *not* removed by the treatment system. This makes a significant difference in TWPEs removed for biological treatment.

UWAG's detailed comment address these errors (30 pages) for FGD wastewater.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 95 (in comment code 10.c).

Commenter Name: Paul Chu
Commenter Affiliation: Electric Power Research Institute (EPRI)
Document Control Number: EPA-HQ-OW-2009-0819-4499-A1
Comment Excerpt Number: 5
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

The incremental pollutant removals of biological treatment should be evaluated in assessing the cost-effectiveness of this technology, in addition to the pollutant removals of combined chemical precipitation and biological treatment. This is important because 85% of constituents are removed by the CP system, while the remaining 15% are removed by the biological system.

Comment Response:

For the role of cost-effectiveness in EPA's decisions for the final rule, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 27 in Comment Code 6.h.

The final rule does not establish limitations or standards for FGD wastewater based on chemical precipitation alone for reasons stated in preamble sections VIII.C.1 and VIII.D (BAT and NSPS, respectively).

Regarding the evaluation of "incremental" cost-effectiveness for biological treatment, see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 107.

Commenter Name: Paul Chu
Commenter Affiliation: Electric Power Research Institute (EPRI)
Document Control Number: EPA-HQ-OW-2009-0819-4499-A1
Comment Excerpt Number: 47
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

EPRI estimated pollutant loading reductions (removals) and compared its estimate with EPA's. EPA's estimated pollutant removals are generally overstated, especially for biological treatment, as EPA included manganese, cyanide, magnesium, and boron removal, which appears to be an artifact of mismatched influent and effluent data sets.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 95 (in comment code 10.c).

Commenter Name: Paul Chu
Commenter Affiliation: Electric Power Research Institute (EPRI)
Document Control Number: EPA-HQ-OW-2009-0819-4499-A1
Comment Excerpt Number: 3
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

The pollutant removals calculated by EPA for chemical precipitation, biological, and CP and VCE treatment are substantially greater than those calculated by EPRI.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 48.

Commenter Name: Elizabeth E. Aldridge, Hunton & Williams
Commenter Affiliation: UWAG
Document Control Number: EPA-HQ-OW-2009-0819-4655
Comment Excerpt Number: 11
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

EPA's TWPE removal calculations include pollutants that are not actually removed by the treatment systems being evaluated.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 95 (in comment code 10.c).

9. FGD Chemical Precipitation

Commenter Name: John McManus
Commenter Affiliation: American Electric Power System (AEP)
Document Control Number: EPA-HQ-OW-2009-0819-4448-A1
Comment Excerpt Number: 23
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

f. The incremental benefit of chemical precipitation following surface impoundment treatment is not cost effective.

EPA identified 117 plants that operate wet FGD systems and discharge FGD wastewater. Of these, EPA categorized 47 plants as operating a treatment system more advanced than a surface impoundment. Therefore, up to 70 plants operate impoundments to treat this wastewater.[17] As part of its FGD wastewater treatment evaluation, EPA assumed that plants with such surface impoundments would install one-stage chemical precipitation treatment systems to meet the effluent requirements associated with this option.[18] Therefore, EPA estimated its $/TWPE under the assumption that the wastewater entering the chemical precipitation system had been "treated" with an existing surface impoundment prior to chemical precipitation.

AEP does not operate settling ponds upstream of its FGD wastewater treatment facilities, but it was possible to simulate this treatment to obtain $/TWPE estimates. Surface impoundments effectively remove pollutants in the particulate phase, but are generally ineffective in removing dissolved pollutants. Since dissolved metals data were available, AEP was able to use this data in lieu of actual surface impoundment influent data. As with the previous analysis, flow data were obtained from the AEP ELG ICR response or from AEP operational or environmental data records. Since an upstream pond would remove most of the suspended metals before entering a wastewater treatment facility, the treatment plant inlet can be simulated by using AEP's wastewater treatment plant inlet dissolved metals, from which the $/TWPE can be determined. Samples were collected from the inlet and outlet of the FGD wastewater physical-chemical system; however, the inlet samples were analyzed for dissolved metals, while the outlet metals were analyzed for total metals, using EPA Methods 200.7, 200.8, 1631E (mercury) and SM20 4500NO3H (nitrate-nitrite). Pollutants that were not removed with an efficiency of at least 25% were deleted from the analysis. All cost data were adjusted to 2010$ using RS Means Historical Cost Indices and, as done by EPA, costs were annualized over a 20-year period using a 7% annual inflation rate.

As with the chemical precipitation analysis, the EPA assumption of settling pond use prior to chemical precipitation, generated cost effectiveness values much higher than those obtained by EPA (Table 2). The values based on a 20-year annualization period ranged from $341 to $1791 and averaged $808 per TWPE removed, which is well above what is considered to be cost effective. When presented as fully loaded costs based on a 15-year annualization period, the $/TWPE removed ranged from $494 to $2608 and averaged $1175. Likewise, these values are not cost effective and illustrate that if a settling pond is used prior to chemical precipitation, the incremental benefit in pollutant removal is not cost effective. These cost differences would be even larger if O&M expenses had been included in the analysis.

---

[17] Incremental Costs and Pollutant Removals for the Proposed Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category; EPA, April 2013, at 10-5.

[18] Id. at 10-10.

Comment Response:

EPA disagrees with the commenter's assertion that "EPA estimated its $/TWPE under the assumption that the wastewater entering the chemical precipitation system had been 'treated' with an existing surface impoundment prior to chemical precipitation." EPA does not assume that plants with existing surface impoundments will install chemical precipitation systems that treat the effluent from the existing impoundment. In fact, EPA expects that most plants would bypass the existing impoundment and send the wastewater directly to the chemical precipitation system. EPA calculates pollutant removals at the industry level based on comparing the loadings for the post-compliance options to the baseline loadings, as such, the removals for the chemical precipitation system are based on a comparison of the chemical precipitation loadings to the surface impoundment effluent loadings (for those plants currently operating a surface impoundment).

See response to DCN EPA-HQ-OW-2009-0819-4463-A1, Excerpt Number 32 regarding EPA's selection of BAT and NSPS applicable to discharges of FGD wastewater for the final rule.

As discussed in preamble sections V.D and V.F, EPA has revised its cost estimates and pollutant reductions analyses, respectively, in response to comments received on the proposed rule. These revised estimates are used in the cost-effectiveness analysis for the promulgated rule (see section preamble section XV). EPA notes that the cost-effectiveness ratios for the final rule remain well within the range of cost-effectiveness ratios for BAT of other industries. EPA conducts the cost-effectiveness analyses on an industry-wide basis, not on a site-specific and/or company-specific basis.

For the role of cost-effectiveness in EPA's decisions for the final rule, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 27 in Comment Code 6.h.

Commenter Name: Tom DeLawrence
Commenter Affiliation: Public Service Company of New Hampshire(PSNH)

Document Control Number: EPA-HQ-OW-2009-0819-4633-A1
Comment Excerpt Number: 20
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

PSNH supports a determination that, at most, imposes chemical precipitation as BAT for FGD waste water (i.e. Option 1) for certain facilities. However, PSNH believes EPA cannot even impose on the industry effluent limits based on this technology relying upon the current regulatory record; nor could the industry consistently achieve the effluent limits EPA is currently contemplating based on this technological option.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4463-A1, Excerpt Number 32 regarding EPA's selection of BAT and NSPS applicable to discharges of FGD wastewater for the final rule.

Regarding the effluent limits and regulatory record for the chemical precipitation technology option, see preamble section VIII. In addition, see Section 13 of the TDD and the Statistical Support Document for Effluent Limitations regarding the basis for the final effluent limitations for arsenic and mercury in discharges of FGD wastewater. These documents demonstrate that EPA has a sound technical basis and statistical basis for the effluent limitations and that the limitations are achievable.

Commenter Name: Bruce W. Ramme
Commenter Affiliation: We Energies
Document Control Number: EPA-HQ-OW-2009-0819-4475-A1
Comment Excerpt Number: 11
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

EPA should consider making Chemical Precipitation Best Available Technology Economically Achievable for Existing Dischargers and New Sources. Chemical precipitation, using predictable inorganic chemical reactions, is a proven technology to treat FGD wastewater that consistently achieves a high level of pollutant removal. The Electric Power Research Institute ("EPRI") estimates the industry-wide cost-effectiveness for installing chemical precipitation technology to be $273/lb-eq (1981 dollars), which is below the threshold EPA has traditionally set to achieve effluent limitations guidelines ($404/lb-eq in 1981 dollars).

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4463-A1, Excerpt Number 32 regarding EPA's selection of BAT and NSPS applicable to discharges of FGD wastewater for the final rule. Also see the preamble and TDD for the final rule.

As discussed in preamble sections V.D and V.F, EPA has revised its cost estimates and pollutant reductions analyses, respectively, in response to comments received on the proposed rule. These revised estimates are used in the cost-effectiveness analysis for the promulgated rule (see section preamble section XV). EPA notes that the cost-effectiveness ratios for the final rule remain well within the range of cost-effectiveness ratios for BAT of other industries.

For the role of cost-effectiveness in EPA's decisions for the final rule, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 27 in Comment Code 6.h.

Commenter Name: Chris M. Hobson
Commenter Affiliation: Southern Company
Document Control Number: EPA-HQ-OW-2009-0819-4379-A1
Comment Excerpt Number: 89
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

UWAG's analysis of the cost-effectiveness of chemical precipitation indicates that it may be cost effective only for plants with maximum design flow rates greater than 200 gpm. However, for all the data and analytical reasons already discussed, there remains considerable uncertainty about this analysis. UWAG believes EPA may want to collect additional FGD wastewater samples across a broader range of facilities.

Comment Response:

As discussed in preamble sections V.D and V.F, EPA has revised its cost estimates and pollutant reductions analyses, respectively, in response to comments received on the proposed rule. These revised estimates are used in the cost-effectiveness analysis for the promulgated rule (see section preamble section XV). EPA notes that the cost-effectiveness ratios for the final rule remain well within the range of cost-effectiveness ratios for BAT of other industries.

For the role of cost-effectiveness in EPA's decisions for the final rule, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 27 in Comment Code 6.h.

EPA disagrees that chemical precipitation of FGD wastewater is not technically or economically available for lower flow facilities (i.e., below 200 gpm). EPA's rulemaking record demonstrates that chemical precipitation treatment of FGD wastewater is available for a wide range of flow rates, and the commenter offers no data to the contrary. In fact, EPA's dataset of plants with chemical precipitation treatment in place shows that nearly 40% of plants operating chemical precipitation of FGD wastewater have flow rates less than 200 gpm.

See response to DCN EPA-HQ-OW-2009-0819-4463-A1, Excerpt Number 32 regarding EPA's selection of BAT and NSPS applicable to discharges of FGD wastewater for the final rule.

See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 124, in comment code 4.b, for more information regarding the representativeness of the plants and samples collected to characterize FGD wastewater.

Commenter Name: Tom DeLawrence
Commenter Affiliation: PowerSouth Energy Cooperative
Document Control Number: EPA-HQ-OW-2009-0819-4460-A1
Comment Excerpt Number: 35
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

The agency's cost-effectiveness estimate of $69 per toxic-weighted pound equivalents ("TWPEs") removed in 1981 dollars ("1981 $") is grossly understated. This is confirmed by UWAG's independent cost-effectiveness analysis, as well, which found that the cost-effectiveness of requiring physical/chemical treatment technologies to be $311/TWPE (1981 $). This $311/TWPE value is well above the less than $200/TWPE that EPA has typically imposed on other industries. See 68 Fed. Reg. 25,686, 25,701-02 (May 13, 2003). More importantly, however, this estimate is based on EPA's limited and self-selected data, as explained above. EPA must collect additional sampling data from a representative cross-section of the industry before it can assess the true costs associated with imposing this technology on the industry.

Comment Response:

As discussed in preamble sections V.D and V.F, EPA has revised its cost estimates and pollutant reductions analyses, respectively, in response to comments received on the proposed rule. These revised estimates are used in the cost-effectiveness analysis for the promulgated rule (see section preamble section XV). EPA notes that the cost-effectiveness ratios for the final rule remain well within the range of cost-effectiveness ratios for BAT of other industries.

For the role of cost-effectiveness in EPA's decisions for the final rule, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 27 in Comment Code 6.h.

See response to DCN EPA-HQ-OW-2009-0819-4463-A1, Excerpt Number 32 regarding EPA's selection of BAT and NSPS applicable to discharges of FGD wastewater for the final rule.

See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 124, in comment code 4.b, for more information regarding the representativeness of the plants and samples collected to characterize FGD wastewater.

Commenter Name: Chris M. Hobson
Commenter Affiliation: Southern Company
Document Control Number: EPA-HQ-OW-2009-0819-4379-A1
Comment Excerpt Number: 19
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

EPA's other option for FGD wastewater – chemical precipitation only – is an expensive option with a cost of $315 per TWPE removed (1981 dollars). This is much higher than $200 per TWPE threshold EPA typically applies in effluent guidelines rulemakings. While it is closer to cost effectiveness than the other options, Southern recommends that EPA conduct more sampling of FGD wastewater across a wider range of facilities with varied coal types to further evaluate whether chemical precipitation is cost effective for the industry as a whole. In addition, EPA should include all the major cost elements in their cost models for each technology option. Once the sampling is complete and the costs modified, EPA should revise its cost effectiveness analysis for chemical precipitation treatment, release the new data and analysis, and provide an opportunity for review and comment.

Comment Response:

As discussed in preamble sections V.D and V.F, EPA has revised its cost estimates and pollutant reductions analyses, respectively, in response to comments received on the proposed rule. These revised estimates are used in the cost-effectiveness analysis for the promulgated rule (see section preamble section XV). EPA notes that the cost-effectiveness ratios for the final rule, as for the proposed rule, remain well within the range of cost-effectiveness ratios for BAT of other industries.

For the role of cost-effectiveness in EPA's decisions for the final rule, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 27 in Comment Code 6.h.

See response to DCN EPA-HQ-OW-2009-0819-4463-A1, Excerpt Number 32 regarding EPA's selection of BAT and NSPS applicable to discharges of FGD wastewater for the final rule.

See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 124, in comment code 4.b, for more information regarding the representativeness of the plants and samples collected to characterize FGD wastewater.

Commenter Name: Tom DeLawrence
Commenter Affiliation: Public Service Company of New Hampshire(PSNH)
Document Control Number: EPA-HQ-OW-2009-0819-4633-A1
Comment Excerpt Number: 32
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

As discussed above, EPA can only realistically consider the chemical/physical (i.e., chemical precipitation) treatment process as BAT for FGD waste water at certain facilities. This treatment system is used by numerous power plants around the country, and has been relied upon by those using FGD systems for many years to treat FGD waste water. EPA's exclusion of this technology from its "preferred" options for treating FGD waste water ignores the fact that chemical precipitation, without the addition of biological treatment, has proven to be effective at treating FGD waste water to levels satisfactory of water quality standards. Moreover, chemical precipitation is vastly more cost effective than either biological treatment or ZLD technology.

Comment Response:

EPA did not select chemical precipitation as BAT for FGD wastewaters discharged by existing and new sources for the reasons stated in preamble sections VIII.C.1 and VIII.D (BAT and NSPS, respectively).

EPA agrees with the commenter that chemical precipitation is a proven technology that achieves a high level of removal of various metals. However, chemical precipitation, alone, is not effective at removing selenium, nitrogen compounds, and certain metals that contribute to high concentrations of TDS in FGD wastewater. Accordingly, as applied to FGD wastewater discharges, EPA rejected chemical precipitation alone as BAT or NSPS in favor of chemical precipitation followed by anaerobic/anoxic biological treatment and chemical precipitation followed by evaporation, respectively. The final rule also establishes, as part of BAT, a voluntary incentives program that includes BAT limitations applicable to FGD wastewater discharges based on chemical precipitation plus evaporation (see preamble section VIII.C.13). In accordance with the Clean Water Act, EPA determined that the technologies that form the bases for the final rule are available and demonstrated, they are economically achievable for the industry as a whole, and they have acceptable non-water quality environmental impacts (see preamble section VIII).

EPA's cost-effectiveness ratios for the final rule remain well within the range of cost-effectiveness ratios for BAT of other industries. See preamble section XV. For the role of cost-effectiveness in EPA's decisions for the final rule, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 27 in Comment Code 6.h.

EPA notes that, at its Merrimack Station power plant, the commenter installed an FGD wastewater treatment system that includes chemical precipitation followed by mechanical vapor compression evaporation, demonstrating that the technology is both available and affordable for that plant/company.

Commenter Name: Kevin D. Frizzell
Commenter Affiliation: Owensboro Municipal Utilities (OMU) Elmer Smith Station (ESS)
Document Control Number: EPA-HQ-OW-2009-0819-4683-A2
Comment Excerpt Number: 5
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

4. Chemical precipitation is not a cost-effective treatment for plants with a maximum design flow rate of 200 gpm or less.

EPA has not justified chemical precipitation as a national standard for FGD wastewater for smaller flow rates. In the Clean Water Act (CWA), it clearly states in its review that EPA's selection of a regulatory option must be based upon cost- effectiveness in a final rule. Plants with flow rates less than 200 gpm should be given the opportunity to demonstrate either chemical precipitation would not be cost-effective to treat their FGD wastewater or that it would be technically or economically unavailable due to site-specific features or conditions.

Comment Response:

As discussed in preamble sections V.D and V.F, EPA has revised its cost estimates and pollutant reductions analyses, respectively, in response to comments received on the proposed rule. These revised estimates are used in the cost-effectiveness analysis for the promulgated rule (see section preamble section XV). EPA notes that the cost-effectiveness ratios for the final rule remain well within the range of cost-effectiveness ratios for BAT of other industries. EPA conducts the cost-effectiveness analyses on an industry-wide basis, not on a site-specific and/or company-specific basis.

EPA disagrees with the commenter that the Clean Water Act "clearly states in its review that EPA's selection of a regulation option must be based upon cost-effectiveness in a final rule." For the role of cost-effectiveness in EPA's decisions for the final rule, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 27 in Comment Code 6.h.

See response to DCN EPA-HQ-OW-2009-0819-4379-A1, Excerpt Number 89 regarding plants with flow rates less than 200 gpm.

See response to DCN EPA-HQ-OW-2009-0819-4463-A1, Excerpt Number 32 regarding EPA's selection of BAT and NSPS applicable to discharges of FGD wastewater for the final rule.

Regarding site-specific features or conditions, although EPA has based the rule limitations on the use of chemical precipitation and biological treatment, the rule does not prescribe a specific type of treatment. Power plants may install and use any technology or practice they choose to meet the FGD wastewater limitations and standards. EPA notes, however, that it has not identified any reason why the BAT basis would not be available for a given plant, nor has the commenter provided any such data showing that it would not be available. Additionally, EPA evaluated the costs of the ELG and determined that it was economically achievable, or affordable, for the steam electric industry as a whole. See the preamble and the RIA for more information.

Commenter Name: Theresa Pugh
Commenter Affiliation: American Public Power Association (APPA)
Document Control Number: EPA-HQ-OW-2009-0819-5140-A2
Comment Excerpt Number: 31
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

For FGD wastewater, APPA strongly endorses UWAG's analysis which shows that chemical precipitation treatment is not cost-effective for plants with a maximum design flow rate of 200 gpm or less. Because of shortcomings in the data and cost calculations, documented below, EPA has not justified chemical precipitation as a national standard for FGD wastewater for smaller flow rates. Smaller flow rates are not always a reflection of megawatt (MW) size, but APPA has many member utilities with smaller flow rates.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4379-A1, Excerpt Number 89.

Commenter Name: Elizabeth E. Aldridge, Hunton & Williams
Commenter Affiliation: UWAG
Document Control Number: EPA-HQ-OW-2009-0819-4655
Comment Excerpt Number: 128
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

UWAG's analysis of the cost-effectiveness of chemical precipitation indicates that it may be cost effective only for plants with maximum design flow rates greater than 200 gpm. However, for all the data and analytical reasons already discussed, there remains considerable uncertainty about this analysis. UWAG believes EPA may want to collect additional FGD wastewater samples across a broader range of facilities.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4379-A1, Excerpt Number 89.

Commenter Name: Elizabeth E. Aldridge, Hunton & Williams
Commenter Affiliation: UWAG
Document Control Number: EPA-HQ-OW-2009-0819-4655
Comment Excerpt Number: 12
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

However, based on the available data, UWAG's preliminary analysis shows that chemical precipitation treatment is not cost-effective for plants with a maximum design flow rate of 200 gpm or less. Because of shortcomings in the data and cost calculations, documented below, EPA has not justified chemical precipitation as a national standard for FGD wastewater for smaller flow rates.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4379-A1, Excerpt Number 89.

Commenter Name: S. L. Phillips
Commenter Affiliation: Louisiana Department of Environmental Quality
Document Control Number: EPA-HQ-OW-2009-0819-5509-A2
Comment Excerpt Number: 5
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

In the proposed rule, EPA is creating a separate category of wastewaters related to scrubber systems and is proposing limits that would require the installation of physical/chemical treatment systems to meet limits for arsenic, mercury, selenium and nitrate/nitrite.

Industry experience with physical/chemical treatment has shown that this technology is cost effective.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4633-A1, Excerpt Number 32.

Commenter Name: Tom DeLawrence
Commenter Affiliation: Public Service Company of New Hampshire(PSNH)
Document Control Number: EPA-HQ-OW-2009-0819-4633-A1
Comment Excerpt Number: 36
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Based on the BAT factors, the physical/chemical system may be an appropriate technology for some facilities within the coal-fired utility industry, as demonstrated by PSNH's experience with its physical/chemical system at Merrimack Station. EPA must undertake a more in-depth review of this technological option prior to imposing it on the industry, however.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4633-A1, Excerpt Number 32.

Commenter Name: Theresa Pugh
Commenter Affiliation: American Public Power Association (APPA)
Document Control Number: EPA-HQ-OW-2009-0819-5140-A2
Comment Excerpt Number: 34
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

It is possible that with additional data, EPA may be able to justify installing chemical precipitation for FGD wastewater *at some plants*. APPA believes that the EPA will see that these are justified: Chemical precipitation treatment is <u>not</u> cost-effective for plants with a maximum design flow rate of 200 gpm or less.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4379-A1, Excerpt Number 89.

Commenter Name: Bruce W. Ramme
Commenter Affiliation: We Energies
Document Control Number: EPA-HQ-OW-2009-0819-4475-A1
Comment Excerpt Number: 35
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

EPRI estimates the industry-wide cost-effectiveness for installing chemical precipitation technology to be $273/lb-eq (1981 dollars), which is below the threshold EPA has traditionally set to achieve effluent limitations guidelines ($404/lb-eq in 1981 dollars).

Comment Response:

As discussed in preamble sections V.D and V.F, EPA has revised its cost estimates and pollutant reductions analyses, respectively, in response to comments received on the proposed rule. These revised estimates are used in the cost-effectiveness analysis for the promulgated rule (see section preamble section XV). EPA notes that the cost-effectiveness ratios for the final rule remain well within the range of cost-effectiveness ratios for BAT of other industries.

For the role of cost-effectiveness in EPA's decisions for the final rule, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 27 in Comment Code 6.h.

See response to DCN EPA-HQ-OW-2009-0819-4463-A1, Excerpt Number 32 regarding EPA's selection of BAT for FGD wastewater.

Commenter Name: Dean Ellis
Commenter Affiliation: Dynegy Inc.
Document Control Number: EPA-HQ-OW-2009-0819-4491-A1
Comment Excerpt Number: 16
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

As to chemical precipitation, UWAG's analysis shows that such treatment is not cost effective for plants with a maximum design flow rate of 200 gpm or less, and EPA has not justified chemical precipitation for FGD wastewater for these lower flow rates.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4379-A1, Excerpt Number 89.

Commenter Name: Bruce W. Ramme
Commenter Affiliation: We Energies
Document Control Number: EPA-HQ-OW-2009-0819-4475-A1
Comment Excerpt Number: 78
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Chemical precipitation should be chosen as BAT for FGD wastewater because the use of predictable inorganic chemical reactions to consistently achieve a high level of pollutant removal is a proven and cost-effective technology.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4633-A1, Excerpt Number 32.

Commenter Name: Dorothy Kellogg and Michael Leitman
Commenter Affiliation: National Rural Electric Cooperative Association (NRECA)
Document Control Number: EPA-HQ-OW-2009-0819-4565
Comment Excerpt Number: 6
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

NRECA also recommends:

Flue Gas Desulfurization (FGD) wastewater limits based on chemical precipitation, but only for plants with maximum design flow (mdf) rate greater than 200 gallons per minute (gpm).

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4379-A1, Excerpt Number 89.

Commenter Name: Ron Shipman
Commenter Affiliation: Georgia Power Company
Document Control Number: EPA-HQ-OW-2009-0819-4447-A1
Comment Excerpt Number: 4

External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Subject to further evaluation for industry-wide use, and with some exceptions, chemical precipitation may be cost effective for FGD wastewater flows greater than 200 GPM.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4379-A1, Excerpt Number 89.

Commenter Name: Ron Shipman
Commenter Affiliation: Georgia Power Company
Document Control Number: EPA-HQ-OW-2009-0819-4447-A1
Comment Excerpt Number: 22
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

FGD Wastewater Treatment With Chemical Precipitation, While More Expensive Than Is Typical, It Is Below The High End Cost-Effectiveness Limit of $404/TWPE (1981 dollars).

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4448-A1, Excerpt Number 23.

Commenter Name: F. Gilzow
Commenter Affiliation: Missouri Joint Municipal Electric Utility Commission
Document Control Number: EPA-HQ-OW-2009-0819-5517-A2
Comment Excerpt Number: 6
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Chemical precipitation treatment is not cost-effective for plants with a maximum design flow rate of 200 (gallons per minute) gpm or less;

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4379-A1, Excerpt Number 89.

Commenter Name: S. L. Phillips
Commenter Affiliation: Louisiana Department of Environmental Quality
Document Control Number: EPA-HQ-OW-2009-0819-5509-A2
Comment Excerpt Number: 7
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Option 3a, without the requirement for biological treatment , would provide cost effective benefits.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4463-A1, Excerpt Number 32.

9.a. FGD CP – Demonstration/Performance

Commenter Name: Raven Power Holdings, LLC
Commenter Affiliation: Raven Power Holdings, LLC
Document Control Number: EPA-HQ-OW-2009-0819-4467-A1
Comment Excerpt Number: 21
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Chemical precipitation treatment systems are a reliable, proven technology that have been implemented across diverse geographical regions and operating conditions. Chemical precipitation is an active treatment system that can effectively respond to variable water conditions typical of FGD operations. TWPE reduction of nearly 90 percent is achievable with these systems. These systems have been supplied by a number of vendors, under varying configurations to meet site specific requirements.

EPA's evaluation of chemical precipitation treatment and the demonstrated TWPE reduction was based on systems that were being operated to meet current NPDES permit requirements under existing ELG rules. These systems were not being operated in an attempt to demonstrate maximum practicable chemical precipitation treatment technology performance. As EPA noted, neither the Belews Creek nor Allen operations were utilizing organo- sulfide addition. This additive was not used because final outfall mercury limits were being achieved without the added chemical and operating expense. This situation also applies to Raven Power.

Operating chemical precipitation systems at pH's greater than those used at the sites EPA used in their characterization of system performance enhances the removal of a number of additional constituents included in EPA's TWPE calculations. Operating at this elevated pH range increases the cost of alkaline reagent and acid per volume of wastewater treated but results in a significant increase in TWPE removed.

Another operational variable not considered in evaluating chemical precipitation systems is the incorporation of enhanced filtration and separation technologies. The clarifiers and sand filters utilized by the systems EPA evaluated were again designed and operated to meet current permit requirements, not to maximize the capabilities of the chemical precipitation systems.

As chemical precipitation, with its inherent reduction of total suspended solids, is an upstream prerequisite treatment for both vapor compression evaporation and bioreactor technologies, it is necessary to accurately and individually characterize the TWPE removal capability of this technology before evaluating the net TWPE removal of other downstream systems. That is, a physical chemical treatment system optimized to meet more stringent requirements will not only have a greater TWPE removal, but it will also drastically reduced the differential TWPE removal of downstream systems.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4633-A1, Excerpt Number 32, in comment code 9, regarding EPA's selection of BAT and NSPS applicable to discharges of FGD wastewater for the final rule.

EPA agrees with the commenter that the Agency's BAT performance dataset for plants operating chemical precipitation may not represent optimal performance for the reasons described by the commenter. However, EPA has used the best data available to characterize performance of the chemical precipitation technology option for control of FGD wastewater discharges, and the commenter has not provided data or other information to quantify the additional removals that may be possible if this technology were to be further optimized.

EPA did not select chemical precipitation, alone, as BAT or NSPS for control of FGD wastewaters discharged by existing and new sources for reasons stated in preamble sections VIII.C.1 and VIII.D (BAT and NSPS, respectively). Thus, EPA did not estimate pollutant removals associated with treatment using chemical precipitation, alone, as suggested by the commenter. Furthermore, for the reasons mentioned by the commenter, chemical precipitation is an "upstream prerequisite treatment" for both the chemical precipitation plus biological treatment technology basis and the chemical precipitation plus evaporation technology basis. Because the biological treatment technology and evaporation for FGD wastewater are not "standalone" technologies, it would not be appropriate to evaluate them without including the chemical precipitation pretreatment stage. Therefore, EPA evaluated the combined treatment systems.

EPA notes that the regulations do not require facilities to implement the specific technologies that form the bases for the final rule, but only that the final effluent limitations and standards applicable to discharges from steam electric generating units be achieved. Plants may find that employing optimized chemical precipitation systems with enhanced solids separation technologies is an appropriate strategy for meeting the final limitations and standards.

Commenter Name: John McManus
Commenter Affiliation: American Electric Power System (AEP)
Document Control Number: EPA-HQ-OW-2009-0819-4448-A1
Comment Excerpt Number: 24
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

g. EPA needs to consider the variability of FGD wastewater treatment performance.

There are a number of concerns with the performance of chemical precipitation processes. Large volumes of water (long residence times) are used in the treatment process and failure of a single component (agitator, rake mechanism, feed pump) can incapacitate the process for up to 7 days. Significant changes in the quality of the coal and limestone also occur and the operating conditions of the boiler vary, all of which can affect the FGD wastewater influent quality and have an impact on system performance.

EPA data for arsenic (As) removal in the FGD wastewater treatment process appear based upon limestone, forced-oxidation FGDs. AEP data indicates that majority (up to 97%) of As is oxidized and in the solid state. This compares to the inhibited oxidized FGDs where the As is predominately dissolved. AEP data indicate that the chemical precipitation process is very effective at removing suspended arsenic, but not at removing dissolved arsenic. As such, there should be further clarification relative to the form of a metal or metalloid species that can be effectively removed in a given process.

Comment Response:

Treatment System Component Failure

EPA is aware that treatment components can fail, but a properly designed and operated treatment system includes sufficient redundancy to ensure that while an individual component may fail, backup equipment would be available to allow the treatment system to continue operating. Accordingly, EPA's cost estimates for the FGD wastewater treatment technologies it evaluated incorporate good engineering practices to mitigate the impacts of potential failures. First, EPA's estimated equipment purchase costs include cost for duplicate (i.e. redundant) equipment or excess capacity for key equipment. For example, EPA's costs estimates include two 100 percent capacity pumps (for all pumps in the system); two 75 percent capacity solids contact clarifiers; two 100 percent capacity or three 50 percent capacity filter presses (depending on plant flow rate); and two 100 percent capacity sand filters. Second, EPA's estimated maintenance materials costs include costs for replacement parts. Third, EPA's estimated maintenance labor costs include costs for labor to maintain and repair the wastewater treatment system. The design basis used by EPA for estimating the cost of the BAT bases includes sufficient redundancy and capacity to ensure the treatment system can continue operating should a pump or other equipment experience a failure. See the *Incremental Costs and Pollutant Removals for the Final Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category* (Cost & Loads Report) (DCN SE05831/SE05832) for more information on EPA's cost estimates for the BAT system.

Impact of Varying Operating Conditions

EPA is well aware that, in some cases, changes in the coal burned or other factors may have an effect on the characteristics of the FGD wastewater. EPA has extensively reviewed data regarding the variability of untreated FGD wastewater and how changes in plant operations (including fuel or other raw materials) may, or may not, affect the wastewater characteristics and the pollutant removal efficacy of the BAT/NSPS treatment technologies. However, based on discussion with industry personnel, EPA is also aware that plants can make changes to the coal type and boiler operations sporadically, without informing the operators of the downstream wastewater management operators. That issue can easily be resolved through more effective communication and planning. By making wastewater treatment operators aware of changes to the coal types and boiler operation, operators can monitor the treatment system to evaluate how the system responds to such changes and adjust the system accordingly. Chemical precipitation systems are designed, and system operating conditions are adjusted on an ongoing basis, to account for such variations. This is supported by many commenters operating chemical precipitation systems to treat FGD wastewater:

- Raven Power Holdings, LLC (DCN EPA-HQ-OW-2009-0819-4467-A1, Excerpt Number 21): "Chemical precipitation treatment systems are a reliable, proven technology that have been implemented across diverse geographical regions and operating conditions. Chemical precipitation is an active treatment system that can effectively respond to variable water conditions typical of FGD operations…. These systems have been supplied by a number of vendors, under varying configurations to meet site specific requirements."
- Duke Energy (DCN EPA-HQ-OW-2009-0819-4305-A3, Excerpt Number 38): "Chemical precipitation systems, as included in Option 1, are a cost-effective reliable technology that can be employed across all geographical regions and under different operating scenarios. Specifically, these systems can be designed, and are proven, to operate over a wide range of fuel types, fuel additives, operating temperatures, and chloride concentrations."
- We Energies (DCN EPA-HQ-OW-2009-0819-4475-A1, Excerpt Number 34): "Chemical precipitation using an alkali-sulfide process has a number of advantages including its ability to adjust chemical dosages to treat various influent concentrations and the predictability of the chemical reactions to treat the influent's metals concentrations."
- Alabama Power Company (DCN EPA-HQ-OW-2009-0819-4489-A1, Excerpt Number 11): "The physical/chemical system [chemical precipitation] may be an available, proven, effective, and operationally efficient technology in some instances. This treatment system is used by power plants around the country, and has been relied upon by those using FGD systems to treat FGD wastewater."
- Public Service Company of New Hampshire (DCN EPA-HQ-OW-2009-0819-4633-A1, Excerpt Number 32): "chemical precipitation… has proven to be effective at treating FGD waste water to levels satisfactory of water quality standards."

In addition, EPA bases the effluent limitations guidelines and standards on long-term average effluent values and variability factors that account for variation in treatment performance over time.

<u>Arsenic Form and Treatability</u>

The commenter provided no data to support the assertion that "inhibited oxidized FGDs [generate FGD wastewater] where the As is predominately dissolved," nor the assertion that chemical precipitation is not effective at removing dissolved arsenic. Therefore, in the absence of any data from the commenter, EPA reviewed the following available EPRI reports to identify dissolved arsenic data for inhibited oxidation FGD systems:

- PISCES Water Characterization Field Study: Site A
- PISCES Water Characterization Field Study: Site B
- PISCES Water Characterization Field Study: Site C

- PISCES Water Characterization Field Study: Site D
- PISCES Water Characterization Field Study: Site E (matches the data found in SE001816)
- PISCES Water Characterization Field Study: Site F
- PISCES Water Characterization Field Study: Site G
- Flue Gas Desulfurization (FGD) Water Characterization: 2008 Update (DCN: SE00408A2)
- Impact of Wet Flue Gas Desulfurization (FGD) Design and Operating Conditions on Selenium Speciation (DCN SE00408A3)
- The fate of Mercury Absorbed in FGD systems
- Flue Gas Desulfurization (FGD) Wastewater Characterization (DCN: SE001816)
- FGD Wastewater Characterization and Management: 2007 Update (DCN: SE00408A1)

From this review, EPA identified two reports that contained arsenic data for inhibited oxidations systems. The following summarizes the information in each report.

Flue Gas Desulfurization (FGD) Wastewater Characterization: EPA identified one site operating an inhibited oxidation system (Site E) from this data source. The EPRI report provided FGD characterization data for this site; however, the report only includes data for total recoverable arsenic, and no data for dissolved arsenic. Therefore, these data are not usable for evaluating the presence and treatability of dissolved arsenic for inhibited oxidation systems.

FGD Wastewater Characterization and Management: 2007 Update: EPA identified multiple inhibited oxidation systems in this report; however, the report only included inhibited oxidation FGD wastewater characterization data for Site R from the CH2M HILL FGD Wastewater Screening Study. The data indicated dissolved arsenic concentrations for As^{3+} and As^{5+} species of 4.02 µg/L and 3.51 µg/L, respectively.

EPA compared the one data point for the inhibited oxidation system to the available dissolved arsenic data for forced oxidation FGD systems and determined that the inhibited oxidation dissolved arsenic concentrations were within the range of dissolved arsenic concentrations present in wastewater from forced oxidation systems. In fact, the average concentration of dissolved arsenic for the inhibited oxidation FGD system was lower than the average concentration for forced oxidation systems. Additionally, the total combined dissolved concentration for both species of arsenic (As^{3+} and As^{5+}) is below the final effluent limitation and standard for arsenic in FGD wastewater. Therefore, EPA did not identify any data showing that the arsenic present in FGD wastewater from inhibited oxidation systems will predominantly be present in dissolved form. More importantly, EPA did not identify any data, nor did the commenter provide any such data, showing that plants operating inhibited oxidation FGD systems would be unable to meet the ELGs for arsenic (or any other pollutant) in FGD wastewater.

Additionally, EPA's review of the responses to the Steam Electric Survey indicates that there are approximately 20 plants that operate inhibited oxidation systems. Of those plants, EPA estimates that roughly 75% of them do not discharge FGD wastewater and, therefore, only a few plants operating inhibited oxidation systems are not already in compliance with the final BAT limitations applicable to FGD wastewater discharges. The data in the record show that these plants could meet the effluent limitations by installing the BAT model technology (or equivalent) and, for the purposes of EPA's costs analysis, EPA assumed that these plants would take that approach to comply with the ELGs. However, based on the information in the record, an alternative compliance approach for these plants might include modifying their handling practices for the FGD wastewater and scrubber sludges so that they do not discharge FGD wastewater, such as by mixing the wastes with fly ash or other material to produce a pozzolanic material for landfill disposal.

Regarding the treatment of dissolved arsenic, see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 56.

Commenter Name: Paul Chu
Commenter Affiliation: Electric Power Research Institute (EPRI)
Document Control Number: EPA-HQ-OW-2009-0819-4499-A1
Comment Excerpt Number: 53
External Review Flag: Statistics
External Review Incorporated into Response: No

Comment Excerpt:

5.2 Long-term data from Pleasant Prairie shows that even a two-stage clarification treatment approach using ferric chloride and organosulfide as BAT would not be able to consistently meet EPA's proposed arsenic and mercury limits.

Pleasant Prairie Power Plant's FGD wastewater treatment consists of two-stage treatment system that uses both ferric chloride and organosulfide, as shown in Figure 5-5. EPA did not include data it collected from Pleasant Prairie to calculate arsenic and mercury effluent limitations because EPA's technology option is a one-stage system. EPA states in the footnote on page 34,487 of the *Federal Register* that

"Based on data EPA has evaluated for the steam electric industry and other industry sectors, two-stage chemical precipitation systems generally achieve better pollutant removals than one-stage systems. Since the technology basis for chemical precipitation treatment of FGD wastewater in the proposed rule is a one- stage system and that is the configuration used to estimate compliance costs, EPA concluded that effluent data for the two-stage system (Pleasant Prairie) should not be used when calculating effluent limits for the technology option." [EPA, 2013]

Long-term monitoring data, along with EPA's own data, shows Pleasant Prairie could not consistently meet the arsenic and mercury technology-based ELG limits, despite having a well-run treatment system using all aspects of EPA's BAT-defining treatment (ferric chloride and organosulfide, followed by clarification). It is unlikely that facilities with one-stage treatment systems will be able to meet these limitations consistently if a facility with two-stage treatment cannot.

Pleasant Prairie Power Plant burns sub-bituminous coal (Powder River Basin [PRB]). This is a lower-chloride coal, which allows FGD systems to operate at higher cycles (i.e., water is recycled through the FGD adsorber more times before it has to be blown down due to buildup of chlorides causing corrosivity). This cycling allows for build-up of trace metals and water constituents that may make it difficult to remove the trace metals (such as chelating agents). The level of mercury and arsenic in Pleasant Prairie FGD wastewater may be indicative of the challenges inherent in treating FGD wastewater from units burning PRB coal.

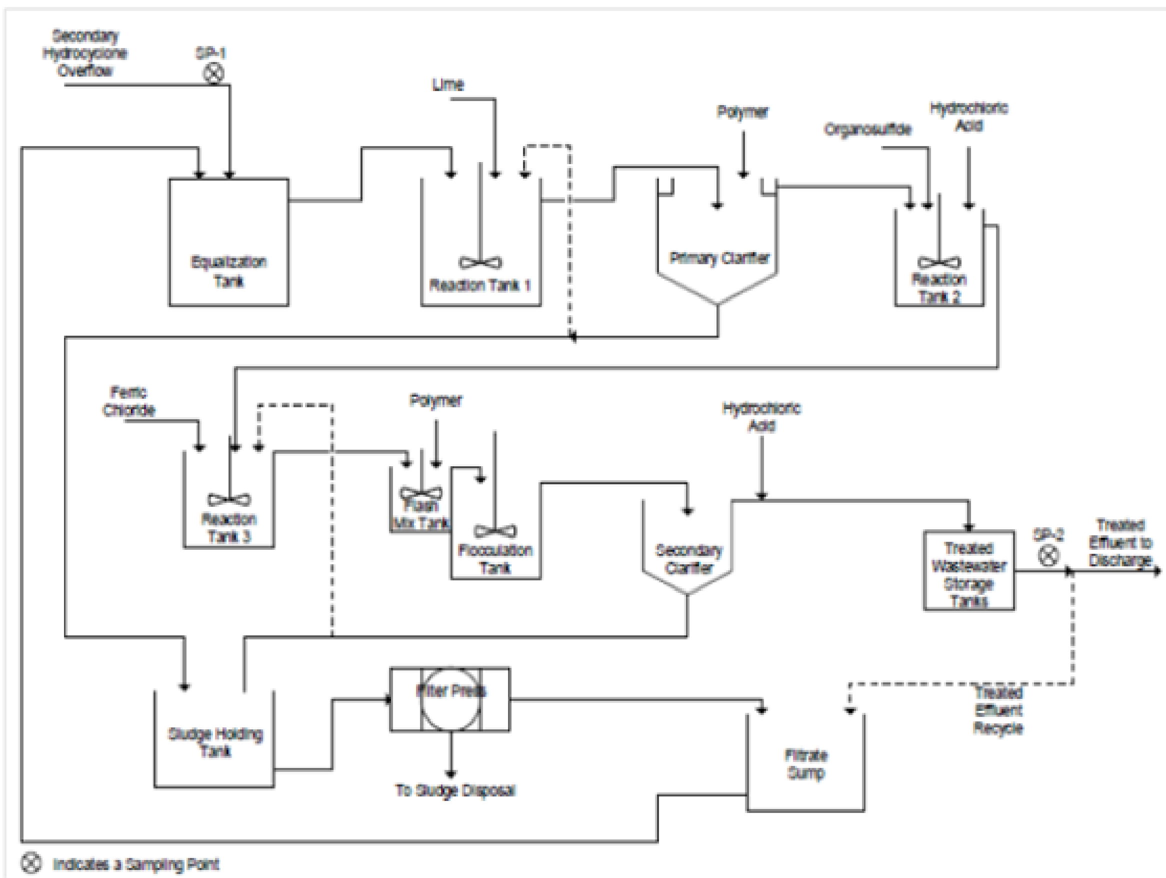


Figure 5-5
Pleasant Prairie FGD Wastewater Treatment System Process Flow Diagram
Source: EPA, 2012.

The effluent data collected at Pleasant Prairie by EPA during EPA and Clean Water Act (CWA) sampling shows that concentrations of mercury were below the proposed daily limit for all samples, but exceeded the proposed monthly limit twice during the CWA sampling. However, a review of long-term monitoring data for effluent mercury (Figure 5-6) shows that Pleasant Prairie would not be able to consistently meet the proposed daily maximum limitation of 242 ng/L or the proposed monthly average limitation of 119 ng/L for mercury.

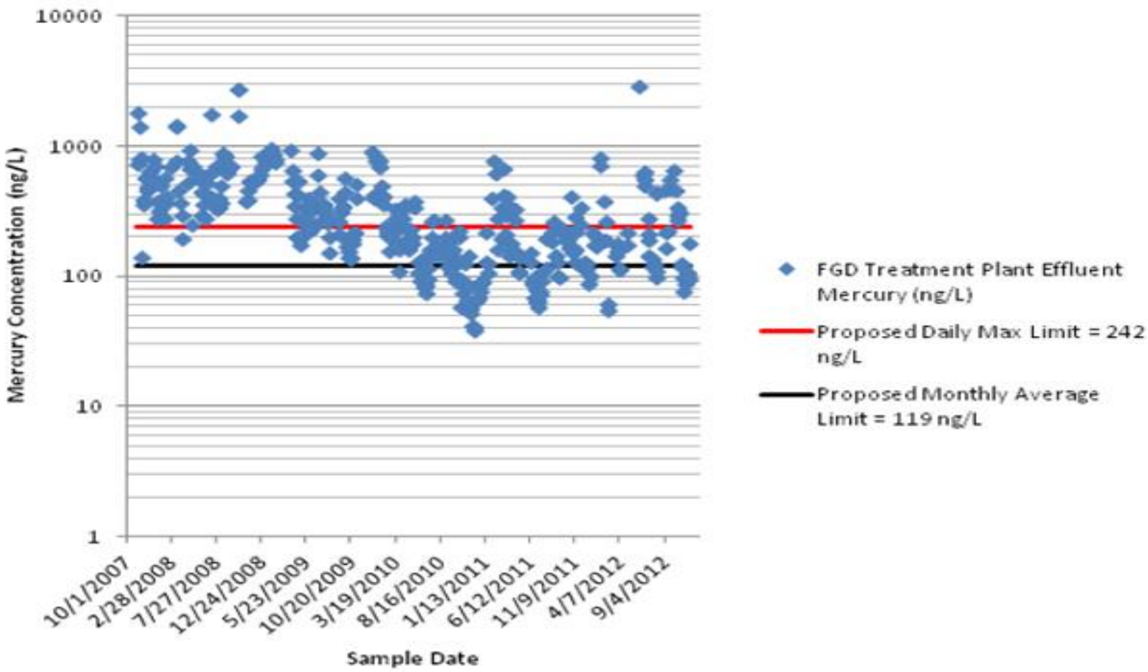


Figure 5-6
Comparison of Total Mercury Effluent to Proposed Mercury Limits for Pleasant Prairie
Source: We Energies

The effluent data collected at Pleasant Prairie by EPA during EPA and CWA sampling shows that concentrations of arsenic exceeded the monthly limitation of 6 µg/L for 5 of 8 samples. Additionally, review of long-term data on effluent arsenic from Pleasant Prairie (Figure 5-7) shows effluent arsenic as high as 21 µg/L. Thus, the site cannot consistently meet the proposed monthly average limitation of 6 µg/L and the proposed daily maximum limitation of 8 µg/L.

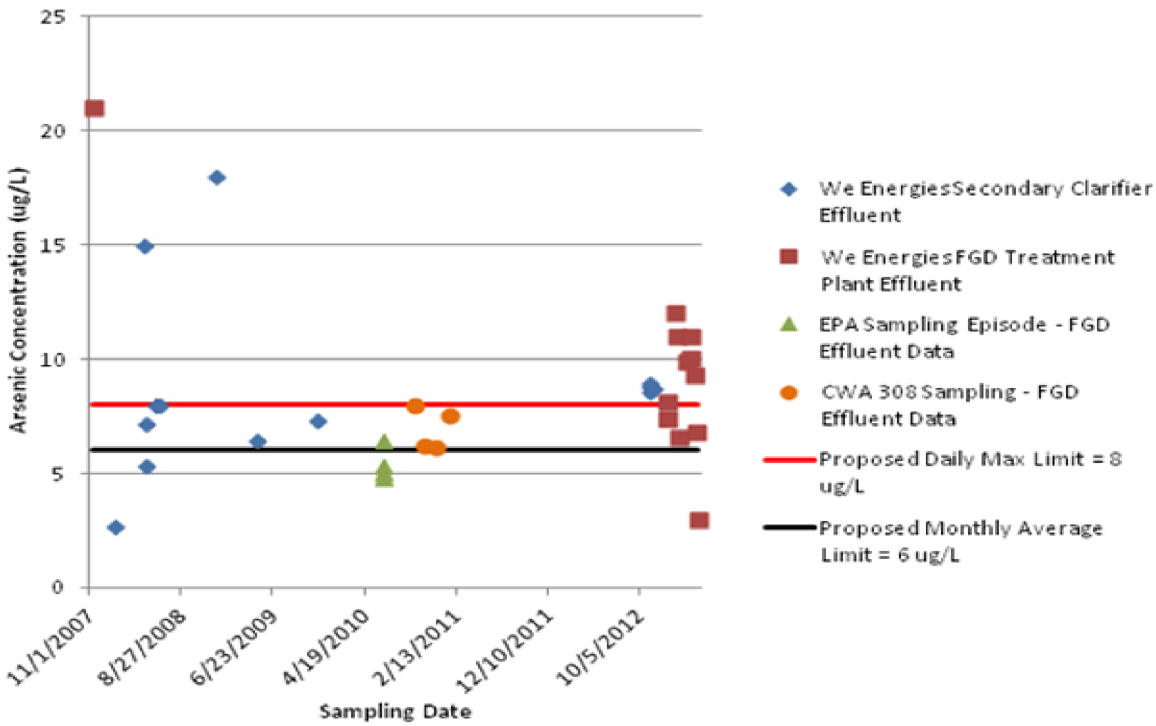


Figure 5-7
Comparison of Total Arsenic Effluent Long-Term Data to Prposed Arsenic Limits for Pleasant Prairie
Source: We Energies

Comment Response:

Regarding the performance of the Pleasant Prairie Power Plant chemical precipitation system, since proposal, EPA received additional data from We Energies to use in its analyses. These additional data, along with other data EPA received as a result of public comments, were evaluated and, as appropriate, used to calculate the effluent limitations for the final rule. See the Statistical Support Document for Effluent Limitations for EPA's evaluation of the data for Pleasant Prairie and how these data compare to the effluent limitations for the final rule. Also see Section 13 of the TDD.

Commenter Name: Cari Boyce
Commenter Affiliation: Duke Energy
Document Control Number: EPA-HQ-OW-2009-0819-4305-A3
Comment Excerpt Number: 57
External Review Flag: Statistics
External Review Incorporated into Response: No

Comment Excerpt:

Arsenic and Mercury BAT Limits

Table 1-10 is a summary of the arsenic and mercury data from Duke Energy's Miami Fort Station compared with EPA's proposed BAT limits. Miami Fort Station was one of three stations used to develop the proposed limits. The table compares self- monitoring data with the data EPA collected.

Table 1-10. Compliance Rate with Proposed Arsenic and Mercury Limits

Miami Fort Station FGD WWTS Effluent: Treatment = Chemical Precipitation								
Parameter	**Arsenic (ppb)**				**Mercury (ppt)**			
Sampling Type	Self-monitoring		EPA		Self-monitoring		EPA	
Number of Samples Collected	*62*		8		62		8	
Number of Samples below Detection Limit	49		8		0		0	
Number of Samples D L> Proposed Limit (1)	49/62		0/8		0/0		0/0	
Proposed Limit (daily, monthly)	(<=8 ppb, <=6 ppb)				(<=242 ppt, <=119 ppt)			
Compliant with BAT daily max	12/13	92.0%	8/8	100.0%	47/62	76.0%	6/8	75.0%
Compliant with BAT monthly max	12/13	92.0%	8/8	100.0%	30/62	48.0%	2/8	25.0%

(1) Detection Limit = 20 ug/L

Arsenic: The eight samples from EPA's field testing conducted at Miami Fort[11], demonstrate that the chemical precipitation system achieved a 100% compliance rate with both the daily maximum (8 ug/L) and the monthly average (6 ug/L) limits for arsenic. Duke Energy's self–monitoring data from Miami Fort shows a 92% compliance rate with both the daily maximum (8 ug/L) and the monthly average (6 ug/L) limits. Based on the limited amount of data the arsenic summary shows that the chemical precipitation system at Miami Fort has the capability as a BAT process for arsenic removal when data is available which is sufficiently sensitive, to meet the low reporting limit. However, EPA set the limit for arsenic too low to be able to consistently detect at concentrations at or below the proposed limits. As illustrated in Table 1-10 above, 49 of the 62 self-monitoring data were at a detection limit above the proposed arsenic daily and monthly limits. EPA, therefore, should revise the arsenic limits to ensure commercial laboratories can reliably and consistently measure at concentrations below the final limit. Duke Energy addresses the capability of commercial laboratories to achieve detection limits below the proposed effluent limit in section j. below.

Mercury: The eight samples from EPA's field testing conducted at Miami Fort, demonstrate that the chemical precipitation system achieved a 75% compliance rate with the daily maximum (242 ng/L) limit, however only a 25% compliance rate with the monthly average (119 ug/L) limit. Duke Energy's self–monitoring data from Miami Fort shows a 76% compliance rate with the daily maximum (242 ng/L) limit and only a 46% compliance with the monthly average (119 ng/L). This indicates a slightly better performance than during the 8-event EPA field tests, however, the station would have been out of compliance with the monthly average over 50% of the time. To comply 100% of the time with the mercury limit as proposed, additional treatment would be needed. The cost for this additional treatment was not included in the EPA's cost analysis. Although the chemical precipitation process is a capable technology for mercury removal, the proposed limits should be revised to better align with the EPA and Duke data and the process capability.

---

[11] EPA Sampling at Duke Energy Miami Fort Station 7/13/2010 – 1/14/2011

Comment Response:

As a result of public comments, EPA received additional data from Duke Energy for its Miami Fort Station to use in its analyses. Upon receipt of these additional data, EPA contacted Duke Energy to discuss the data, including the detection limit associated with the arsenic data. The following summarizes the reason Duke Energy reports an arsenic detection limit of 20 ug/L (see DCN SE04331 for additional details):

"In July 2009, Duke Energy conducted an initial screening of the FGD wastewater for Outfall 608 in response to the 'monitor and report' limits included in the plant's NPDES permit. Because the plant did not have specific numeric limits, the laboratories determined that 20 ug/L was an appropriate reporting limit to meet the NPDES permit requirements while maintaining appropriate QA/QC requirements. Duke Energy was not required to meet a lower reporting limit, so they used the 20 ug/L suggested by the laboratory."

Thus, the observations reported by Duke Energy's laboratory as nondetect (with the 20 ug/L quantitation limit) used an artificially high quantitation limit. In laboratory analyses of other samples from Miami Fort Station, both EPA and Duke Energy demonstrated much lower quantitation limits were achievable by the analytical laboratories.

Additionally, EPA notes that the numeric limitations for FGD wastewater have been revised upward for the final rule based on the additional data received since proposal. The data received from Duke Energy for the Miami Fort Station, along with other data EPA received as a result of public comments, were evaluated and, as appropriate, used to calculate the effluent limitations for the final rule. See the Statistical Support Document for Effluent Limitations for EPA's evaluation of the data for Miami Fort and how these data compare to the effluent limitations for the final rule. Also see Section 13 of the TDD.

EPA notes that, in their comments on the proposed rule, Duke Energy stated that the plants operating chemical precipitation treatment systems that were used as the basis for calculating effluent limitations were operating the technologies at a level needed to comply with the effluent limitations in their NPDES permits and they were not optimizing the treatment technology to maximize pollutant removals. EPA further notes that the arsenic and mercury limits in the final ELGs are based on the performance of chemical precipitation technology, and that the biological treatment stage of the BAT technology would provide additional removal of mercury and arsenic. See the Statistical Support Document for Effluent Limitations for additional information.

Regarding the capability of commercial laboratories to achieve detection limits below the effluent limits, see responses to DCN EPA-HQ-OW-2009-0819-4305-A3, Excerpt Numbers 65, 66, and 67 (in comment codes 26.d and 32). Also see the Statistical Support Document for Effluent Limitations and Section 13 of the TDD.

Commenter Name: Paul Chu
Commenter Affiliation: Electric Power Research Institute (EPRI)
Document Control Number: EPA-HQ-OW-2009-0819-4499-A1
Comment Excerpt Number: 56
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

5.5 Chemical precipitation removed little or no dissolved arsenic, based on the BAT data set EPA used to establish numeric limits. BAT evaluation criteria were not met because influent dissolved arsenic levels were below the proposed limits and thus were too low to evaluate removal.

The primary source of arsenic in FGD wastewater is coal burned at the facility. The arsenic content of coal varies by specific coal type and varies within coal seams. As facilities use coals of varying arsenic content, the resulting FGD wastewater influent total and dissolved arsenic levels will vary.

Total arsenic includes both dissolved and particulate forms, and arsenic removal in FGD wastewater treatment plants is strongly affected by the amount of dissolved, as compared with particulate, arsenic present. Particulate arsenic can be removed by using physical methods such as settling or filtration. This removal can be enhanced by coagulation/flocculation processes and the addition of a coagulant such as ferric chloride. Dissolved arsenic can be more difficult to remove than particulate arsenic.

EPA's evaluation of BAT for arsenic removal does not accurately represent the range of influent dissolved arsenic levels within the industry. In the proposed Effluent Guidelines, EPA states that one of the criteria used to select data as the basis for the limitations and standards is as follows:

"A second criterion generally requires that influents and effluents from the treatment components represent typical wastewater from the industry …" [EPA, 2013, page 34486]

The influent dissolved arsenic levels present at BAT sites are low compared to those in data reported by facilities in the ICR or collected by EPRI as part of past studies. Figure 5-10 shows a range of influent dissolved arsenic levels in FGD wastewater from an EPRI characterization study [EPRI, 2008]. The sites where EPA collected samples showed low influent dissolved arsenic, often in the single-digit ppb range. Sites with high influent dissolved arsenic may have more difficulty in achieving the proposed limits set by the ELG for arsenic in FGD wastewater.

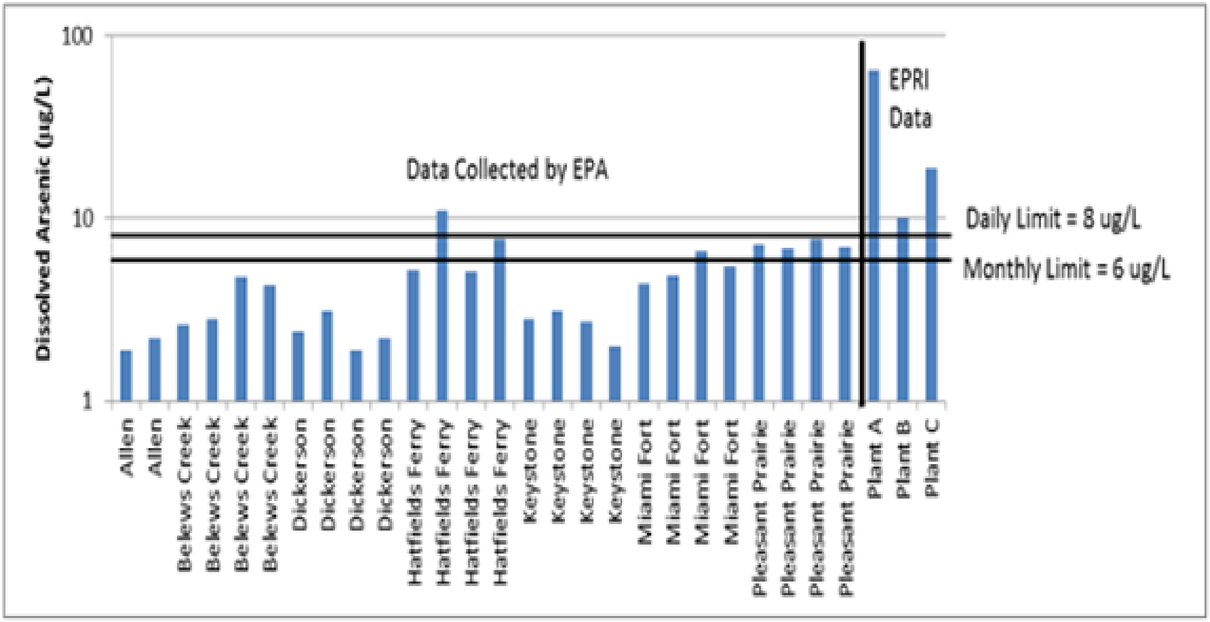


Figure 5-10
Range of FGD Wastewater Influent Dissolved Arsenic Levels

Source: EPRI, 2008; EPA, 2012a – EPA 2012g

At the BAT sites evaluated by EPA for chemical precipitation technology (Hatfield's Ferry, Keystone, and Miami Fort), effluent dissolved arsenic was not present at high enough levels to evaluate treatment effectiveness. In the ELG, EPA states that one of the criteria used to select data as the basis for the limitations and standards is as follows:

"A third criterion typically ensures that the pollutants are present in the influent at sufficient concentrations to evaluate treatment effectiveness." [EPA, 2013, page 34486]

Figure 5-11 shows that influent dissolved arsenic levels are at such low levels—below the proposed limits of 6 µg/L (monthly average) and 8 µg/L (daily maximum) in most instances—that they did not meet this criterion. Moreover, the influent and were similar to effluent total and dissolved arsenic levels for the BAT sites evaluated by EPA. This result demonstrates that influent dissolved arsenic generally was not removed by the chemical precipitation technology. Moreover, the influent and effluent total and dissolved arsenic levels were similar for the BAT sites evaluated by EPA, indicating that influent dissolved arsenic generally was not removed by the chemical precipitation technology.

One consequence of these findings is that sites with higher influent dissolved arsenic may not be able to meet the proposed limits by employing one-stage chemical precipitation. In addition, sites with typically low influent dissolved arsenic may not be able to meet the proposed limits during periods when their influent dissolved arsenic rises, without additional treatment beyond the one-stage chemical precipitation evaluated by EPA.

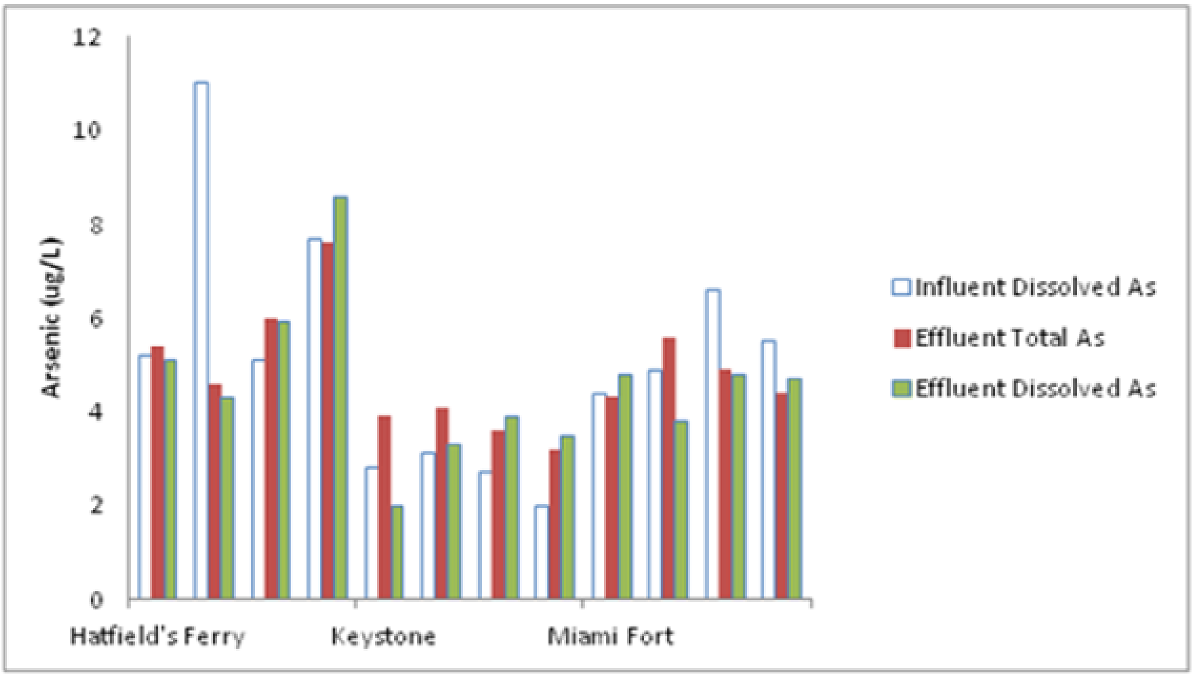


Figure 5-11
Comparison of Influent Dissolved Arsenic with Effluent Total and Dissolved Arsenic
Source: EPA, 2012a; EPA, 2012e; and EPA, 2012g

Comment Response:

EPA agrees with the commenter that fuel source and other operating conditions may affect the concentration and form of arsenic (particulate versus dissolved) in FGD wastewater, and that different treatment mechanisms are required to remove the particulate and dissolved forms of arsenic. However, EPA's chemical precipitation technology basis includes mechanisms to remove both forms of arsenic (i.e., precipitating dissolved arsenic into insoluble particulates that flocculate/coagulate into larger particles that are then removed by settling and/or filtration).

EPA disagrees with the commenter that the arsenic data used in development of the final effluent limitations and standards did not meet the data selection criteria. EPRI based their analysis on an evaluation of the concentrations of dissolved arsenic; however, the final rule regulates total recoverable arsenic. Thus, EPA's application of the data selection criteria to arsenic was based on the data for total recoverable arsenic, not dissolved arsenic. EPA notes that the total recoverable arsenic data met all the data selection criteria for use in development of effluent limitations and standards.

EPA disagrees with the commenter's assessment that "chemical precipitation removed little or no arsenic." The dissolved arsenic data in the FGD wastewater influent samples were at or near the quantitation limit and, therefore, it is difficult to quantify further removals of dissolved arsenic by the treatment system. However the data certainly do not indicate that dissolved arsenic was not removed. EPA notes that chemical precipitation involves converting soluble (dissolved) constituents to insoluble (particulate) forms. The precipitated solids are then removed from solution by coagulation/flocculation followed by sedimentation and filtration. Hydroxide precipitation (lime) is the predominant type of chemical precipitation used by the steam electric industry for FGD wastewater treatment. To enhance precipitation, the steam electric power generating industry commonly adds the chemical reagent ferric chloride to induce iron coprecipitation, whereby dissolved metals and metal hydroxides are enmeshed by iron precipitates, improving their removal. Some steam electric power plants use sulfide precipitation (organosulfide) in addition to hydroxide precipitation. The sulfide precipitation process can (for many metals) achieve lower effluent metals concentrations than hydroxide precipitation because metal sulfides often have lower solubility limits than metal hydroxides. EPA's chemical precipitation technology basis includes all of these forms of precipitation (hydroxide precipitation, iron coprecipitation, and sulfide precipitation). The solids separation components of EPA's technology basis include coagulation/flocculation (aggregation of particulates to form a floc), clarification (to settle the floc by gravity for removal), and gravity sand filtration (wastewater polishing to remove additional solids). Also, multiple stages of precipitation and solids separation can be used to remove multiple target metals that exhibit different minimum solubilities at different pH levels.

EPA agrees that influent arsenic concentrations are important considerations in the design and operation of chemical precipitation systems; however, EPA disagrees with the commenter's general characterization of such treatment as being "more difficult." Assuming proper chemical precipitation design and operation (e.g., chemical dosage, pH control, chemical mixing, chemical contact time, clarifier solids recirculation, clarifier overflow rate), effluent metals concentrations are independent of influent concentrations and instead depend on the metals present, precipitants used, the reaction conditions (especially pH), and the presence of other materials that may inhibit or enhance precipitation. This is supported by many commenters operating chemical precipitation systems to treat FGD wastewater; see response to DCN EPA-HQ-OW-2009-0819-4448-A1, Excerpt Number 24.

The commenter states that dissolved arsenic can be more difficult to remove than particulate arsenic. Although factual, the statement has no relevance, except perhaps to imply that dissolved arsenic cannot be removed – and EPA strongly disagrees with that. There is no question that particulates are more easily removed than dissolved pollutants because they can be removed merely by the settling and filtration processes. The dissolved pollutants must first be precipitated into insoluble particulates before they can be removed by settling and filtration, but as described above, EPA's BAT basis for the ELGs includes the necessary processes to accomplish this removal.

The commenter provided no data showing that dissolved arsenic (nor particulate arsenic, for that matter) cannot be removed by the BAT basis, especially when considering the removals achieved across both the chemical precipitation and biological treatment stages. The data in the record suggests that dissolved arsenic is typically present in FGD wastewater as arsenate (As(V)). Arsenate can easily be removed through precipitation with ferric chloride (i.e., iron coprecipitation). Although it has not been shown to be present in high concentrations in FGD wastewater, EPA evaluated the potential presence of a different form of arsenic, arsenite (As(III)), and whether it would affect the ability of plants to comply with the final limitations for arsenic. Arsenite is a soluble form of arsenic that generally must be oxidized in order to be precipitated. As part of this evaluation, EPA reviewed a paper prepared by Tom Higgins, of CH2MHill, which is a frequent consultant for the commenter. The paper, "Recent Applications of Meeting Compliance Challenges through Flue Gas Desulfurization (FGD) Wastewater," presented at the Power Plant Pollutant Control "MEGA" Symposium in Baltimore, MD, August 19-21, 2014, evaluated a pilot study conducted at the Indianapolis Power and Light Petersburg plant. Although the pilot study did not collect data for arsenic species, the author speculated that a portion of the arsenic present in the FGD wastewater "may also be present as arsenite (AsIII) and/or as more complex forms." Even so, the pilot test demonstrated the efficacy of the BAT technology, which includes both chemical precipitation and biological treatment, at removing arsenic. The paper concluded that "the ABMet® system offers additional As treatment. A variety of mechanisms of removal in the ABMet® columns could be responsible for removal, including filtration of particulate As, bioabsorption in the biomass, or potentially sulfide precipitation within the process. The specific mechanism was not investigated in the pilot study. All samples of ABMet® system effluent had As concentrations below the ELG limits for As." [Higgins, 2014].

Therefore, this pilot test demonstrates that the treatment system using chemical precipitation followed by biological treatment that is reflective of the BAT basis was able to meet the final effluent limitations. Additionally, if a plant were to determine that it had significantly higher levels of dissolved arsenite in its FGD wastewater, an oxidizing agent (e.g., bleach, hydrogen peroxide, potassium permanganate) could be added to the wastewater prior to the ferric chloride addition step, to oxidize the arsenite to arsenate. Although the data in the record indicates that such pretreatment would not be required, the cost of a chemical addition skid to add the oxidizing agent would be very small (approximately $30,000-$50,000), relative to the cost of the entire treatment system. The oxidizing agent would be added upstream of the reaction tanks to oxidize the arsenite prior to the precipitation/coprecipitation step; if necessary, a reducing agent (e.g., sodium bisulfite) can subsequently be added to the FGD wastewater prior to entering the biological system to ensure that all the oxidant has been consumed so bacterial population is not affected by the oxidants (equipment for adding sodium bisulfite is accounted for in EPA's analysis of compliance costs – see the Costs and Loads Report).

EPA notes that the commenter has not provided any information to indicate which plants could potentially need this additional treatment step.

Commenter Name: Cari Boyce
Commenter Affiliation: Duke Energy
Document Control Number: EPA-HQ-OW-2009-0819-4305-A3
Comment Excerpt Number: 40

External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

There are a number of engineering firms, equipment suppliers, and construction firms, located throughout the country, who have broad experience in designing and installing chemical precipitation systems and related process equipment for FGD wastewater. Duke Energy has worked with Sargent Lundy, Shaw (Division of Chicago Bridge Iron) and Babcock & Wilcox as primary Architectural Engineering firms for chemical precipitation systems. Technology providers have included; Infilco Degremont, Westech, Eimco, Siemens Water. Other firms, such as URS, Burns & McDonald, CH2M Hill, have provided consulting services to Duke Energy related to these systems and have capability to provide experienced engineering for chemical precipitation systems;. This resource availability is not true for the other technologies under consideration.

Comment Response:

EPA agrees there are many commercial firms with broad experience in designing and installing chemical precipitation systems for treating FGD wastewater.

Considering the context of the comment, EPA interprets the statement that "this resource availability is not true for the other technologies under consideration" to refer to biological treatment of FGD wastewater. See response to DCN EPA-HQ-OW-2009-0819-4607-A1, Excerpt Number 13, in comment code 10.a. Any of the engineering firms identified by the commenter would have the capability to install the treatment technology a plant selects, such as the BAT technology upon which the effluent limitations are based. In addition, there are at least three technology vendors actively marketing biological treatment systems to the power industry for removing selenium and nitrate-nitrite from FGD wastewater (Infilco Degremont, GE Water, and Frontier Water). Other technology vendors are developing non-biological treatment technologies for removing selenium in FGD wastewater, which if successful can be used in conjunction with traditional denitrification technology marketed by a number of vendors, including Veolia. Other technology solutions for complying with the ELGs are also available to plants, including evaporation technologies (e.g., Veolia, GE Water, Aquatech, and GEA), fixation technologies that mix FGD wastewater with fly ash and fixating agents to produce a solid material for landfill disposal (with no discharge of FGD wastewater), evaporating the purge from a wet scrubber in a dry FGD or spray dryer. As this shows, there are a number of potential compliance approaches available to the industry, and extensive engineering and treatment technology resources available to plants.

Commenter Name: Bruce W. Ramme
Commenter Affiliation: We Energies
Document Control Number: EPA-HQ-OW-2009-0819-4475-A1
Comment Excerpt Number: 34

External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Advantages of Chemical Precipitation Treatment

When We Energies went through the permitting process prior to building the Elm Road Generating Station, we submitted to the Wisconsin Department of Natural Resources an Engineering Report on the Selection of a Wastewater Treatment System for Mercury Removal (prepared by Bechtel Power Corporation dated October, 2004) to treat the FGD wastewater from the proposed new units. This submittal documented the evaluation of the alkali-sulfide precipitation treatment system, whether the proposed system was the best commercially available technology, and the capabilities, costs, and cost-effectiveness of any supplemental or "polishing" treatment technologies to remove additional mercury. Bechtel undertook an extensive evaluation of the technologies used to treat wet FGD wastewaters in use in the United States and abroad. Based on their survey of facilities treating wet FGD wastewaters, Bechtel concluded that alkali-sulfide precipitation is the predominant technology used to reduce mercury from FGD type effluents to the low parts per billion range. Bechtel was unaware of any other technology that has been commercially demonstrated to achieve greater mercury removal in FGD type effluents. Bechtel evaluated other treatment technologies used alone or in combination with alkali-sulfide precipitation to remove mercury from FGD effluent (e.g., granulated activated carbon adsorption, powdered activated carbon adsorption, ion exchange, membrane filtration); however these technologies are not commercially proven for this waste stream. Based on the technology review, Bechtel concluded that alkali-sulfide treatment was the most effective, commercially demonstrated technology for removing mercury from FGD effluents.

We Energies has installed and operated chemical precipitation treatment systems, utilizing alkali-sulfide reactions, to treat FGD wastewater at the Pleasant Prairie Power Plant ("Pleasant Prairie" or "PPPP") and the combined FGD wastewater from Oak Creek Power Plant and Elm Road Generating Station ("OCER"). Treatment at these sites consists of raising the pH with lime to reduce supersaturation of calcium sulfate (desaturation), which is removed along with influent suspended solids by settling in a primary clarifier. The effluent from the primary clarifier flows to an equalization tank, from where it is pumped through a series of mix tanks in which organosulfide, ferric chloride, hydrochloric acid, lime, and polymer are added to the wastewater. These chemicals react to precipitate mercury and other soluble metals and promote growth of the resulting particles (flocculation). These particles are then removed from the water in a secondary clarifier and a gravity media filter. Solids trapped in the filter are removed by backwashing with clean effluent, with the resulting dirty backwash water returned to the head of the plant for treatment. Sludge from the clarifiers is transferred to a sludge thickener, and the thickened sludge is dewatered using a plate and frame filter press.

Chemical precipitation using an alkali-sulfide process has a number of advantages including its ability to adjust chemical dosages to treat various influent concentrations and the predictability of the chemical reactions to treat the influent's metals concentrations. Chemical precipitation is effective in removing pollutants in a batch or continuous process, and the treatment process can be restarted quickly after an outage period of any duration. At PPPP, significant mercury, arsenic, and selenium reductions have been calculated (99.9, 95, and 78 percent removals, respectively) through treatment of FGD wastewater in the alkali-sulfide chemical precipitation wastewater treatment system.

Comment Response:

EPA agrees with the commenter regarding the advantages of the "alkali-sulfide" chemical precipitation system, which is why EPA has retained the hydroxide and sulfide chemical precipitation system as an important component of the chemical precipitation plus biological treatment technology basis applicable to FGD wastewater discharges for the final rule. However, chemical precipitation is not effective at removing selenium, nitrogen compounds, and certain metals that contribute to high concentrations of TDS in FGD wastewater. Accordingly, with respect to discharges of FGD wastewater, EPA rejected chemical precipitation, alone, as BAT or NSPS in favor of chemical precipitation followed by anaerobic/anoxic biological treatment and chemical precipitation followed by evaporation, respectively. See response to DCN EPA-HQ-OW-2009-0819-4633-A1, Excerpt Number 32, in comment code 9.

EPA notes that the regulations do not require facilities to implement the specific technologies that form the bases for the final rule, but only that the final effluent limitations and standards applicable to discharges from steam electric generating units be achieved. Plants may find that employing optimized chemical precipitation systems with enhanced solids separation technologies is an appropriate strategy for meeting the final limitations and standards.

Commenter Name: Paul Chu
Commenter Affiliation: Electric Power Research Institute (EPRI)
Document Control Number: EPA-HQ-OW-2009-0819-4499-A1
Comment Excerpt Number: 57
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

5.6 Dissolved arsenic removal depends on speciation. Plants with excess arsenite that fail to achieve proposed numeric limits using EPA's BAT will be out of compliance and/or face additional treatment costs.

Dissolved arsenic removal depends on the species of arsenic present in FGD wastewater. Inorganic arsenic is present as arsenite (As[III]) or arsenate (As[V]). Coagulation/filtration processes employed to treat wastewater in other industries may be optimized to remove dissolved inorganic arsenate from FGD water by adsorption on the ferric hydroxide precipitate. However, this optimization scenario has not been rigorously evaluated for FGD wastewaters. In this scenario, arsenite is not effectively removed because of its overall neutral charge under natural pH conditions. Therefore, pre-oxidation will likely be required if arsenic is present as arsenite. Table 5-1 displays EPRI data on the speciation of arsenic in FGD wastewater. The data show that arsenic typically appears as arsenate, but some arsenite is also observed.

Table 5-1
Arsenic Species Present in Influent FGD Wastewater

Arsenic Parameter	Plant 1 (µg/L)	Plant 2 (µg/L)	Plant 3 (µg/L)	Plant 4 (µg/L)
As(III)	ND (2.9)	ND (1.4)	1.26	0.22
AS(V)	46.4	7.89	2.78	4.89
MMA	ND (1.9)	ND (1.4)	ND (0.41)	0
DMA	ND (1.9)	ND (1.4)	ND (0.48)	3.85
Other arsenic	0	0	0	2.46

As(III) = arsenite
As(IV) = arsenate
MMA = monomethylarsenic acid
DMA = dimethylarsenic acid
ND = non-detect

Facilities that are unable to meet the proposed arsenic numeric limits will need to evaluate polishing technologies for arsenic treatment. These technologies have been extensively evaluated for drinking water applications, but have not been evaluated for FGD wastewaters. By omitting this treatment step, EPA has underestimated the costs of arsenic treatment. Examples of technologies that could remove dissolved arsenic include sorption and coagulation-assisted membrane filtration. Aluminum- or iron-based adsorptive media (such as granular ferric hydroxide) have been used extensively to remove arsenic from groundwater to ensure that drinking water meets a maximum contaminant limit of 10 µg/L arsenic. However, adsorptive media have not been extensively tested to treat FGD wastewater, which contains high amounts of other ions that could compete with arsenic removal.

Various technologies for treating arsenic in FGD wastewater should be researched to clarify their effectiveness and ease of implementation, as well as the implications for their use in the electric power industry. Facilities required to implement additional treatment would incur greater capital and operating costs. Adding these costs would further impact the cost-effectiveness assessment for meeting the proposed arsenic limits.

Comment Response:

The data presented by the commenter regarding the concentrations of arsenite in FGD wastewater are all extremely low concentrations that are substantially below the final effluent limitations and standards for arsenic. The commenter has not presented any data showing that any plants will actually have high arsenite levels that would require additional treatment, nor that the arsenic would not be removed by the BAT chemical precipitation plus biological treatment technology basis. EPA does not agree that facilities will need to evaluate additional polishing technologies for arsenic treatment. As such, EPA determined that it was not necessary to include any additional costs in its cost estimates. See response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 56.

Commenter Name: Betsy Natz
Commenter Affiliation: Institute of Clean Air Companies (ICAC)
Document Control Number: EPA-HQ-OW-2009-0819-4549-A1
Comment Excerpt Number: 4
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

FGD waste water chemistry is highly variable and can present considerable treatment challenges. Its composition is dependent on coal type, limestone, makeup water, upstream air pollution control equipment, and plant operations[6]. In light of this, ICAC has concerns regarding the limited number of waste water treatment systems, their scope, and performance data that the EPA used as a basis for the standards. Only (3) chemical precipitation systems, including Miami Fort, Keystone, and Hatfield's Ferry were used. These systems all represent plants that are geographically located in the Ohio River Valley, firing eastern bituminous coals, and likely using waters and limestone sourced from similar origins. Conversely, the EPA cited removal of Pleasant Prairie from their analysis since it was a two stage chemical precipitation. Yet, Pleasant Prairie inclusion would factor in performance and operational data from a plant using water and limestone sourced from the Great Lakes region and firing PRB coal. In addition, Pleasant Prairie is considered one of the more challenging FGD waste waters and has hosted a number industry sponsored pilot technology studies[7,8].

---

[6] http://wpca.info/pdf/presentations/Charlotte2013/2-Treatment%20Options%20for%20FGD%20Wastewater%20by%20Gordon%20Maller,%20URS.pdf

[7] CH2MHill, Final Report Prepared for WE Energies. *Evaluation of Treatment Technologies for Mercury Removal Pleasant Prairie Power Plant Pleasant Prairie, Wisconsin*, December 2008; EPA-HQ-OW-2008-0517-0231.1[1]

[8] EPA/EPRI Meeting, *EPRI Water Characterization and Treatment R&D Summary*, Washington DC, July 28, 2009; EPA-HQ-OW-2008-0517-0470.2[1]

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 53 regarding the use of the data from the Pleasant Prairie Power Plant. EPA included data from Pleasant Prairie in its analysis and calculation of effluent limitations for the final rule.

EPA selected the plants used to calculate the numeric limitations because they operate the BAT technology that serves as the basis for the final effluent limitations. Throughout this rulemaking, EPA has extensively evaluated differing plant characteristics and factors that may (or may not) affect those characteristics, as well as the characteristics and treatability of FGD wastewater. EPA determined that these plants are representative of the industry, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 124, in comment code 4.b, and DCN EPA-HQ-OW-2009-0819-4655-A2, Excerpt Number 20, in comment code 8.c, regarding the representativeness of the data.

See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 81, in comment code 8.c, regarding the geographic location of the data.

Commenter Name: Paul Chu
Commenter Affiliation: Electric Power Research Institute (EPRI)
Document Control Number: EPA-HQ-OW-2009-0819-4499-A1
Comment Excerpt Number: 131
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

In its engineering evaluation of the proposed limits [EPA, 2012a] EPA identifies instances where mercury limits were exceeded by the facilities evaluated for BAT. EPA states that those plants could meet the limits if they further optimized dosages of sulfides and chemical additives or installed an in-house mercury analyzer to monitor system performance on a daily basis [EPA, 2012a]. However, EPA did not determine how much mercury reduction would occur with optimization, nor did it demonstrate that optimization would reduce mercury in wastewater streams to levels below the proposed limits.

Mercury can be difficult to capture in a media filter like that used in the one-stage chemical precipitation process that EPA has established as BAT. Standard media filters typically capture particles only down to 5 to 10 microns in size. Mercury can be present in FGD water in small (colloidal) particulate sizes, well below 5 microns. Figure 5-4 shows the particle size distribution of mercury through various stages of a FGD water treatment system that includes the EPA's BAT-defined treatment (iron and organosulfide addition, clarification, and filtration) (EPRI, 2009). As shown, the mercury is not well removed, especially the portion in particulates less than 5 microns. For this facility, the final effluent was well above the proposed ELG limit of 119 µg/L.

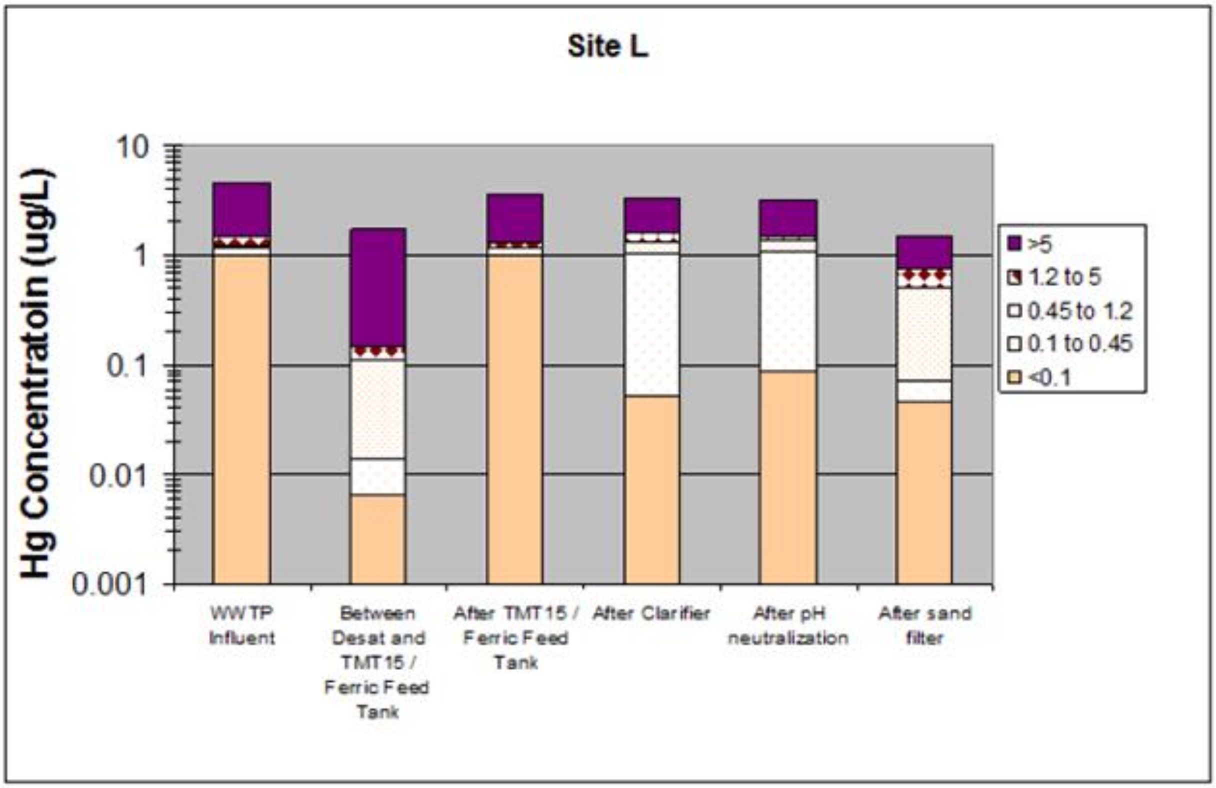


Figure 5-4
Mercury Particle Sizes throughout FGD Water Treatment
Source: EPRI, 2009.

Comment Response:

If a plant properly designs and actively operates its wastewater treatment system to achieve the long-term average for the chemical precipitation plus biological treatment BAT basis (rather than targeting performance at the effluent limitations themselves), it will be able to achieve stable, optimized pollutant removal performance and comply with the limitations. EPA acknowledges that variability around the long-term average occurs during normal operations. This variability means that plants may discharge at a level that is higher (or lower) than the long-term average. To allow for these normal variations, while also requiring that dischargers provide on-going control, EPA has established the daily maximum and monthly average limitations. EPA's allowance for reasonably anticipated variability in its effluent limitations, coupled with the availability of the upset defense, reasonably accommodates acceptable excursions. Any further excursion allowances would go beyond the reasonable accommodation of variability and would jeopardize the effective control of pollutant discharges on a consistent basis.

As described by the commenter, EPA has identified various approaches plants can use to improve their performance and achieve the limitations. EPA notes that its compliance cost estimates for the final rule includes costs for all required capital equipment and for active operation and maintenance (e.g., adequate staffing by trained personnel, frequent monitoring of treatment system operating conditions, and proper dosing of treatment system chemical additives).

The benefits of system optimization are also supported by other commenters operating chemical precipitation systems to treat FGD wastewater:

- Duke Energy (DCN EPA-HQ-OW-2009-0819-4305-A3, Excerpt Number 39): "The operation and performance of chemical precipitation systems for FGD water treatment is continuing to evolve and improve. The industry's current chemical precipitation system performance data does not accurately reflect optimized performance for TWPE calculations. The performance of the chemical precipitation treatment systems from which EPA's data relies were optimized to meet current facility NPDES permit requirements and may not reflect the system's maximum performance. For example, operating these systems at higher pH levels can increase the percentage of metal removal. Improved treatment chemicals, improved clarification and filtration can further increase removal percentages. If necessary, modifications to chemical precipitation systems towards optimizing removal of specific constituents, not currently permitted, can result in more effective treatment of FGD wastewater."
- Raven Power Holdings, LLC (DCN EPA-HQ-OW-2009-0819-4467-A1, Excerpt Number 21): "EPA's evaluation of chemical precipitation treatment and the demonstrated TWPE reduction was based on systems that were being operated to meet current NPDES permit requirements under existing ELG rules. These systems were not being operated in an attempt to demonstrate maximum practicable chemical precipitation treatment technology performance."

EPA notes that, as applied to discharges of FGD wastewater, the final effluent limitations for arsenic and mercury were transferred from limitations developed using the chemical precipitation technology option. However, chemical precipitation is only the first step in the biological treatment technology selected for the final rule. EPA's data demonstrate that the biological treatment stage provides pollutant removals for mercury (and other pollutants of concern with similar removal mechanisms) in addition to the pollutant removals that occur in the chemical precipitation stage of the biological treatment technology option. Thus, plants employing and optimally operating all components of the biological treatment technology option (including adding organosulfide to achieve sulfide precipitation) should achieve pollutant removals for arsenic and mercury (and other pollutants with similar removal mechanisms) that are equal to or even greater than the removals based on chemical precipitation technology alone. See the Statistical Support Document for Effluent Limitations for additional information.

EPA did not quantify the additional amount of arsenic and mercury (and other pollutants with similar removal mechanisms) reduction that could be achieved at the plants used to calculate the limitations; instead, EPA used existing data to calculate the limitations. By optimizing their treatment processes to target effluent concentrations at the long-term average of the BAT basis, the plants would benefit by both lowering the overall (i.e., long term average) effluent concentrations for the effluent and reducing the variability observed in the existing data. Both results would ensure the plants can meet the daily maximum and monthly average effluent limitations. The data in the record (e.g., for AEP's Mountaineer plant), as well as comments submitted by industry, clearly demonstrate that most (if not all) plants have not yet optimized their treatment system performance and would achieve lower effluent concentrations if they were to do so. See Duke Energy's description of how they improved the mercury removal at their Miami Fort, DCN EPA-HQ-OW-2009-0819-4305-A3. Also see the Statistical Support Document for Effluent Limitations.

Commenter Name: Cari Boyce
Commenter Affiliation: Duke Energy
Document Control Number: EPA-HQ-OW-2009-0819-4305-A3
Comment Excerpt Number: 39
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

The operation and performance of chemical precipitation systems for FGD water treatment is continuing to evolve and improve. The industry's current chemical precipitation system performance data does not accurately reflect optimized performance for TWPE calculations. The performance of the chemical precipitation treatment systems from which EPA's data relies were optimized to meet current facility NPDES permit requirements and may not reflect the system's maximum performance. For example, operating these systems at higher pH levels can increase the percentage of metal removal. Improved treatment chemicals, improved clarification and filtration can further increase removal percentages. If necessary, modifications to chemical precipitation systems towards optimizing removal of specific constituents, not currently permitted, can result in more effective treatment of FGD wastewater. The same cannot be said for biological treatment. As an example, Miami Fort has implemented several improvements to their chemical precipitation process to improve mercury removal. Increasing pH from initial startup settings, adding coagulants, and organosulfide metal precipitants have led in favorable results. Polymer delivery systems have been modified and the baffling inside the clarifier have also been changed to improve solids settling and reduce the Total Suspended Solids (TSS).

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4467-A1, Excerpt Number 21 regarding optimization of chemical precipitation treatment of FGD wastewater.

EPA's effluent limitations for chemical precipitation followed by anaerobic/anoxic biological treatment are based on the current performance of plants operating these systems to control FGD wastewater pollutants of concern, and do not take into account any increases in performance that may or may not result from future process optimization.

If a plant properly designs and actively operates its wastewater treatment system to achieve the long-term average for the technology basis (rather than targeting performance at the effluent limitations themselves), it will be able to achieve stable, optimized pollutant removal performance and comply with the limitations.

EPA disagrees with the commenter's assertion that the biological treatment system cannot be optimized through modifications to the system. The chemical precipitation system can be optimized to improve performance across the biological system. For example, reducing agents can be added to the chemical precipitation system to remove any free oxidants present, the pH of the wastewater can be adjusted to the optimal pH for the microorganisms. There are nutrient dosages that can be adjusted to for the system and the wastewater temperature could be controlled to using heat exchangers or buildings to keep the wastewater at optimal temperature for the biological system. In addition, effective bed contact time is an extremely important parameter to ensure there is sufficient opportunity (e.g., residence time at the appropriate ORP levels) for effective removal of nitrate-nitrite and selenium. Other optimization considerations include the frequency and duration of degassing and backwash cycles.

Commenter Name: John W. Myers
Commenter Affiliation: Tennessee Valley Authority (TVA)
Document Control Number: EPA-HQ-OW-2009-0819-4607-A1
Comment Excerpt Number: 18
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

d. Proposed Arsenic Limits Have Not Been Demonstrated to be Achievable with High Concentration Soluble Arsenic Influents

As indicated previously, the proposed FGD ELG numerical limits for arsenic are based on three plants with chemical precipitation treatment systems (i.e., Hatfield's Ferry, Keystone, and Miami Fort). The proposed arsenic limits of 6 micrograms per liter (µg/L) monthly average and 8 µg/L daily maximum are very low concentrations. This is due to the fact that the FGD samples utilized by EPA to derive these limits did not have a significant level of dissolved arsenic prior to treatment. An analysis of the arsenic in the 'treated' effluent indicates that the total levels are nearly identical to the level of dissolved arsenic in the influent. This indicates that very little treatment occurred in the systems evaluated. In fact, dissolved arsenic influent levels higher than the proposed ELG limits are typical for many existing FGDs and the use of these non-representative values resulted in overly stringent limits which may be unachievable. If the treatment method is not effective in reliably achieving the proposed arsenic limit, it should not be considered BAT.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 56 and DCN EPA-HQ-OW-2009-0819-4448-A1, Excerpt Number 24. EPA notes the commenter did not provide data supporting the assertion that influent wastewater contains high concentrations of dissolved arsenic, nor that any dissolved arsenic that may be present would not be removed by the chemical precipitation plus biological treatment BAT basis to the level necessary to comply with the final rule. EPA's analysis shows that plants will be able to comply with the effluent limitations in the final rule.

Commenter Name: Tom DeLawrence
Commenter Affiliation: Public Service Company of New Hampshire(PSNH)
Document Control Number: EPA-HQ-OW-2009-0819-4633-A1
Comment Excerpt Number: 34
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

PSNH has experience at Merrimack Station of positive and efficient results utilizing its stand-alone physical/chemical system. Both the physical/chemical and polishing systems installed by PSNH at Merrimack Station use unit processes that are standard in the water and waste water treatment industry with a long history of successful operation. Operation and maintenance of these systems is accomplished by trained, experienced individuals. The process is suited for the reduction of suspended solids and dissolved solids, including metals, which are present in FGD waste water. EPA itself has recognized the efficiency and success of this technology. See EPA's Steam Electric Power Generating Point Source Category: Final Detailed Study Report, EPA 821-R-09-008 at 4-50 (Oct. 2009)[16] (noting that the "data show that chemical precipitation is an effective means for removing many metals from the FGD wastewater").

16 Available here: http://water.epa.gov/lawsregs/guidance/cwa/304m/archive/upload/2009_10_26_guide_steam_finalreport-2.pdf.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4633-A1, Excerpt Number 32, in comment code 9.

EPA notes that this plant does not rely entirely on chemical precipitation to treat its FGD wastewater and has installed an evaporation stage to treat the effluent from chemical precipitation.

Commenter Name: Cari Boyce
Commenter Affiliation: Duke Energy
Document Control Number: EPA-HQ-OW-2009-0819-4305-A3

Comment Excerpt Number: 38
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Chemical precipitation systems, as included in Option 1, are a cost-effective reliable technology that can be employed across all geographical regions and under different operating scenarios. Specifically, these systems can be designed, and are proven, to operate over a wide range of fuel types, fuel additives, operating temperatures, and chloride concentrations. As an example, Duke Energy's Allen, and Belews Creek Steam Stations in North Carolina, Cayuga Generating Station in Indiana and Miami Fort Generating Station in Ohio burn different types of coal, have different scrubber operations and all use a chemical precipitation system to effectively treat FGD wastewater. Chemical precipitation systems can reduce TWPE loading by over 90% from FGD wastewater and are active treatment systems that can effectively deal with variable water conditions.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4633-A1, Excerpt Number 32, in comment code 9.

EPA agrees that chemical precipitation can effectively treat a number of the pollutants present in FGD wastewater and can accommodate the variability present in the untreated wastewater. Likewise, the technology can operate effectively in different geographic regions. However, EPA also determined that chemical precipitation, alone, does not represent BAT or NSPS for control of FGD wastewater discharges. See the preamble for the final ELGs and the TDD for more information. Additionally, EPA determined that the chemical precipitation plus biological treatment BAT basis can effectively remove pollutants (even more so than chemical precipitation alone) and can effectively operate in all geographic regions and under different operating scenarios.

Commenter Name: Pamela F. Faggert
Commenter Affiliation: Dominion Resources, Inc.
Document Control Number: EPA-HQ-OW-2009-0819-4631-A1
Comment Excerpt Number: 31
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

In addition, the "optimization strategies" for chemical precipitation referenced by EPA in determining the limits for arsenic and mercury are not detailed and have not been consistently demonstrated. For example, the existing chemical precipitation at Dominion's Chesterfield

Power station was not designed for the limits proposed by EPA and those limits are not part of the performance guarantee. It is uncertain if the existing plant can achieve the limits in the draft rule.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 131.

Specific to the chemical precipitation system operated at the Chesterfield Power station, while the system incorporates many of the components that form EPA's chemical precipitation technology option, EPA identified deficiencies in equipment components and operating conditions and estimated incremental costs required to upgrade the plant to achieve the effluent limitations.

Also see the TDD and the Statistical Support Document for Effluent Limitations.

Commenter Name: Cari Boyce
Commenter Affiliation: Duke Energy
Document Control Number: EPA-HQ-OW-2009-0819-4305-A3
Comment Excerpt Number: 36
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Duke Energy supports EPA's Option 1 in establishing chemical precipitation as the model technology for FGD wastewater, but disagrees with EPA's proposed flow minimization requirements required under this option. It is Duke Energy's belief that these flow minimizations are not achievable based on the metallurgy of the FGD system.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4633-A1, Excerpt Number 32, in comment code 9, regarding chemical precipitation as BAT for FGD wastewater.

See responses to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 102, in comment code 8, and DCN EPA-HQ-OW-2009-0819-4305-A3, Excerpt Number 64, in comment code 8, regarding FGD wastewater flow minimization.

Commenter Name: Cari Boyce
Commenter Affiliation: Duke Energy
Document Control Number: EPA-HQ-OW-2009-0819-4305-A3

Comment Excerpt Number: 33
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Duke Energy, however, disagrees with EPA's assessment of chemical precipitation and asserts that chemical precipitation has been demonstrated on an industry level to be a very effective treatment technology for FGD wastewater, removes the majority of constituents in FGD wastewater, and is readily available.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4633-A1, Excerpt Number 32, in comment code 9.

Commenter Name: Paul Chu
Commenter Affiliation: Electric Power Research Institute (EPRI)
Document Control Number: EPA-HQ-OW-2009-0819-4499-A1
Comment Excerpt Number: 14
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Chemical precipitation removed little or no dissolved arsenic, based on the BAT data set EPA used to establish numeric limits. BAT evaluation criteria were not met because influent dissolved arsenic levels were below the proposed limits and thus were too low to evaluate removal.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 56.

Commenter Name: Raven Power Holdings, LLC
Commenter Affiliation: Raven Power Holdings, LLC
Document Control Number: EPA-HQ-OW-2009-0819-4467-A1
Comment Excerpt Number: 10
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Raven Power supports Option 1 in establishing chemical precipitation as the model technology for FGD wastewater. This technology is well established across a diverse mix of geographical regions and fuel types within the industry and is shown to remove the majority of constituents within FGD wastewater.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4633-A1, Excerpt Number 32, in comment code 9.

9.b. FGD CP – Costs

Commenter Name: Paul Chu
Commenter Affiliation: Electric Power Research Institute (EPRI)
Document Control Number: EPA-HQ-OW-2009-0819-4499-A1
Comment Excerpt Number: 24
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

3.1.1*EPA underestimated the cost factors it used to create a chemical precipitation cost estimate for each individual plant. Cost factors more typical of an industry standard engineering estimate should be used.*

EPA mixed estimating methods by combining factors determined from facility data provided in the ICR with costs provided by vendors. A true bottoms-up approach for calculating total estimated capital cost of large, complex equipment, such as a chemical precipitation wastewater treatment system, would apply typical engineering factors to the purchased equipment cost received from vendors.

EPA used the following factors in the calculation of chemical precipitation costs obtained from the median values provided by facilities surveyed in the ICR, as defined by EPA in *Incremental Costs and Pollutant Removals for the Proposed Effluent Limitations Guidelines and Standards for the Steam Electric Generating Point Source Category* [EPA, 2013]:

- ***Site preparation:*** The costs associated with site clearing, demolition, grading, roads, walkways, and fences, 4%.
- ***Land:*** The cost for the purchase of all necessary property and survey fees, 0%. (EPA considered this factor, but did not add cost for it.)
- ***Engineering Contracts***: The cost for process design and general engineering, cost engineering, consulting fees, supervision and inspections, value redacted.
- ***Contingency***: The cost that may result from incomplete design, unforeseen and unpredictable conditions, or the complexities and uncertainties involved in cost estimating at a conceptual level, 0%. (EPA considered this factor, but did not add cost for it.)
- ***Construction:*** The cost for temporary construction offices, roads, communications, fencing, construction tools and equipment, permits, taxes and insurance, value redacted.

Although these factors were obtained from facilities that had provided installed costs of constructed systems, the factors were applied by EPA to vendor estimates.

The factors provided in Table 3-2 reflect industry standard practice and, therefore, should be used to calculate the total estimated cost of a chemical precipitation treatment system. EPRI applied these factors to the total purchased equipment cost to calculate a total estimated cost for a chemical precipitation treatment system. The values used are based on industry experience

[CH2M HILL, 2009] and standard engineering practice for all industrial sectors. These factors were used by EPRI to calculate a total estimated cost for each of the 116 plants included in the calculation of industry cost. By excluding these line item costs, EPA has underestimated the cost of treatment systems for each facility and accordingly, overall industry costs.

Table 3-2
Chemical Precipitation Cost Factors for EPRI Estimates

Additional Cost Items	Value Used (%)
Site work	4.0
Concrete	17.5
Piping	25.0
Miscellaneous metals, finishes	10.0
Mechanical, heating/ventilation/air conditioning	7.5
Process electrical and site electrical	22.0
Instrumentation and control	15.0
Subcontractor overhead	10.0
General contractor general conditions	12.5
Bonding and insurance	2.9
General contractor profit	14.3
Miscellaneous unidentified cost (contingency)	20.0
Engineering (design, services during construction, start-up, and operator training)	20.0

EPRI has reviewed the non-confidential business information (non-CBI) on the development of purchased equipment costs for chemical precipitation systems treating a range of wastewater flow rate, as supplied in the public docket [EPA, 2013], and generally agrees with EPA's approach. EPRI has taken a similar approach by obtaining vendor quotations for various flow rates for each major piece of equipment in order to develop cost curves. Using these cost curves, EPRI has generated a cost model for chemical precipitation treatment equipment similar to the model EPA created and described in *Incremental Costs and Pollutant Removals for the Proposed Effluent Limitations Guidelines and Standards for the Steam Electric Generating Point Source Category* [EPA, 2013]. The methodology EPRI used to create this cost model is described further in Appendix A-1.

According to the Association for the Advancement of Cost Engineering International (AACE) guidance, cost models based on definitive cost estimates and standard design information can be used for various facility or plant costs at the planning stage, and are often used for conceptual cost estimating [AACE International, 2011a], for Class 5 or Class 4 estimates. Costs developed from these curves are then generally factored to determine the overall capital cost of a project early on in the conceptual planning phase [AACE International, 2011b].

The cost estimate that EPRI prepared takes into account various cost factors, typically applied to engineering estimates, that EPA did not consider. Table 3-3 provides an example cost estimate for a 300 gpm system that includes these additional cost factors. The equipment costs are listed by subsystem. EPA's freight assumption of 4% is applied to the estimate. Installation is then added to the total purchased equipment cost, as well as the cost of a pre-engineered building (as in EPA's estimate). Various additional cost items are then added to the estimate (for example, site work, piping, mechanical/HVAC, instrumentation and controls [I&C], etc.). EPA excluded these additional cost items from their estimate, but they are real costs borne by the power plants to install these systems.

In its estimate, EPA [EPA, 2013] assumes the following: equipment installation, buildings, site preparation, land, engineering contracts, contingency, and construction. EPA estimated the percentage cost factors based on answers to question D6-3 of its ICR, using the median values calculated from ICR responses. The factors in the ICR are based on constructed costs of existing treatment plants and do not adequately cover the costs that should be added (for example, electrical, piping, I&C) when basing a cost estimate on vendor-supplied equipment costs. These factors from the ICR could be used to calculate total estimated costs if EPA were referencing equipment costs from the ICR responses. However, as noted above, EPA is mixing estimating methods by combining factors determined from facility data with costs provided by vendors. A true bottoms-up approach for calculating total estimated capital cost of a chemical precipitation wastewater treatment system would apply typical engineering factors to the purchased equipment cost. The factors provided in Table 3-2 and following the example provided in Table 3-3 should be used to calculate the total estimated cost of a chemical precipitation treatment system for each facility.

Table 3-3
Summary of EPRI's Estimated Chemical Precipitation Treatment System Capital Costs for 300 Gallons-per-Minute System

Cost Item	Chemical Precipitation Cost ($)
Process equipment by subsystem	
Equalization	1,140,000
Desaturation	820,000
Metals removal	48,000
Clarification	940,000
Neutralization	220,000
Filtration	360,000
Solids dewatering	1,400,000
Support equipment (pumps, waste sump)	170,000
Freight (4%) and taxes (0%)	204,000
Subtotal – Purchased Equipment Cost as Delivered	5,302,000
Installation	425,000
Additional cost items [a]	
Pre-engineered building [b]	3,750,000

Cost Item	Chemical Precipitation Cost ($)
Tie-in allowance [c]	130,000
Site work [d]	204,000
Piping	1,275,000
Mechanical/HVAC	382,000
I&C	765,000
Electrical	1,122,000
Concrete	892,000
Miscellaneous metals, finishes	510,000
Sub-total – Subcontractor Direct Cost	14,757,000
Subcontractor overhead and profit	1,476,000
Sub-total – Subcontractor Cost	16,233,000
General contractor general conditions [a]	2,029,000
Bonding and insurance [a]	463,000
Sub-total – Direct Costs	18,725,000
General contractor profit [a]	2,668,000
Subtotal	21,393,000
Miscellaneous unidentified cost (contingency) [a]	4,279,000
Subtotal – Estimated Construction Cost	25,672,000
Engineering (design, SDC, startup, and operator training) [a]	5,134,000
Permitting	83,000
Total Estimated Capital Cost ($M)	31
Total Estimated Capital Cost ($M) + 50%	47
Total Estimated Capital Cost ($M) – 30%	22

[a] See Table 3-2 for factors used to estimate these additional cost items.
[b] Pre-engineered building was estimated at 15,000 square feet (includes two floors) for a 300 gpm system. Building was assumed to accommodate an office, motor control center (MCC), chemicals storage, and dewatering equipment.
[c] Assumes wastewater tie-in piping of 2,000 linear feet installed above ground.
[d] Includes fencing, grading, roads, sidewalks, and similar items.
gpm = gallons per minute
$M = million dollars
HVAC = heating, ventilation, and air conditioning
I&C = instrumentation and controls
MCC = motor control center
SDC = services during construction

Comment Response:

EPA does not agree with the commenter's assertion that it is somehow inappropriate to use actual cost data from the Steam Electric Industry Survey to estimate the costs for installing/retrofitting equipment at power plants, and that such data are of lesser utility than generic cost factors that have been developed as rules of thumb for all types of industrial sectors.

EPA does agree that such engineering cost factors can often be used to provide a reasonable estimate of costs for capital projects; however, whenever industry-specific data are available they would generally be considered to be better predictors of the true cost for that industry or type of capital improvement. Where sufficient data for the steam electric industry were not available, EPA used engineering cost factors to ensure EPA considered and included all aspects of the equipment design, procurement and installation have been taken into account.

EPA does not agree with the commenter's statement that the Industry Survey data for various factors could be used only if EPA also used equipment costs from the Industry Survey, because the vendor quotes EPA obtained are essentially the purchased equipment costs that would be borne by the facility (i.e., the very cost that the commenter suggests the Survey data should be applied to).

Nevertheless, in response to this and other comments, EPA revisited the cost methodology to evaluate whether the vendor quotes and the direct and indirect cost factors include all items that should be included in the cost estimates. EPA agrees with the commenter that its direct and indirect capital cost factors for chemical precipitation of FGD wastewater should consider typical engineering factors in accordance with standard engineering practice when developing planning-level cost estimates. In response to this and other comments, EPA recalculated its direct and indirect capital cost factors for the final rule.

Direct capital cost factor

Direct capital costs include costs for equipment purchase and freight, installation, building, land, and site preparation.

Regarding equipment purchase costs derived from vendor estimates, EPA acknowledges the commenter's agreement with EPA's approach; therefore, differences among these costs do not warrant further discussion.

EPA reviewed its costing methodology for direct capital costs and determined that while estimated purchase costs for the proposed rule appropriately included purchase of equipment and all ancillary equipment such as piping, valves, and controllers, they did not account for instrumentation and controls needed for the combined system. To account for these estimated instrumentation and controls costs in the final rule, EPA developed an additional capital cost factor of 14% of purchased equipment costs, based on information provided in Peters and Timmerhaus' *Plant Design and Economics for Chemical Engineers*.

For purposes of comparison, EPA used information provided by the commenter in Table 3-3 to calculate a corresponding direct capital cost factor of 1.782 times the purchased equipment costs. EPA used information from its cost methodology to develop a comparison to the EPRI total direct capital cost factor and finds the values comparable. In fact, EPA's total direct capital cost factor is larger than the value provided by EPRI. Therefore, EPA considers that its direct capital costing methodology for the final rule reflects typical engineering factors as suggested by the commenter.

Cost Category	**Commenter's Cost Factor**
Installation Costs:	
Installation	0.08
Tie-In Allowances	0.025
Piping	0.24
Miscellaneous metals, finishes	0.096
Process & Site Electrical	0.212
Building Costs:	
Concrete	0.168
Mechanical, heating/ventilation/AC	0.072
Pre-Engineered Building	0.707
Land Costs	Not applicable
Site Work Costs	0.038
Instrumentation & Controls Costs	0.144
Total	**1.782**

Indirect capital cost factor

Indirect capital costs include costs for engineering, construction, other contractor's fees and contingency.

For the final rule, as recommended by the commenter, EPA derived its indirect capital cost factor from typical engineering factors. EPA developed an indirect capital cost factor of 0.43, which accounts for engineering and supervision, construction expenses, contractor's fee, and contingency, based on information provided in Peters and Timmerhaus' *Plant Design and Economics for Chemical Engineers.* See Section 6.1.6.10 (Indirect Capital Cost) of the *Incremental Costs and Pollutant Removals for the Final Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category* (Cost & Loads Report) (DCN SE05831/SE05832) for additional information.

Commenter Name: Paul Chu
Commenter Affiliation: Electric Power Research Institute (EPRI)

Document Control Number: EPA-HQ-OW-2009-0819-4499-A1
Comment Excerpt Number: 25
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

3.1.2 *EPA did not apply a contingency to this estimate. EPRI applied a 20 percent cost factor for miscellaneous unidentified costs (contingency).*

Using zero contingency for a conceptual planning-level estimate is not consistent with industry guidance. A contingency of at least 20 percent should be included in EPA's estimate.

A contingency is typically applied to all planning-level engineering cost estimates. A contingency can be defined as "an amount added to an estimate to allow for items, conditions, or events for which the state, occurrence, or effect is uncertain and that experience shows will likely result, in aggregate, in additional costs" [AACE International, 2013]. A contingency is applied to planning-level estimates to account for costs that are unknown—due to the lack of project definition at this conceptual design stage—but will be incurred during the project. A contingency is typically estimated using statistical analysis or judgment based on past project experience [AACE International, 2005]. It is a function of the level of project definition or design, and should decrease as the design progresses toward maturity. Because it is best practice in estimating, planning-level contingencies should be included in EPA's cost estimates. Examples of unidentified costs captured in the estimating approach of Table 3-2 include running yard piping to the treatment plant across creeks or buried utilities, or undertaking demolition to make room for treatment facilities. Thus, contingencies represent real costs and are based on an average estimate derived from significant previous experience.

AACE International Recommended Practice 18R-97 [AACE International, 2011a] provides guidelines that classify cost estimates and their relative accuracy. The accuracy of the cost estimate is generally a function of the amount of engineering completed at the time of the estimate. Following the AACE guidelines, Table 3-4 describes total installed cost estimates by class, level of accuracy, project definition (% complete), and typical contingency range [AACE International, 2005].

Table 3-4
Contingency, Based on AACE Recommended Practice

Estimate Class	Level of Accuracy (% of estimated cost)	Project Definition (%)	Typical Contingency Range[a] (%)
5	–50 to +100	0 to 2	30 to 35
4	–30 to +50	1 to 15	25 to 30
3	–20 to +30	10 to 40	20 to 25
2	–15 to +20	30 to 70	10 to 15
1	–10 to +20	50 to 100	5 to 10

Source: AACE International, 2005
[a] For wastewater treatment projects

EPRI considers the estimates for chemical precipitation treatment shown in Table 3-3 to be Class 4 estimates—generally defined as study- or feasibility-level estimates—of total installed costs. The purpose of a Class 4 estimate is to prepare for activities such as strategic planning. To prepare a Class 4 estimate, quotes should be obtained for major equipment items. However, according to AACE [AACE International, 2011a], Class 4 estimates can also be produced by using parametric models and even cost factoring [CH2M HILL, 2009].

According to *Incremental Costs and Pollutant Removals for the Proposed Effluent Limitations Guidelines and Standards for the Steam Electric Generating Point Source Category*, EPA states:

"To assess the need for contingency fees, EPA reviewed the responses to Question D6-3 of the Steam Electric Survey for each plant that completed this question specific to FGD wastewater chemical precipitation treatment. Based on this review, EPA determined that 90 percent of the plants reported either zero costs or did not report any costs for contingencies. EPA assumed that contingency costs for the remaining 10 percent of plants are site-specific and not representative of the industry. Accordingly, EPA assumed zero costs for contingencies." [EPA, 2013, page 6-63]

EPRI disagrees with EPA's conclusion that contingencies should be excluded from EPA's estimate because plants may have reported "zero" or not included costs under this line item in the ICR questionnaire. Respondents may not have included contingencies because those costs were already included in the installed costs quoted (since the facility construction was complete). Since EPA has prepared its estimate based on vendor quotations and cost curves for generic systems, this planning-level estimate should include a contingency appropriate for a Class 4 or Class 5 estimate. In the ICR questionnaire, EPA asked for costs of FGD wastewater treatment systems that were already built. Since EPA asked for real costs that are close to a Level 1 estimate, a contingency would likely not be part of the estimate or would play a relatively minor role, according to Table 3-4. EPA applied a zero contingency factor, which is more consistent with a Class I estimate, not a Class 4 or 5 estimate, which is what EPA has developed (because of the limited nature of definition/design work done). EPA applied its zero contingency factor to a screening-level estimate consistent with a Class 4 or 5 estimate obtained from vendor-provided equipment costs. As shown in Table 3-4, a Class 4 estimate typically has an applied contingency of 25 to 30 percent, according to AACE. A contingency of at least 20 percent should be included in EPA's estimate.

Comment Response:

EPA agrees with the commenter that its indirect capital cost factor for chemical precipitation treatment of FGD wastewater discharges should consider contingency in accordance with standard engineering practice when developing screening-level cost estimates. In response to this and other comments, EPA recalculated its indirect capital cost factors for the final rule to include contingency, based on information provided in Peters and Timmerhaus' *Plant Design and Economics for Chemical Engineers.* EPA notes that Peters and Timmerhaus recommends a contingency of about 10% of direct and indirect plant costs. See the response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 24, and Section 6.1.6.10 (Indirect Capital Cost) of the *Incremental Costs and Pollutant Removals for the Final Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category* (Cost & Loads Report) (DCN SE05831/SE05832) for additional information.

Commenter Name: Paul Chu
Commenter Affiliation: Electric Power Research Institute (EPRI)
Document Control Number: EPA-HQ-OW-2009-0819-4499-A1
Comment Excerpt Number: 26
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

3.1.3 *The mean—instead of the median—is statistically more appropriate and should be used as the capacity factor in estimating peak flow rate.*

Flow capacity is a key factor in the cost of many treatment components. Peak flow rate is the main consideration in sizing equipment, while average flow rate has a large impact on operating cost elements such as chemical feed, waste disposal, and electricity. EPRI used the ICR responses to question B5-2 (typical amount of FGD scrubber purge, or slurry discharge, sent to wastewater treatment or discharge) for the average flow rate estimate—assuming the plant operates 24 hours a day, 365 days a year. The average flow rate was then multiplied by a mean capacity factor. The mean capacity factor was calculated by taking the ratio of maximum design flow rate (responses to question D5-3 of the ICR) to typical flow rate (responses to question B5-2 of the ICR) at the 40 plants identified by EPA as operating FGD wastewater chemical precipitation treatment systems.

EPRI calculated the mean capacity factor for the 40 plants, while EPA calculated the median capacity factor. The median generally represents a "typical" value, so it is the best value to use to summarize a likely level, such as the best estimate for a single plant. The mean is simply a standardized sum, so it is the best value to use to represent an aggregate result, such as industry overall capital costs. An assessment of statistical measures was carried out by Dr. Dennis Helsel on behalf of EPRI. Dr. Helsel's conclusions and qualifications are included as Appendix C.

The EPRI-recommended method of using the mean capacity factor to estimate peak flow rate results in a 24 percent increase in total annualized cost of chemical treatment for the industry over EPA's method of using the median capacity factor.

Comment Response:

EPA disagrees with the commenter's recommendation to determine the capacity factor as the mean rather than the median ratio of maximum to typical flow rate. A review of the underlying dataset used to derive the capacity factor reveals that the dataset includes high outliers. These high outliers likely represent plants who have sized their treatment system to not only accommodate normal flow variation (costs appropriately ascribed to the effluent guidelines), but also future growth in plant generating capacity (costs not appropriately ascribed to the effluent guidelines). For example, both Dominion's Chesterfield plant and AEP's Cardinal plant indicated in their responses to Part B of the survey, that the FGD wastewater from planned FGD systems would be treated in the existing FGD wastewater treatment system. Therefore, a comparison of the maximum design flow rate for the system compared to the typical flow rate from only a subset of FGD systems that will ultimately contribute to the FGD wastewater treatment system flow results in an overestimation of the ratio for those plants. The overestimation for those plants would have a greater effect on the mean capacity factor than it would on the median capacity factor. The median is the best method to describe the middle of a set of data that includes outliers to ensure that the capacity factor accounts for normal flow variation only.

EPA notes that the mean is commonly used when a model for the data is assumed and statistical inferences about the mean are desired. However, when a single statistic is needed to describe a set of data, and no other modeling or inferences are desired, then the median should be used over the mean since it is robust to the presence of any extreme values (i.e., is less affected by such values) and always provides a good description of the central tendency of the data.

Commenter Name: Paul Chu
Commenter Affiliation: Electric Power Research Institute (EPRI)
Document Control Number: EPA-HQ-OW-2009-0819-4499-A1
Comment Excerpt Number: 29
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

3.1.6 *Instead of applying EPA's median sludge factor, EPRI used ICR-supplied total suspended solids values to directly calculate the cost of solids dewatering equipment. EPA's use of the median sludge factor, applied to the entire industry, is an indirect and likely less accurate approach.*

EPRI reviewed EPA's methods for sizing solids dewatering equipment. In EPRI's view, costs should be estimated using the influent solids loading calculated by using the influent total suspended solids (TSS) reported in question B5-3 of the ICR, which states:

"… provide the typical solids content of the untreated FGD scrubber purge (or slurry discharge) transferred to the wastewater treatment system after the FGD solids separation process but prior to comingling with other FGD wastewater."

Rather than applying a median sludge factor and assuming 11 percent solids in clarifier underflow for the entire industry, the ICR data provided by responding facilities should be used, since this is site-specific information. For facilities not providing ICR TSS values, the mean TSS calculated from actual ICR responses can be used to compute average solids loading. The peak solids loading is then 1.5 times the mean TSS (peak factor based on industry experience). The EPRI-recommended method of using influent TSS to calculate costs for solids dewatering equipment results in a 15 percent increase in total annualized cost for the industry over EPA's "sludge factor" method.

Comment Response:

EPA disagrees with the commenter's recommendation to size the solids dewatering equipment using a combination of plant-specific and imputed influent solids loading data rather than EPA's median sludge factor. While EPA's cost model does use some plant-specific information to estimate costs, mainly plant-level flow rate and identification of treatment systems in place, most of the cost estimates are based on model-type analyses using median values from the industry-provided survey data to create reasonable estimates of the costs. The use of the median sludge factor is no different. Additionally, EPA determined that only 57 percent of plants that incur FGD wastewater treatment system costs included the TSS data that EPRI used in its estimation. Thus, EPA is unable to use plant-specific information to generate costs when fewer than 60 percent of plants have provided the necessary data. Finally, EPA notes that, other than to suggest that EPA's estimate may be less accurate on a plant-specific basis than other possible (and more complex) cost estimation methods, the commenter has not provided any information or data showing that EPA's estimated costs for solids dewatering equipment are unreasonable.

Commenter Name: Paul Chu
Commenter Affiliation: Electric Power Research Institute (EPRI)
Document Control Number: EPA-HQ-OW-2009-0819-4499-A1
Comment Excerpt Number: 27
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

3.1.4 *Instead of the average flow rate used by EPA, the peak design flow rate or solids loading should be used to size all treatment equipment.*

In *Incremental Costs and Pollutant Removals for the Proposed Effluent Limitations Guidelines and Standards for the Steam Electric Generating Point Source Category* [EPA, 2013], EPA states that average flow rate was used to size tanks. EPRI used peak design flow rate or solids loading to size all treatment equipment. Peak flow rate is generally used to size treatment equipment to ensure that plant capacity is sufficient to handle the maximum flow rate scenario and to ensure compliance with the effluent limitations set for a facility without reducing generating capacity. It is standard industry practice to design subsystems for maximum flows, and appropriate redundancy, to assure that plant generating capacity is not limited by undersized equipment or a single-point equipment failure.

Comment Response:

The commenter mischaracterizes EPA's use of average plant flow rate in sizing the treatment system, including tanks. EPA sized the treatment system using maximum design flow rate (i.e., peak design flow rate), as recommended by the commenter. EPA calculated the maximum design flow rate for each plant by multiplying the plant-specific average flow rate by the capacity factor (capacity factor derived as described in response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 26). See Section 6.1.5 (Key Variables Used in the Capital and O&M Cost Methodologies) of the *Incremental Costs and Pollutant Removals for the Final Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category* (Cost & Loads Report) (DCN SE05831/SE05832) for additional information.

Commenter Name: Paul Chu
Commenter Affiliation: Electric Power Research Institute (EPRI)
Document Control Number: EPA-HQ-OW-2009-0819-4499-A1
Comment Excerpt Number: 104
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

A.1Cost Estimating Summary for Chemical Precipitation of Flue Gas Desulfurization Wastewater

A.1.1*Summary*

The Electric Power Research Institute (EPRI) estimated the cost of chemical precipitation (CP) treatment of flue gas desulfurization (FGD) wastewater to the steam electric industry. This technical memorandum describes the method for calculation of costs of chemical precipitation treatment for an individual plant, the assumptions associated with the cost calculations, and the estimated costs for chemical precipitation treatment to the steam electric industry. Table A-1 outlines the cost to the current industry to install chemical precipitation treatment of FGD wastewater.

Table A-1
Chemical Precipitation Treatment Costs to Industry for FGD Wastewater

Capital Costs ($M, mid-2010))	Operating Costs ($M per year, mid-2010)	Annualized Cost ($M per year, mid-2010)
5,070	130	609

Annualized cost based on 20-year equipment life and 7% interest rate.
$ = U.S. dollars
M = million

A.1.2 *Introduction*

The U.S. Environmental Protection Agency (EPA) is updating the Steam Electric Power Generating effluent limitation guidelines (ELGs) through a comprehensive information collection request (ICR) and sampling at FGD wastewater treatment systems. EPRI estimated the costs of three FGD wastewater treatment technologies in order to comment on EPA's draft ELG rule. The treatment technologies evaluated were (1) chemical precipitation, (2) biological, and (3) chemical precipitation with vapor-compression evaporation/atmospheric crystallization (CP + VCE). The technologies are discussed in separate Appendices A.1 through A.3. The cost evaluation results were extrapolated industry-wide.

A.1.3 *Chemical Precipitation Treatment Overview*

The chemical precipitation treatment system used to evaluate costs for the industry consists of equalization, desaturation, chemical addition to enhance metals removal, clarification, neutralization, media filtration, and solids dewatering. Figure A-1 shows a simplified process flow diagram of this chemical precipitation treatment system.

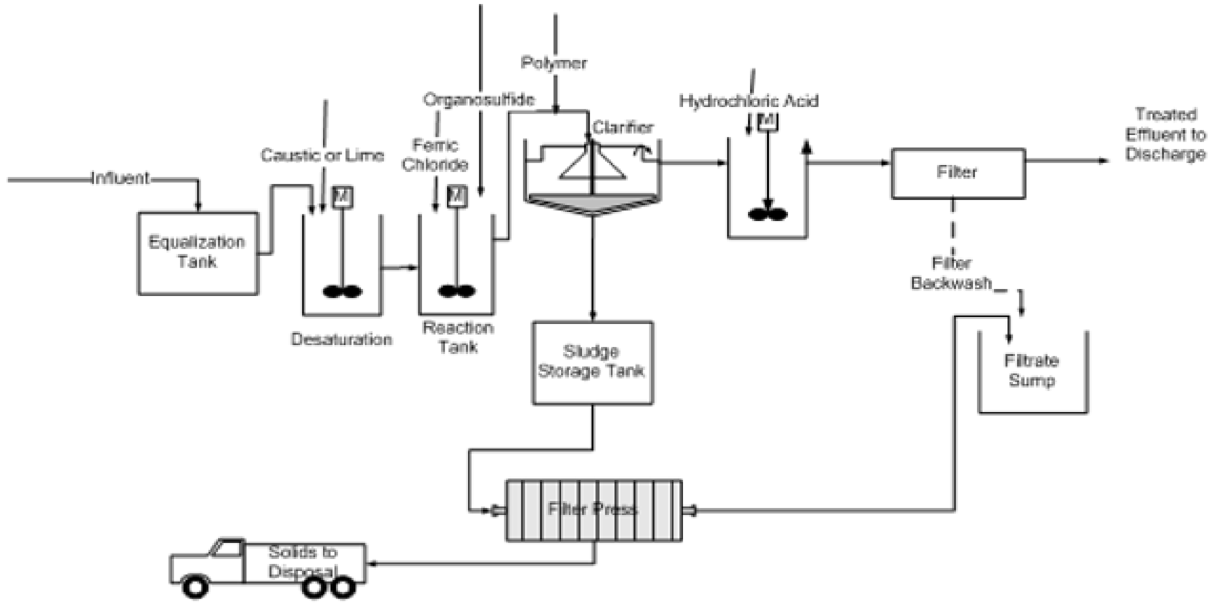


Figure A-1
Chemical Precipitation Treatment System

A.1.4 *Conceptual Design Basis*

The design basis for the cost estimate is described in this section.

A.1.4.1 Flow Rate Basis

Flow capacity is a key factor in the cost of many treatment components. Peak flow rate rate is the main consideration in sizing equipment. Average flow rate has a large impact on operating cost elements such as chemical feed, waste disposal, and electricity. EPRI used answers to question B5-2 of the ICR (typical amount of FGD scrubber purge [or slurry discharge] sent to wastewater treatment or discharge) for the average flow rate estimate, assuming the plant operates 24 hours per day, 365 days per year. The average flow rate was multiplied by a mean capacity factor—that was calculated by taking the ratio of maximum design flow rate (question D5-3 of the ICR) to typical flow rate (question B5-2 of the ICR) at the 41 plants identified by EPA as operating FGD wastewater chemical precipitation treatment systems—to develop the peak flow rate, and then by taking the mean of the plants' ratios. The peak flow rate was used to size all equipment to determine the capital cost of the equipment. Plants identified by EPA as having existing chemical precipitation were sized using the design flow rate provided in D5-3. The average flow rate was used to calculate the operations and maintenance (O&M) cost of operating the treatment system.

For those plants lacking average flow rate information from ICR question B5-2, flow rate was estimated using equation 4-1 from EPA's *Incremental Costs and Pollutant Removals for the Proposed Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category* [EPA, 2013] relating FGD wastewater flow rate to the amount of coal burned.

Capital costs cannot be calculated based on power plant size, expressed in megawatts (MW), because factors such as coal chloride concentration and water recycling play a large role in determining FGD water flow rate. Therefore, costs were calculated for a theoretical treatment plant based on flow rate.

A.1.4.2 Feed Water Quality Characteristics

Equipment is generally sized using peak flow rate. However, peak solids loading is used to size solids dewatering equipment and estimate solids disposal costs. EPRI estimated solids loading using influent total suspended solids (TSS) data from question B5-3 of the ICR (typical solids content of the untreated FGD scrubber purge [or slurry discharge] transferred to the wastewater treatment system after the FGD solids separation process but prior to comingling with other FGD wastewater). The mean TSS from the ICR data set for plants with less than 55,000 milligrams per liter (mg/L) TSS was 10,771 mg/L. If TSS data for a plant were not provided in the ICR, average influent TSS concentration was assumed to be 10,771 mg/L and peak influent TSS was assumed to be 1.5 times the mean, or 16,157 mg/L.

There were a total of seven facilities with TSS of 55,000 mg/L or higher, EPRI assumed that these facilities would likely employ a solids separation process upfront, rather than send this high loading of solids to a wastewater treatment plant where dewatering costs would be very high. EPRI assumed that four of the seven plants would use existing ponds for settling prior to treatment to achieve a peak and average TSS of 30 mg/L. EPRI further assumed that three of the seven plants would use mechanical dewatering in the FGD system to achieve average TSS of 10,771 mg/L and peak TSS of 16,157 mg/L.

EPRI assumed that corrosion-resistant materials were used for process equipment due to the high chloride levels typically present in FGD wastewater.

A.1.5 *Cost Development Methods*

A.1.5.1 Equipment Cost Assumptions

For each subsystem in the treatment train, a cost curve was developed as a function of a key variable affecting cost. The curves included the expected cost, based on the cost of the elements that made up the subsystems (for example, pumps, mixers, and tanks). The equipment in each subsystem and the design criteria used for equipment sizing are shown in Table A-2. The curves were built by developing cost estimates for equipment at seven different flow rates: 25, 50, 100, 200, 400, 600, and 800 gallons per minute (gpm). Costs were zero for a subsystem if it was not needed at a site.

EPRI compared the cost curves it generated with the available cost curves provided by EPA in the appendices of *Incremental Costs and Pollutant Removals for the Proposed Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category* [EPA, 2013]. EPRI also reviewed the available design assumptions presented in the appendices of this document. Costs were generally comparable between the EPRI and EPA estimates.

Table A-2
Equipment Cost Assumptions

Equipment	Design Criterion	Unit	Sizing
Equalization			
Equalization tank	Hydraulic detention time at peak flow rate. FRP tank with dip tube, baffles, and bridge for top-mounted mixer(s); top-entry mixer(s) made of material that resists chloride corrosion	hr	12
Equalization tank mixer(s)	Number and size of mixers based on professional judgment.	hp/1,000 gal	0.1
Desaturation			
Desaturation tank	Hydraulic detention time at daily peak flow rate	min	40
Desaturation tank mixer	Number and size of mixers based on professional judgment	hp/1,000 gal	1
Lime feed system: silo	Lime storage	days	15
Lime feed system: dry feeder	Dose	mg/L (chemical/ wastewater)	3,000
Metals Removal			
Organosulfide chemical feed system	Dosage based on industry experience	mg/L (chemical/ wastewater)	30
Solids Removal/ Clarification			
Reactor tank	Hydraulic detention time at peak flow rate Includes FRP tank with dip tube, baffles, and bridge for top-mounted mixer	min	20
Reactor tank mixer	Number and size of mixers based on professional judgment	hp/1,000 gal	1
Polyblend system	Dose	mg/L (chemical/ wastewater)	10
Ferric chloride feed pump system	Dose	mg/L (chemical/ wastewater)	100
Clarifier	Surface overflow rate Includes circular, steep floor, coated-steel clarifier; high-torque clarifier drive mechanism of stainless steel; picket fence floc mechanism	gpm/ft^2	0.33
Clarifier sludge pumps	Flow rate	gpm	50% of clarifier influent flow rate
Neutralization			
Acid feed system	Dose	mg/L (chemical/ wastewater)	20

Equipment	Design Criterion	Unit	Sizing
Reactor tank	Hydraulic detention time Includes FRP tank with dip tube and bridge for top-mounted mixer	min	20
Reactor tank mixer	Number and size of mixers based on professional judgment	hp/1,000 gal	1
Media Filtration			
Filter	Flow rate Continuous backwash filter	gpm	Equal to wastewater flow rate
Effluent tank	Hydraulic detention time	min	20
Solids Dewatering			
Sludge holding tank	Hydraulic detention time Includes FRP tank with bridge for top-entry mixer	hr	24
Sludge holding tank mixer		hp/1,000 gal	0.5
Filter press feed pump	Pump flow capacity Includes centrifugal type pump		Pump sized to fill press in 5 min
Filter press	Press size Includes chloride corrosion-resistant metallurgy feed piping and filter cloth wash tank		Press capacity sized so daily solids load can be dewatered in 8-hr operator shift, assuming each press cycle takes 2 hr
Support Equipment			
Waste sump	Based on best professional judgment	gal	6,000
Flushing pumps	Flow rate	gpm	Equal to wastewater flow rate
Seal water pumps	Flow rate	gpm	4% of wastewater flow rate

ft^2 = square feet
FRP = fiber reinforced plastic
gal = gallons
gpm = gallons per minute
hp = horsepower
hr = hours
L = liter
mg = milligram
min = minute
TSS = total suspended solids

A.1.6 *Capital Cost Assumptions*

A.1.6.1 Classification of Estimate

The capital costs presented in this estimate are based on total installed costs, which typically include:

- **Direct costs** – equipment, freight, taxes, field construction (buildings, site work, concrete foundation, piping, mechanical, electrical, and field instrumentation and controls), general conditions, and bonding
- **Indirect costs** – engineering, commissioning and start-up, contractor profit, and contingency for miscellaneous unidentified costs

The Association for the Advancement of Cost Engineering (AACE) International Recommended Practice 18R-97 [AACE International, 2011] provides guidelines classifying cost estimates and their relative accuracy. The accuracy of the cost estimate is generally a function of the amount of engineering completed at the time of the estimate. Table A-3 shows the class of total installed cost estimates, the relative accuracy, and the project definition percent complete for each estimate.

Table A-3
AACE Cost Estimating Guideline

Estimate Class	Level of Accuracy (% of estimated cost)	Project Definition (%)
5	–50 to +100	0 to 2
4	–30 to +50	1 to 15
3	–20 to +30	10 to 40
2	–15 to +20	30 to 70
1	–10 to +20	50 to 100

Source: AACE, 2011.

This memorandum presents Class 4 estimates, generally defined as study- or feasibility-level estimates, for total installed costs. The purpose of a Class 4 estimate is to prepare for activities such as strategic planning and alternate scheme analysis. To prepare a Class 4 estimate, quotes should be obtained for major equipment items; however, according to AACE 18R-97, these estimates can be produced with parametric models and even cost factoring [CH2M HILL, 2009]. Class 4 cost estimates are not for any specific plant, but for a hypothetical set of conditions.

These estimates were prepared to guide evaluation of the technology, and are based solely on the information available at the time of the estimate. Actual final costs will depend on the actual labor and material costs, competitive market conditions, site conditions, final project scope, implementation schedule, and other variable factors.

A.1.6.2 Cost Model Factors

System-wide cost factors were applied to develop the cost estimate (Table A-4). Values within the suggested ranges in Table A-4 are typically used in estimating costs of wastewater treatment plants. The mid-point of the suggested range for each cost factor was used to estimate costs for this evaluation unless noted otherwise.

Table A-4
Model Cost Factors

Additional Cost Items	Suggested Range (%)		Value Used (%)	Rationale for Selected Value
Site work	3.0	5.0	4.0	Mid-point of range
Concrete	15.0	20.0	17.5	Mid-point of range
Piping	6.0	8.0	25.0	Higher than range, assumes installation of high-grade alloy
Miscellaneous metals, finishes	5.0	15.0	10.0	Mid-point of range
Mechanical, heating/ventilation/air conditioning	5.0	10.0	7.5	Mid-point of range
Electrical (process electrical and site electrical)	14.0	30.0	22.0	Mid-point of range
Instrumentation and control	10.0	20.0	15.0	Mid-point of range
Subcontractor overhead	5.0	15.0	10.0	Mid-point of range
General contractor general conditions	11.0	14.0	12.5	Mid-point of range
Bonding and insurance	2.7	3.0	2.85	Mid-point of range
General contractor profit	14.1	14.4	14.25	Mid-point of range
Miscellaneous unidentified cost (contingency)	10.0	30.0	20.0	Mid-point of range
Engineering (design, services during construction, start-up, and operator training)	15.0	25.0	20.0	Mid-point of range

A.1.6.3 Major Assumptions

The following additional assumptions were made:

- Freight cost will be 4 percent of the installed equipment cost.
- Materials resistant to high chloride concentrations will be needed for treatment equipment.
- Costs are presented in June 2010 dollars. Construction Cost Index values, as published by Engineering News Record (ENR), were used to escalate costs to June 2010 pricing.
- Dewatering for construction is not required.
- The site is balanced cut/fill.

- Wastewater tie-in piping of 2,000 linear feet will be installed above ground.
- Seeding of disturbed areas is required.
- No painting of galvanized steel, aluminum, stainless steel, or polyvinyl chloride (PVC) material is required.
- Installation cost estimates are based on national averages.
- For all installation options, the sizes and quantities of all equipment were selected based on the system design redundancy. For example, the cost estimate for two trains at 100 percent capacity per train assumes that two tanks will be installed in parallel, both designed for 100 percent capacity. The only exception is filter presses used for dewatering; one spare filter press was assumed for all installation options.
- For all installation options, bulk chemical storage was provided, assuming 15 days of storage time at the design flow rate.
- No costs were included to account for cold weather protection for equipment installed outdoors (for example, heat tracing [except freeze protection for piping], insulation), installation of new utility services, new site development (for example, significant excavation), or installation in areas of limited footprint or remote locations involving delivery issues. These types of cost factors would increase cost estimates for the chemical precipitation treatment system.
- Project will be sales-tax exempt.
- Permitting costs are included.
- Costs of an on-site mercury analyzer are included [EPA, 2013].

A.1.7 *Operations and Maintenance Costs Assumptions*

A.1.7.1 Cost Elements

O&M requirements for this estimate include the following cost elements:

- Chemicals
- Electricity
- Residuals disposal
- Equipment maintenance
- Labor
- Compliance monitoring

A.1.7.2 Major Assumptions

The major assumptions used in calculating these estimated O&M costs were:

- Costs are presented in June 2010 dollars. Construction Cost Index values, as published by Engineering News Record (ENR), were used to escalate costs to June 2010 pricing.
- Labor: a total of 4 full-time equivalents (FTE) operators at $42/hour and 1 supervisor at $65/hour were assumed to staff the treatment plant. One additional FTE at $42/hour is assumed to operate solids dewatering.

- Dosage rates will be typical values. [Actual dosage rates could vary depending on FGD wastewater chemistry.] Costs will be [actual costs will vary by geography, delivery method, and chemical supplier]:
    - Lime – $0.07/lb
    - Ferric chloride (35%) – $1.55/gallon
    - Hydrochloric acid (30%) – $0.54/gallon
    - Polymer – $1.48/lb
    - Organosulfide – $9.31/gallon
- Treatment system operates 90% of the time.
- On-site mercury analyzer O&M costs are included [EPA, 2013].
- All solids will be Resource Conservation and Recovery Act (RCRA) nonhazardous solids with a disposal unit cost of $42.76 per dry ton. The disposal cost was developed as a weighted average using on-site and off-site disposal costs provided in *Incremental Costs and Pollutant Removals for the Proposed Effluent Limitations Guidelines and Standards for the Steam Electric Generating Point Source Category* [EPA, 2013]. EPRI assumed 75 percent of plants would use on-site disposal facilities at $40.41 per dry ton, and 25 percent of plants would use off-site disposal facilities at $49.82 per dry ton.
- Electrical costs will be $0.0405/kilowatt-hour (kWh), which is the unit cost provided in *Incremental Costs and Pollutant Removals for the Proposed Effluent Limitations Guidelines and Standards for the Steam Electric Generating Point Source Category* [EPA, 2013].
- Annual equipment maintenance costs will be 3.0 percent of the total equipment costs for the facility.
- The physical/chemical treatment system will operate 24 hours per day, year-round. It is estimated that the treatment system will be off-line 10 percent of the time, due to scheduled outages and other plant-related events.
- Compliance monitoring costs include costs for sampling and analysis of FGD wastewater effluent discharge.

A.1.8 *Example Cost Estimate*

The cost estimate for chemical precipitation treatment for an example system with peak design flow rate of 300 gallons per minute (gpm) and 2 x 100 percent redundancy is provided in the following subsections.

A.1.8.1 Capital Costs

An example worksheet that shows the total estimated capital costs for a 300-gpm chemical precipitation treatment system is provided in Table A-5. The estimate below assumes 1 percent solids in the treatment system influent. The equipment costs are based on cost quotes provided by the equipment vendors. The cost model factors shown in Table A-4 are added to the purchased equipment cost to obtain a total estimated capital cost for the system.

Table A-5
Summary of Estimated Chemical Precipitation Treatment System Capital Costs for a 300 Gallons-per-Minute System

Cost Element	Chemical Precipitation Treatment ($)
Process Equipment by Subsystem	
Equalization	1,140,000
Desaturation	820,000
Metals Removal	48,000
Clarification	940,000
Neutralization	220,000
Filtration	360,000
Solids Dewatering	1,400,000
Support Equipment (pumps, waste sump)	170,000
Freight (4%) and Taxes (0%)	204,000
Subtotal – Purchased Equipment Cost as Delivered	5,302,000
Installation	425,000
Additional cost items [a]	
Pre-engineered building [b]	3,750,000
Tie-in allowance [c]	130,000
Site work [d]	204,000
Piping	1,275,000
Mechanical/HVAC	382,000
I&C	765,000
Electrical	1,122,000
Concrete	892,000
Miscellaneous metals, finishes	510,000
Sub-total – Subcontractor Direct Cost	14,757,000
Subcontractor overhead and profit	1,476,000
Sub-total – Subcontractor Cost	16,233,000
General contractor general conditions [a]	2,029,000
Bonding and insurance [a]	463,000
Sub-total – Direct Costs	18,725,000
General contractor profit [a]	2,668,000
Subtotal	21,393,000
Miscellaneous unidentified cost (Contingency) [a]	4,279,000
Subtotal – Estimated Construction Cost	25,672,000
Engineering (design, SDC, startup, and operator training) [a]	5,134,000
Permitting	83,000
Total Estimated Capital Cost ($M)	31
Total Estimated Capital Cost ($M) +50%	47
Total Estimated Capital Cost ($M) –30%	22

Notes for Table A-5

[a] See Table A-4 for factors used to estimate these additional cost items.

[b] Pre-engineered building was estimated at 15,000 and 20,000 square feet (includes two floors) for 300 gpm and 600 gpm alternatives, respectively. Building was assumed to accommodate an office, motor control center (MCC), chemicals storage and dewatering equipment.

[c] Assumes wastewater tie-in piping of 2,000 linear feet installed above ground

[d] Includes fencing, grading, roads, sidewalks, and similar items.

gpm = gallons per minute

$ = U.S. dollars

M = million

HVAC = heating, ventilation, and air conditioning

I&C = instrumentation and controls

MCC = motor control center

SDC = services during construction

A.1.8.2 Operations and Maintenance Costs and Quantities

The total estimated O&M costs for chemical precipitation treatment for a 300-gpm chemical precipitation treatment system with 1 percent solids are provided in Table A-6.

Table A-6
Summary of Chemical Precipitation Treatment Annual Operations and Maintenance Costs for a 300-Gallons-per-Minute System

Cost Element	Quantity	Cost [a] ($ per year)	Assumptions
Electricity (megawatt hours per year) [a]	974	39,000	$0.0405 per kilowatt-hour
Residuals (dry tons per year) [a]	5,900	253,000	$42.76 per dry ton. All wastes are assumed to be RCRA nonhazardous solids.
Maintenance	-	138,000	3.0% of total installed equipment cost
Major chemicals [b]			
Hydrated lime (tons per year)	2,100	284,000	Hydrated lime: $0.07 per pound
Ferric chloride (35%) (gallons per year)	22,500	35,000	Ferric chloride (35%): $1.55 per gallon
Hydrochloric acid (30%) (gallons per year)	50,900	27,000	Hydrochloric acid (30%): $0.54 per gallon
Polymer (pounds per year)	5,300	8,000	Polymer: $1.48 per pound
Organosulfide (gallons per year)	1,600	15,000	Organosulfide: $9.31 per gallon
Labor (full-time equivalents)			
Operators	4	349,000	$42 per hour for operator
Dewatering	1	87,000	$42 per hour for operator
Supervisor	1	136,000	$42 per hour for supervisor
Compliance	-	58,500	
Total Estimated O&M Cost ($M per year)		**1.4**	

[a] On-line factor of 90% applied to annual O&M quantities to account for 10% annual downtime due to maintenance.
[b] Chemical costs are industry average and include an assumed national average freight. Chemical costs will vary depending on plant location and local chemical distributors.
RCRA = Resource Conservation and Recovery Act
O&M = operations and maintenance

A.1.8.3 Annualized Costs

Capital cost estimates (Table A-5) and O&M cost estimates (Table A-6) were used to calculate total annualized costs for chemical precipitation treatment. Capital costs were annualized assuming an equipment lifetime of 20 years and 7 percent interest rate. As an example, using these values, the annualized cost for a 300-gpm 2 x 100 percent redundancy system is $4.3 million per year.

A.1.9 *Industry Cost Extrapolation*

Costs were estimated for the current industry. Based on information from the "Steam Electric Survey" [ERG, 2012], EPA identified 116 plants discharging FGD wastewater (after excluding oil-fired units and units with a capacity of 50 MW or less). This value was used to extrapolate the total cost of chemical precipitation treatment to the current industry.

Current industry costs are based on a total of 116 plants. Since plant identifications were redacted, the following assumptions were used to attempt to recreate EPA's list of 116 plants:

- Included plants responding *Yes* or *No Answer* to Wet FGD systems in question D5-2
- Excluded plants with a capacity of 50 MW or less
- Excluded plants reporting in the ICR as retiring all FGD units prior to December 31, 2014
- Excluded plants reporting zero FGD wastewater discharge in current or planned industry profile
- Excluded plants that did not report a National Pollutant Discharge Elimination System (NPDES) permit
- Excluded plants that reported an evaporation pond

The conceptual design costs, such as those presented in Tables A-5 and A-6, were used to estimate costs for the plants described above. Capital, O&M, and annualized costs were calculated for each of the 116 plants, using cost estimating curves based on each plant's FGD flow rate and solids loading.

The following additional assumptions were made to estimate the cost of chemical precipitation treatment to the industry:

- Of the 116 plants identified for the industry extrapolation, plants that had chemical precipitation treatment or zero liquid discharge (ZLD) already installed in their facility were not included in the cost calculation. EPA identified 41 plants that had existing chemical precipitation systems; of those, 20 plants had an existing chemical precipitation, biological, or VCE treatment system that included each subsystem in Figure A-1. This evaluation assumed that those 20 plants would continue to use their existing treatment systems for settling and removal of FGD purge solids, so costs were not included for these systems.
- If a facility had a pond, it was assumed that the pond would be replaced by a chemical precipitation treatment system shown in Figure A-1. A total of 68 plants had FGD ponds as their only FGD wastewater treatment. The cost of pond closure was not included in this estimate.
- If a facility had a treatment system that did not include one of the components shown in Figure A-1 (for example, metals removal using organosulfide, media filter) only the cost of adding this equipment was included in the cost to the industry. Equipment required to achieve Best Available Technology Economically Acheivable (BAT) for each plant was determined using ICR questions D5-2 and B7-4. A total of 28 facilities did not have one or more subsystems shown in Figure A-1.
- This evaluation assumes a 2 x 100 percent redundancy for the industry.

Table A-7 summarizes chemical precipitation treatment costs to the current industry.

Table A-7
Chemical Precipitation Treatment Costs to Industry for FGD Wastewater

Capital Cost ($M)	Operations and Maintenance Cost ($M per year)	Annualized Cost ($M per year)
5,070	130	609

Annualized cost based on 20-year equipment life and 7% interest rate.
$ = U.S. dollars
M = million

Comment Response:

EPA reviewed the commenter's detailed cost methodologies and calculations. Although there are aspects of the commenter's cost methodologies/calculations with which EPA agrees and that are consistent with those used in EPA's estimates, EPA does not agree with certain aspects of the commenter's methodologies. The following is a list of the commenter's methodologies/calculations that differ from EPA's estimates and describes why EPA agrees or disagrees with the commenter's recommended approach.

- EPA acknowledges that the commenter's chemical precipitation treatment overview and design basis are generally similar to EPA's design. EPA also agrees with the commenter that "[equipment purchase] costs were generally comparable between EPRI and EPA estimates." One exception is equipment redundancy (discussed below).
- EPA disagrees with the commenter's flow rate basis for sizing the treatment system for the reasons discussed in response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 26.
- EPA disagrees with the commenter's cost methodology for solids dewatering equipment (and subsequent sludge disposal) for the reasons discussed in response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 29.
- EPA concludes that the commenter's derivation of direct and indirect capital cost factors, while different from EPA's approach, results in comparable cost factors as described in response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 24.
- EPA disagrees with the commenter's assumption that costs should be based on a completely redundant chemical precipitation system (i.e., 2 x 100% redundancy). While a certain degree of redundancy is appropriate and good engineering practice, and has been accounted for in EPA's cost estimates (see response to DCN EPA-HQ-OW-2009-0819-4448-A1, Excerpt Number 24), 100% redundancy for the entire system is not necessary, even if some companies/plants choose to include that amount of redundancy. Furthermore, EPA has not observed that degree of redundancy installed at plants that have already installed chemical precipitation and other treatment technologies.
- EPA notes differences in EPA's and EPRI's costing methodologies for solids disposal. The commenter estimated disposal costs using a weighted average disposal cost for all plants, based on an assumed percentage of plants using onsite- versus off-site disposal. EPA's methodology uses plant-specific information on current landfills to determine whether each plant will dispose of solids onsite or offsite. EPA considers its plant-

specific estimates, which result in higher costs than those estimated by the commenter, to be more accurate.
- Based on this comment, EPA reevaluated its chemical dosage rates and unit costs. For the final rule, EPA revised its chemical dosage rates to account for changes in the population of plants whose performance data were used to develop the arsenic and mercury limitations based on chemical precipitation treatment of FGD wastewater. EPA also updated its chemical unit costs based on additional vendor data. These revisions reduced EPA's estimated chemical costs to be closer to those estimated by the commenter.

Commenter Name: Paul Chu
Commenter Affiliation: Electric Power Research Institute (EPRI)
Document Control Number: EPA-HQ-OW-2009-0819-4499-A1
Comment Excerpt Number: 23
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

3 FGD WASTEWATER TREATMENT COSTS

EPA's costs are generally too low, as all the cost factors typical of these installations are not included to extraplotate from vendor equipment costs to total installed costs.

3.1 EPA underestimated the cost of chemical precipitation treatment for the industry. EPRI's annualized cost estimate is approximately twice as high as EPA's estimate.

Table 3-1 shows EPA's cost to the industry for chemical precipitation treatment, based on Table IX-3 in *Incremental Costs and Pollutant Removals for the Proposed Effluent Limitations Guidelines and Standards for the Steam Electric Generating Point Source Category* [EPA, 2013]. Table 3-1 also shows the cost to the industry calculated by EPRI.

The major differences between estimates made by EPA and EPRI include the following, each of which is discussed in more detail in the subsections below:

- EPA underestimated the cost factors used to calculate a total installed cost from the vendor estimates [EPA, 2013]. Standard industry practice for developing budgetary cost estimates uses cost factors that are more typical of an engineering estimate; these engineering cost factors should be used.

- A contingency for miscellaneous unidentified costs was not included by EPA. EPRI applied a 20% contingency to its estimate, which is standard industry practice.
- EPA's method of applying a median sludge factor to each plant to calculate the cost of solids dewatering equipment is an indirect approach and may lead to inaccuracies. A more direct and accurate approach would be to use the influent total suspended solids values supplied in EPA's Steam Electric Technical Questionnaire Database "Steam Electric Survey" [ERG, 2012] to calculate the cost of solids dewatering equipment.
- Use of the mean—instead of the median—is statistically more appropriate when applying capacity factors to calculate peak flow rate from average flow rate. The mean is statistically appropriate, as the flow rates are used to calculate plant-specific costs which are then summed to calculate an industry total.
- Use of the peak flow rate—instead of average flow rate—is more appropriate for sizing equipment. These systems must be designed to treat peak flow rates to assure that the plant can always meet full capacity on a continuous basis. Using peak flow rate is standard wastewater treatment design practice when sizing all treatment equipment to ensure compliance under all operating conditions.
- EPA's use of reduced FGD wastewater flow rates, calculated for plants with discharge flow rates greater than 1,000 gallons per minute (gpm), is likely to be incorrect. The evaluation EPA performed was incomplete and did not take into account additional costs beyond the cost of recycle conveyance.

Table 3-1
Chemical Precipitation Cost Comparison for the Industry, in Millions of Pre-Tax 2010 Dollars

	Capital Costs ($M, mid 2010)	Operating Costs ($M per year, mid 2010)	Annualized Cost ($M per year, mid 2010)
EPA (Regulatory Option 1)	1,450	194	331
EPRI	5,070	130	609

Assume 7% interest rate and 20-year life for annualized cost.
$ = U.S. dollars
M = million

Comment Response:

Specific concerns raised in the commenter's letter are addressed elsewhere in this response to comment document:

- Regarding the comment about chemical precipitation cost factors, see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 24.
- In response to this and other comments, EPA recalculated its indirect capital cost factors for the final rule to include contingency. See response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 25.

- EPA does not agree with the commenter's approach regarding the chemical precipitation sludge factor. See response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 29.
- Regarding chemical precipitation design capacity factor, EPA disagrees with the commenter's recommendation to determine the capacity factor as the mean rather than the median ratio of maximum to typical flow rate. See response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 26.
- The commenter mischaracterizes EPA's use of average plant flow rate in sizing the treatment system. See response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 27.
- Regarding the FGD wastewater flow reduction costs, see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 28, in comment code 8.

Commenter Name: Tom DeLawrence
Commenter Affiliation: PowerSouth Energy Cooperative
Document Control Number: EPA-HQ-OW-2009-0819-4460-A1
Comment Excerpt Number: 34
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

PowerSouth does not refute that physical/chemical treatment is a legally "available" technology for the industry. However, it contends that each of the following command a conclusion that physical/chemical treatment is not BAT for the industry: the onerous burden it would place on the industry to modify its current processes to comply with any such requirements, the capital, as well as annual operational and maintenance, dollars needed to build and operate required infrastructure that far exceed any expected additional environmental benefits, and the limited real estate available to many facilities to construct the necessary treatment systems. PowerSouth has preliminarily estimated in 2012 dollars that it would cost in excess of $51 million to install a physical/chemical treatment system at the Lowman Plant, with an annual increase in operational and maintenance costs of approximately $3 million. EPA's average estimated capital costs for the 116 facilities that would need to install this technology, on the other hand, is a mere $12.5 million (2010 $), with estimated, annual, operational and maintenance costs expected to average approximately $1.5 for these facilities.[5] See TDD at 9-28. In addition to the infrastructure EPA considered in its cost estimates, PowerSouth would likely need to construct a large water treatment building and lime storage silo, as well as possibly excavate and backfill an existing pond at the site due to the limited available real estate at the site (including the perceived inability to purchase land from adjacent property owners). PowerSouth's preliminary cost estimates provide some illustration of the deficiencies in EPA's cost analyses.

---

5 PowerSouth recognizes that these average costs are not expected to be distributed evenly to all 116 facilities and that actual costs will likely vary at each facility based on MW output and/or flow of the FGD waste stream, among other factors.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4463-A1, Excerpt Number 32, in comment code 9, regarding EPA's selection of BAT and NSPS applicable to discharges of FGD wastewater for the final rule.

EPA disagrees with the commenter that the final rule imposes an "onerous burden" on the industry. In accordance with the Clean Water Act, EPA determined that the costs of the final are affordable for the industry as a whole – i.e., the rule is economically achievable. See preamble sections VIII and IX and the RIA.

EPA disagrees with the commenter that the final rule imposes costs that that "far exceed any expected additional environmental benefits." See response to DCN EPA-HQ-OW-2009-0819-4464-A1, Excerpt Number 3.

The commenter's assertion that the Lowman plant has limited available real estate to construct necessary treatment systems is not supported by data the company submitted in its response to the *Questionnaire for the Steam Electric Power Generating Effluent Guidelines.* In their response to the Questionnaire, PowerSouth reported having a total of 480 acres at the Lowman plant. Of that total acreage, 206 acres were reported as developed and 120 acres were reported as unusable; thus, the remaining 154 acres of land would be available for siting the FGD wastewater treatment system. This available acreage is much larger than required for the treatment system, which has a footprint of several acres. (Note that the plant has an existing impoundment, which the commenter suggests would close and provide additional available acreage to the facility. The ELG does not require impoundments to dewater and close, but a plant may choose to do so on its own accord. Such costs would generally not be attributable to the ELGs.) EPA also more broadly evaluated whether other plants would likely incur land acquisition or development costs, not already accounted for by the site preparation costs included in EPA's cost estimates, to install/upgrade their wastewater treatment systems. EPA determined that would not be likely, based on survey data indicating that plants incurred zero or very little expense (approximately 1 percent of purchased equipment costs) associated with acquiring land for FGD wastewater treatment systems. EPA's determination regarding land requirements for FGD wastewater treatment also appears to be generally supported by commenters. For example, the Electric Power Research Institute's detailed Cost Estimating Summary for Chemical Precipitation of Flue Gas Desulfurization Wastewater (see Appendix A.1 of DCN EPA-HQ-OW-2009-0819-4499-A1) does not include estimated costs for acquiring land.

The commenter also suggests that EPA has significantly underestimated costs primarily due to site-specific conditions (e.g., large water treatment building, lime storage silo, excavate and backfill an existing pond). EPA notes that its cost estimates include costs for plants to install a lime storage silo(s) needed to store a 15-day supply of lime, and a cost factor to account for building costs.

Commenter Name: Tom DeLawrence
Commenter Affiliation: Public Service Company of New Hampshire(PSNH)
Document Control Number: EPA-HQ-OW-2009-0819-4633-A1
Comment Excerpt Number: 35
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

The capital costs for the physical/chemical system range from $19 to $21 million. O&M costs for the system are expected to be around $1.1 million. PSNH's numbers are the product of actual experience, engineering expertise, and site-specific knowledge.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4463-A1, Excerpt Number 32, in comment code 9, regarding EPA's selection of BAT and NSPS applicable to discharges of FGD wastewater for the final rule. EPA's cost estimates for any individual plant are a function of characteristics specific to that plant, including equipment the plant may already have in place since that factors into the determination of whether the plant needs to upgrade an existing system or replace the existing system outright. Other plant-specific factors include wastewater flow rates, whether treatment system residuals will be disposed of onsite or offsite, and other considerations. Thus, EPA's cost estimates are more precise than a one-size-fits-all approach. See the TDD and the Costs & Loads Report for additional information about EPA's cost methodology. EPA notes that, as discussed elsewhere in this Comment Response Document, EPA updated certain aspects of its cost methodologies in response to comments on the proposed rule.

Commenter Name: Thomas Cmar
Commenter Affiliation: Earthjustice, et al.
Document Control Number: EPA-HQ-OW-2009-0819-4684-A1
Comment Excerpt Number: 95
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

4. EPA's cost estimates for options 3a and 3b exclude the costs of complying with BPJ determinations.

The primary reason that EPA reaches such a low estimate of the costs of Options 3a and 3b is that the Agency has ignored costs for the installation of BAT for FGD wastewaters based on case-by-case determinations.[363] EPA included costs for only 66 facilities under Option 3a, and for only 80 facilities under Option 3b,[364] which is far fewer than the 117 facilities operating wet FGD systems.[365] In other words, for facilities where BAT for the FGD wastewater would be determined through a case-by-case BPJ determination, EPA assumes there would be no cost for compliance with the Clean Water Act's BAT requirement. However, this assumption is contrary to EPA's assertion elsewhere that BPJ determinations will reflect the wide range of innovative treatments for FGD wastewater, and encourage the development of more advanced technologies.[366] Nor does the record support EPA's assumption that there would be zero costs on the ground that these plants have already installed BAT technology based on a state BPJ determination. As discussed above, states have failed to impose BAT-based limits for toxic pollutants in the vast majority of power plant permits.[367]

If states are doing proper BPJ determinations, they will arrive at BAT determinations very similar to what EPA has proposed for FGD wastewater in Options 4 and 5—at costs in line with what EPA has calculated for those Options. Instead of assuming zero cost for units exempt from the ELGs and subject only to BPJ under Options 3a and 3b, EPA should include estimated costs for treatment based on the state BPJ determinations. If EPA opts not to include such estimated costs, it is an implicit admission that states could continue to neglect their duty to impose BAT-based limits on FGD wastewater in virtually every permit they issue.

---

[363] *See* ERG, Methodologies for Estimating Costs and Pollutant Removals for Steam Electric ELG Regulatory Options 3a and 3b, EPA-HQ-OW-2009-0819-2145.

[364] *Id.* Tables 1-1 & 2-1. There appears to be an error in either Table 1-1 or Table 2-1, as the difference between the number of facilities affected should be 17—the number of plants with more than 2,000 MW of wet-scrubbed capacity that would be subject to the ELGs under Option 3b, but not under 3a. Instead, the difference is only 14 plants, and the public portions of the memorandum provide no explanation for the discrepancy.

[365] 78 Fed. Reg. at 34,483.

[366] *Id.* at 34,460, 34,470.

[367] *See supra* Section I.C.

Comment Response:

The final rule does not require permitting authorities to perform site-specific BPJ determinations to establish BAT limitations for discharges of FGD wastewater for the reasons stated in preamble sections VIII.C. This rule instead establishes BAT limitations for FGD wastewater based on chemical precipitation followed by biological treatment, except for discharges of FGD wastewater from "small" or oil-fired generating units (see preamble Section VIII.C.12). The rule also establishes a voluntary incentives program with applicable BAT limitations for FGD wastewater based on chemical precipitation plus evaporation (see preamble section VIII.C.13). Consequently, the commenter's concerns have been resolved by the final rule.

Commenter Name: Chris M. Hobson
Commenter Affiliation: Southern Company
Document Control Number: EPA-HQ-OW-2009-0819-4379-A1
Comment Excerpt Number: 160
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

The chemical precipitation treatment system costs are based on removing the biological reactors and associated equipment from the Siemens conceptual design estimate for Plant Bowen. Removal of the bioreactors and associated equipment reduces the treatment costs by 50 percent.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4379-A1, Excerpt Number 128, in comment code 10.b.

9.c. FGD CP – Pollutant Loadings

Commenter Name: Elizabeth E. Aldridge, Hunton & Williams
Commenter Affiliation: UWAG
Document Control Number: EPA-HQ-OW-2009-0819-4655-A2
Comment Excerpt Number: 18
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

- Tables 10-3 and 10-4 of the TDD present the average effluent concentrations for FGD surface impoundments and one-stage chemical precipitation systems. The data in Table 10-3 and Table 10-4 show that the concentrations of boron, chloride and sulfate in the effluent wastewater increase after chemical precipitation. In a chemical precipitation wastewater treatment system, facilities add chemicals such as organosulfides and ferric chloride to the wastewater to remove metal pollutants (US EPA, 2013b, pg. 7-4). The addition of the chemicals to the treatment system may explain the increase in sulfate and chloride concentrations in the chemical precipitation effluent. However, increase in boron concentration in the effluent is not explained in the TDD document, and may not be representative. For example, at the Pleasant Prairie facility (ERG, 2012a, Table 4-4), total boron concentration decreased from 12,000 μg/L to 9,830 μg/L, following chemical precipitation of the FGD wastewater. Similarly, at the Belews Creek (ERG, 2012b) and Allen facilities (ERG, 2012c), dissolved selenium and mercury concentration in the effluent wastewater increase after chemical precipitation. Since such increases are not observed at other facilities (i.e., Pleasant Prairie, Big Bend) operating similar treatment technologies (ERG, 2012a; US EPA, 2009a), the data cited by US EPA may not be representative of the treatment technology performance. US EPA should specify the reasons for the observed increase in pollutant loadings after treatment using a chemical precipitation system and describe why the value selected are representative and appropriate to use in the ELG justification.

Comment Response:

EPA disagrees with the commenter's analysis of comparing the settling pond effluent concentrations to the chemical precipitation effluent concentrations and referring to any increases or decreases as representative of treatment across the chemical precipitation system. The settling pond effluent concentrations represent the projected effluent from an impoundment used to treat FGD wastewater. EPA's methodology used to estimate the settling pond effluent concentrations is described in Section 11.1.5.1 of the *Incremental Costs and Pollutant Removals for Final Effluent Limitation Guidelines and Standards for the Steam Electric Generating Point Source Category* report. These projected concentrations are used to represent the baseline discharges from plants that currently operate surface impoundments to treat FGD wastewater and are not representative of the influent to the chemical precipitation system. Plants operating chemical precipitation systems do not operate surface impoundments upstream of the chemical precipitation system. Therefore, a more accurate representation of the treatment effectiveness of the chemical precipitation system would be to compare the untreated FGD wastewater concentrations presented in Section 6.1 of the TDD to the chemical precipitation effluent concentrations presented in Section 10.2.1.2 of the TDD. Any comparison of the settling pond effluent to the chemical precipitation effluent would be a comparison of the performance of the two different treatment systems. However, this too is a flawed analysis because different sets of plants are used to generate the average concentrations for the two data sets. For example, for the final rule, EPA used eight plants to generate the settling pond effluent concentrations and four plants to generate the chemical precipitation effluent concentrations. The additional plants included in the settling pond effluent data set may have lower concentrations of certain pollutants compared to the plants included in the chemical precipitation analysis, which would drive down the average settling pond effluent concentrations and result in the perception that the chemical precipitation system does not result in any additional removals compared to the settling pond effluent. The issue of using different datasets was raised by this commenter in relation to EPA's FGD wastewater removal calculations, which EPA addressed for the final rule. See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 95, in comment code 10.c.

Commenter Name: Cari Boyce
Commenter Affiliation: Duke Energy
Document Control Number: EPA-HQ-OW-2009-0819-4305-A3
Comment Excerpt Number: 53
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

EPA only used data collected from the chemical precipitation effluent from Miami Fort, Keystone and Hatsfield Ferry to characterize and assess the performance of a chemical precipitation treatment system. Data, however, was collected from the chemical precipitation effluent at Belews Creek and Allen Steam Stations. EPA chose not to use this data because these systems do not add organosulfide to the treatment system. In EPA's view, these systems were not optimized. However, utilizing this data actually shows a lower average effluent concentration for chemical precipitation and thus, portrays better treatment performance. For example, EPA reported an average selenium effluent concentration of 455 ppb for chemical precipitation; however, if EPA were to include the data from Allen and Belews Creek, the average selenium effluent concentration would reduce to 381 ppb. This is virtually the same for all the constituents, except for mercury, which is expected, since Belews Creek and Allen do not use organosulfide to treat for mercury in the chemical precipitation system.

In addition, the concentrations of several of the constituents EPA's TWPE for a combined chemical precipitation and biological treatment system relied upon are significantly reduced when the chemical precipitation data from Allen and Belews Creek is included in the average (see Table 1-7 below). This clearly shows that if EPA were to include the average concentrations from the chemical precipitation systems at Belews Creek and Allen, the TWPE removal from a chemical precipitation system would greatly increase. The comparison of the chemical precipitation effluent average concentrations is provided in Appendix A, Table A-5.

Table 1-8. Chemical Precipitation Effluent: Comparison between EPA's Reported Average and the Average including Belews Creek and Allen Steam Stations

Analyte	EPA's Reported Average Chemical Precipitation Effluent (ppb)	Average Chemical Precipitation Effluent (including Belews Creek and Allen) (ppb)
Nitrate/Nitrite (as N)	67,300	36,973
Boron	279,000	179,161
Magnesium	3,340,000	1,597,167
Manganese	13,600	5,869
Selenium	455	381

Furthermore, EPA's characterization data misrepresents the performance of a chemical precipitation system. For EPA's sampling efforts, only samples collected from the FGD purge during the 4-day EPA sampling event were analyzed for dissolved metals and, thus, only used to calculate the "settled" effluent. Samples of the FGD purge were collected during the CWA 308 sampling event, but EPA chose not to have those samples analyzed for dissolved metals. EPA, however, used the data collected from the 4-day EPA sampling event, as well as the CWA 308 sampling event, to determine the average effluent concentration for chemical precipitation. By using only the data collected from the EPA 4-day sampling event, EPA's analysis does not account for the seasonal variability of the constituents in the FGD purge and unduly diminishes the treatment performance of a chemical precipitation system. This is evident upon examining the plant-specific average concentrations for each constituent. For example, the TWPE loading for selenium at Miami Fort increased by 73% across the chemical precipitation system when comparing the average "settled" effluent with the average chemical precipitation effluent. EPA may argue that little to no dissolved selenium is removed in the chemical precipitation system, but an increase of 73% clearly misrepresents the treatment system.

Duke Energy recommends EPA conduct their analysis for chemical precipitation, account for the artificial increase in constituents across the chemical precipitation system and include data collected from the chemical precipitation effluent from the other stations. Based on Duke Energy's experience, the revised analysis will show a significant increase in the TWPE removal for a chemical precipitation system and a lower incremental removal for biological treatment.

Comment Response:

Performance of Chemical Precipitation

Since proposal, as a result of public comments, EPA received additional data to use in its effluent limitations and standards development, pollutants of concern identification, and pollutant loadings estimates. These data increased both the size of EPA's dataset as well as the variety of plant operations represented within the dataset. See preamble section IV.3 and Section 3 of the TDD for additional information on the data sources used for the final rule. In addition, EPA has revised its cost estimates and pollutant reductions analyses in response to comments received on the proposed rule, see preamble sections IV.D and IV.F, respectively.

While EPA supplemented its dataset representing the performance of chemical precipitation for the final rule, including adding We Energies' Pleasant Prairie Power Plant, EPA did not include chemical precipitation performance data from the Belews Creek and Allen plants Stations as recommended by the commenter. EPA's rationale for excluding data from these two plants is that these plants do not operate the BAT basis for chemical precipitation and, therefore, their data cannot be used to represent its performance. Specifically, EPA's chemical precipitation technology basis includes multiple forms of precipitation – hydroxide precipitation, iron coprecipitation, and sulfide precipitation – and the Belews Creek and Allen plants do not perform sulfide precipitation. The sulfide precipitation process can (for many metals) achieve lower effluent metals concentrations than hydroxide precipitation because metal sulfides often have lower solubility limits than metal hydroxides (see a comparison of the solubilities of metal hydroxides and sulfides as a function of pH in Figure 6-2 of the *Incremental Costs and Pollutant Removals for the Final Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category* (Cost & Loads Report) (DCN SE05831/SE05832).

EPA disagrees with the commenter's arguments that data from the Belews Creek and Allen plants should be included because use of the data would "lower average effluent concentration for chemical precipitation" and because "the TWPE removal from a chemical precipitation system would greatly increase." EPA utilized rigorous data selection criteria as described in Section 13.1.1 of the TDD. EPA used representative data that met the quality criteria in its pollutant-specific treatment effectiveness analysis as described in Section 10.2.1.2 of the TDD.

Regarding the "artificial increase in constituents across the chemical precipitation system," see response to DCN EPA-HQ-OW-2009-0819-4655-A2, Excerpt Number 18.

Characterization of Effluent from FGD Surface Impoundments

EPA agrees with the commenter that it is preferable to derive baseline FGD wastewater concentrations from a data set which spans an extended period of time (e.g., accounts for seasonal variability), and EPA's practice is to use such data whenever available and whenever appropriate. For example, EPA updated the dataset used to develop the settling pond effluent concentrations to include those days where plants provided self-monitoring data that contained both total recoverable and dissolved metals concentrations for the same pollutant, as well as a TSS concentration. With those three data points (total recoverable metal, dissolved metal, and TSS concentrations), EPA was able to calculate a "settled" effluent concentration and used the data in its analysis. Without all three data points, EPA is unable to use the data in its settling pond effluent analysis. EPA notes that it collected additional self-monitoring data from all the plants included in the BAT analyses after proposal and, in most cases, the plants only provided total recoverable metals data (dissolved data were not provided); therefore, EPA was not able to incorporate the additional data into the settling pond effluent analysis. Therefore, EPA used the best available data in its analyses.

Commenter Name: Paul Chu
Commenter Affiliation: Electric Power Research Institute (EPRI)
Document Control Number: EPA-HQ-OW-2009-0819-4499-A1
Comment Excerpt Number: 109
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

B.1.4.1 CP Influent and Effluent

EPRI used the settled data from the 12 plants that EPA sampled (4 in 2007 and 8 in 2010) to calculate CP influent. As described above, EPA's methodology of calculating settled FGD wastewater was used on the raw data from the plants that didn't have a settling pond. Out of the 12 plants, Miami Fort, Keystone, Allen, Belews Creek, Homer City, Widows Creek, Mitchell, Roxboro, and Dickerson settled data were averaged together to characterize CP influent for plants that use bituminous coal as fuel. Hatfield's Ferry and Big Bend settled data were averaged together to characterize CP influent for "Blend/Other" plants. Pleasant Prairie CP settled was used to characterize CP influent for plants that use Powder River Basin (PRB) or sub-bituminous coal as fuel.

The effluent from CP systems was calculated from the Hatfield's Ferry, Keystone, Miami Fort, and Pleasant Prairie data. CP effluent for Keystone and Miami Fort were averaged to represent plants that use bituminous coal as fuel. CP effluent for Hatfield's Ferry was used to represent "Blend/Other" plants. And CP effluent of Pleasant Prairie was used to represent plants that use PRB coal as fuel.

The removal was calculated by coal type. The bituminous coal removal across CP was calculated by subtracting the bituminous CP influent by the bituminous CP effluent. The blend coal removal across CP was calculated by subtracting the blend coal CP influent by the blend coal CP effluent. And the PRB removal was calculated by subtracting the PRB CP influent by the PRB CP effluent.

Table B-4 shows the average CP influent, effluent, and removal by coal type in ug/L for each parameter. Each of the parameters was then multiplied by the toxic weighting factor (TWF) to calculate as ug/L times TWF (TWug/L).

Table B-4
CP Influent and Effluent Concentration and TWug/L

		Untreated Settled									
		MF Settled Effluent (Bit)	KY Settled Effluent (Bit)	AL Settled Effluent (Bit)	BC Settled Effluent (Bit)	HC Settled Effluent (Bit)	WC Settled Effluent (Bit)	MI Settled Effluent (Bit)	RX Settled Effluent (Bit)	DI Settled Effluent (Bit)	Settled Effluent (Bit Average)
Analyte	TWF	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Aluminum	0.064691216	10,328	912	965	813	677	111	98	345	781	1,670
Antimony	0.01225	3	0	3	2	0	12	2	74	4	11
Arsenic	4.041333333	7	5	11	6	27	48	20		4	16
Barium	0.001990757	162	390	374	668	176	179	488	387	186	334
Beryllium	1.056603774	6	0	1	0	11	3	6	1	0	3
Cadmium	23.1168	415	85	2	3	25	4	1	2	23	62
Calcium	0.000028	656,110	5,077,168	1,930,002	3,310,305	1,992,774	986,500	2,352,787		2,025,000	2,291,331
Chloride	0.0000243	9,500,000	15,150,000	3,900,000	7,600,000	11,800,000	1,115,000	7,200,000		7,675,000	7,992,500
Chromium	0.075696709	7	4	3	6	11	8	41	82	5	19
Cobalt	0.114285714	393	475	22	23	201	25	25	11	72	139
Copper	0.634822222	69	5	13	4	13	2	11	7	17	16
Hex. Chromium	0.516557576	1	1	1	1	1				1	1
Iron	0.0056	1,193	2,435	909	951	1,909	50	298	925	1,077	1,083
Lead	2.24	1	1	2	2	1	1	1	11	2	2
Manganese	0.07043299	120,008	450,037	3,382	4,561	173,117	623	27,904	1,690	9,774	87,899
Mercury	117.1180233	2	1	1	15	1	0	1	1	0	2
Molyb-denum	0.201438849	113	1	18	23	31	1,500	22	43	216	219
Nickel	0.108914308	1,977	2,179	82	128	1,453	36	434	200	4	721
Nitrate/ Nitrite	0.0032						95				95
Selenium	1.121344	316	1,228	333	720	591	208	449	1,770	179	644

		Untreated Settled									
		MF Settled Effluent (Bit)	KY Settled Effluent (Bit)	AL Settled Effluent (Bit)	BC Settled Effluent (Bit)	HC Settled Effluent (Bit)	WC Settled Effluent (Bit)	MI Settled Effluent (Bit)	RX Settled Effluent (Bit)	DI Settled Effluent (Bit)	Settled Effluent (Bit Average)
Analyte	TWF	ug/L	Analyte	TWF	ug/L	Analyte	TWF	ug/L	Analyte	TWF	ug/L
Silver	16.47072824	0	0	0	0	1	1	1	0	0	0
Sodium	0.00000549	405,035	315,018	33,742	481,896	1,439,977	69,450	323,959		192,500	407,697
Sulfate	0.0000056					6,920,000	2,055,000	1,640,000	1,236,538		2,962,885
Thallium	1.027058824	32	28	1	4	23	11	4	4	1	12
Tin	0.301075269	4	2	2	7	15	15	15		3	8
Titanium	0.029319372	5	10	23	21	8	5	7		36	14
Vanadium	0.035	20	5	4	4	12	42	11	5	12	13
Zinc	0.046886	7,787	76	40	36	39	5	162	50	714	990
Ammonia as N	0.00111						220				220
Boron	0.008341667	722,528	395,024	72,272	147,537	253,932	31,450	231,988	80,244	187,526	235,834
Magnesium	0.000865533	9,050,630	2,825,140	472,936	695,388	3,099,233	189,000	1,370,410		1,450,463	2,394,150
Cyanide	1.116923077										

		Untreated Settled (continued)				CP Effluent					CP Removal		
		HF Settled Effluent (Blend)	BB Settled Effluent (Blend)	Settled Effluent (Blend Average)	P4 Settled Effluent (PRB/Sub-bit Average)	KY CP Effluent (Bit)	MF CP Effluent (Bit)	CP Effluent (Bit Average)	HF CP Effluent (Blend - Average)	P4 CP Effluent (PRB/Sub-bit Average)	CP Re-moval Bit	CP Re-moval Blend	CP Re-moval PRB/ Sub-bit
Analyte	TWF	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Aluminum	0.064691216	1,098	213	656	1,293	6	45	25	107	75	1,645	549	1,219
Antimony	0.01225	8	22	15	4	0	5	3	9	3	8	6	1
Arsenic	4.041333333	9	137	73	9	3	4	4	7	7	12	66	2
Barium	0.001990757	162	1,819	990	97	230	122	176	141	66	159	850	31
Beryllium	1.056603774	3	3	3	1	0	0	0	0	0	3	2	1
Cadmium	23.1168	365	190	278	5	3	1	2	5	1	60	273	4
Calcium	0.000028	795,920	4,483,400	2,639,660	553,743	4,695,000	928,500	2,811,750	1,360,000	687,000	0	1,279,660	0

		Untreated Settled (continued)				CP Effluent					CP Removal		
		HF Settled Effluent (Blend)	BB Settled Effluent (Blend)	Settled Effluent (Blend Average)	P4 Settled Effluent (PRB/Sub-bit Average)	KY CP Effluent (Bit)	MF CP Effluent (Bit)	CP Effluent (Bit Average)	HF CP Effluent (Blend - Average)	P4 CP Effluent (PRB/Sub-bit Average)	CP Re-moval Bit	CP Re-moval Blend	CP Re-moval PRB/ Sub-bit
Analyte	TWF	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Chloride	0.0000243	7,092,500	24,200,000	15,646,250	1,800,000	13,650,000	6,755,000	10,202,500	6,430,000	2,310,000	0	9,216,250	0
Chromium	0.075696709	5	163	84	12	1	12	7	9	2	12	75	10
Cobalt	0.114285714	348	26	187	115	1	1	1	1	1	138	186	115
Copper	0.634822222	14	21	17	39	0	1	1	2	4	15	16	35
Hex. Chromium	0.516557576	1	24	12	1	1	7	4	4	1	0	9	0
Iron	0.0056	856	192	524	3,865	76	142	109	139	117	974	385	3,748
Lead	2.24	1	5	3	3	0	0	0	0	0	2	3	3
Manganese	0.07043299	85,257	9,684	47,471	69,789	35,450	506	17,978	4,917	11,240	69,922	42,554	58,549
Mercury	117.1180233	1	0	1	20	0	0	0	0	0	2	0	20
Molyb-denum	0.201438849	515	581	548	48	36	226	131	386	50	88	162	0
Nickel	0.108914308	1,126	1,039	1,083	940	8	3	6	6	5	716	1,077	935
Nitrate/ Nitrite	0.0032					20,510	64,400	42,455	116,800	182,000	0	0	0
Selenium	1.121344	549	3,281	1,915	3,816	139	547	343	680	2,595	301	1,235	1,221
Silver	16.47072824	0	10	5	0	0	0	0	0	0	0	5	0
Sodium	0.00000549	447,523	1,973,380	1,210,452	490,000	263,000	530,500	396,750	464,500	506,500	10,947	745,952	0
Sulfate	0.0000056		3,590,000	3,590,000		1,565,000	12,140,000	6,852,500	4,695,000	12,620,000	0	0	0
Thallium	1.027058824	28	39	33	10	9	8	8	9	1	4	24	8
Tin	0.301075269	2	15	9	16	2	2	2	2	3	6	6	13
Titanium	0.029319372	9	15	12	43	7	1	4	1	1	10	11	42
Vanadium	0.035	57	112	84	15	3	17	10	24	1	3	61	14
Zinc	0.046886	2,332	61	1,197	101	7	9	8	6	15	982	1,190	86
Ammonia as N	0.00111					8,020	13,205	10,613	845	5,510	0	0	0
Boron	0.008341667	322,510	618,048	470,279	12,991	272,000	387,500	329,750	177,500	12,965	0	292,779	26
Magnesium	0.000865533	5,200,510	4,114,346	4,657,428	3,927,203	2,025,000	5,435,000	3,730,000	2,775,000	3,545,000	0	1,882,428	382,203
Cyanide	1.116923077					92	3,305	1,698	129	241	0	0	0

		Settled Effluent			CP Effluent			CP Removal		
		Settled Effluent (Bit Average)	Settled Effluent (Blend Average)	P4 Settled Effluent (PRB/Sub-bitAverage)	CP Effluent (Bit Average)	HF CP Effluent (Blend Average)	P4 CP Effluent (PRB/Sub-bit Average)	CP Removal Bit	CP Removal Blend	CP Removal PRB/Sub-bit
Analyte	TWF	TWug/L	TWug/L	TWug/L	TWug/L	TWug/L	TWug/L	TWug/L	TWug/L	TWug/L
Aluminum	0.064691216	108	42	84	2	7	5	106	35	79
Antimony	0.01225	0	0	0	0	0	0	0	0	0
Arsenic	4.041333333	64	295	34	14	27	27	50	267	8
Barium	0.001990757	1	2	0	0	0	0	0	2	0
Beryllium	1.056603774	3	3	1	0	0	0	3	3	1
Cadmium	23.1168	1,434	6,420	113	37	111	14	1,397	6,309	100
Calcium	0.000028	64	74	16	79	38	19	0	36	0
Chloride	0.0000243	194	380	44	248	156	56	0	224	0
Chromium	0.075696709	1	6	1	1	1	0	1	6	1
Cobalt	0.114285714	16	21	13	0	0	0	16	21	13
Copper	0.634822222	10	11	25	0	1	3	10	10	22
Hex. Chromium	0.516557576	1	6	1	2	2	1	0	4	0
Iron	0.0056	6	3	22	1	1	1	5	2	21
Lead	2.24	5	7	7	1	1	1	4	6	6
Manganese	0.07043299	6,191	3,343	4,915	1,266	346	792	4,925	2,997	4,124
Mercury	117.1180233	288	64	2,358	14	33	12	274	31	2,345
Molybdenum	0.201438849	44	110	10	26	78	10	18	33	0
Nickel	0.108914308	79	118	102	1	1	1	78	117	102
Nitrate/Nitrite	0.0032	0	0	0	136	374	582	0	0	0
Selenium	1.121344	722	2,147	4,279	385	762	2,910	337	1,385	1,369
Silver	16.47072824	8	85	5	5	5	5	3	80	0
Sodium	0.00000549	2	7	3	2	3	3	0	4	0
Sulfate	0.0000056	17	20	0	38	26	71	0	0	0
Selenium	1.121344	722	2,147	4,279	385	762	2,910	337	1,385	1,369

		Settled Effluent			CP Effluent			CP Removal		
		Settled Effluent (Bit Average)	Settled Effluent (Blend Average)	P4 Settled Effluent (PRB/Sub-bitAverage)	CP Effluent (Bit Average)	HF CP Effluent (Blend Average)	P4 CP Effluent (PRB/Sub-bit Average)	CP Removal Bit	CP Removal Blend	CP Removal PRB/Sub-bit
Analyte	TWF	TWug/L	TWug/L	TWug/L	TWug/L	TWug/L	TWug/L	TWug/L	TWug/L	TWug/L
Thallium	1.027058824	12	34	10	9	9	1	4	25	8
Tin	0.301075269	2	3	5	1	1	1	2	2	4
Titanium	0.029319372	0	0	1	0	0	0	0	0	1
Vanadium	0.035	0	3	1	0	1	0	0	2	0
Zinc	0.046886	46	56	5	0	0	1	46	56	4
Ammonia as N	0.00111	0	0	0	12	1	6	0	0	0
Boron	0.008341667	1,967	3,923	108	2,751	1,481	108	0	2,442	0
Magnesium	0.000865533	2,072	4,031	3,399	3,228	2,402	3,068	0	1,629	331
Cyanide	1.116923077	0	0	0	1,897	145	269	0	0	0
Total		13,360	21,216	15,560	10,157	6,012	7,967	**7,279**	**15,730**	**8,539**

MF – Miami Fort Station
KY – Keystone Generating Station
AL – Allen Steam Station
BC – Belews Creek Steam Station
HC – Homer City Power Plant
WC – Widow's Creek Fossil Plant
MI – Mitchell Plant
RX – Roxboro Plant
DI – Dickerson Generating Station
HF – Hatfield's Ferry Station
BB – Big Bend Station
P4 – Pleasant Prairie Power Plant
Bit = bituminous
Sub-bit = sub-bituminous

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 48, in comment code 8.d.

Commenter Name: Pamela F. Faggert
Commenter Affiliation: Dominion Resources, Inc.
Document Control Number: EPA-HQ-OW-2009-0819-4631-A1
Comment Excerpt Number: 30
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

For chemical precipitation, data from *only three* facilities is used to characterize FGD effluent nationwide. In addition to the very small sample size, a number of facilities appear excluded that would seem to significantly alter the EPA results. From the record, it appears chemical precipitation data from four facilities was excluded. One of the facilities excluded was the Pleasant Prairie facility. Pleasant Prairie is equipped with both chemical precipitation and biological treatment, thus this facility should intuitively outperform a facility with chemical precipitation alone. The effluent data for Pleasant Prairie, however, suggest that <u>less</u> stringent limits are warranted than those proposed for standalone chemical precipitation. The data for Pleasant Prairie was excluded in the development of the chemical precipitation standards on the grounds that the treatment technology at Pleasant Prairie was too advanced. This exclusion of the Pleasant Prairie data seems counter intuitive as evidence of underperformance by more advanced technologies should be factored into the development of national technology standards.

A second facility, Dickerson Generating Station, was excluded on the grounds that it did not use the correct chemicals at the time of sampling and the facility experienced upsets and shutdowns. Upsets and shutdowns are operational realities that we believe should be included and accounted for when developing technology-based standards. At a minimum, Dickerson Generation Station points to the fact that chemical precipitation technology presents operational difficulties for power generating stations. Data from two additional facilities, Big Bend and Homer City, is also excluded. We request EPA to develop technology based standards that reflect the realities of operating these technologies. Underperformance of technologies, frequent shutdowns, and upsets should be included when establishing national technology standards. This type of data should be recognized so that these operational realities are properly reflected in the standards themselves.

Comment Response:

EPA agrees with the commenter that performance data from Pleasant Prairie Power Plant should be included in its data set characterizing the performance of the chemical precipitation component of BAT. However, the commenter incorrectly describes the treatment system operated at the Pleasant Prairie Power Plant as chemical precipitation and biological treatment and, therefore, also incorrectly describes EPA's rationale for excluding data from Pleasant Prairie at proposal. See response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 53, in comment code 9.a for EPA's rationale for including data from Pleasant Prairie Power Plant for the final rule.

EPA excluded data from Dickerson Generating Station because this plant does not operate the BAT basis for chemical precipitation and, therefore, their data cannot be used to represent BAT performance. Specifically, Dickerson does not perform sulfide precipitation. See response to DCN EPA-HQ-OW-2009-0819-4305-A3, Excerpt Number 53 for more information regarding the chemical precipitation technology basis and the importance of sulfide precipitation.

As also mentioned by the commenter, an additional reason that EPA excluded performance data from Dickerson is because the plant experienced upsets and shutdowns. The final rule establishes effluent limitations that reflect Best Available Technology Economically Achievable. Under the Clean Water Act, BAT is to reflect the highest performance in the industry (and may reflect a higher level of performance than is currently being achieved based on technology transferred from a different subcategory or category, bench scale or pilot plant studies, or foreign plants). *See Chem. Mfrs. Ass'n v. EPA*, 870 F.2d 177, 226, 235 (5th Cir. 1989) ("Congress intended [BAT] limitations to be based on the performance of the single best performing plant in an industrial field."); *Am. Meat Inst. v. EPA*, 526 F.2d 442, 462-463 (7th Cir. 1975) ("[BAT is] to be based on a broader range of technological alternatives, including techniques which exist in operation or which can be applied as a result of public and private research efforts. . . . [R]ather than establishing the range of levels in reference to the average of the best performers in an industrial category . . . the range should, at a minimum, be established with reference to the best performer in any industrial category.") (internal quotations and citations omitted); *Kennecott Copper v. EPA*, 780 F.2d 445, 447 (4th Cir. 1985) ("In setting BAT, EPA uses not the average plant, but the optimally operating plant, the pilot plant which acts as a beacon to show what is possible.") (citation omitted). Therefore, EPA disagrees with the commenter that BAT should reflect the entirety of the range of performance of chemical precipitation systems operated by the industry, or even the average of the best systems. Within the steam electric power generating industry, EPA identified the best chemical precipitation facilities as those well-designed and well-operated treatment systems that reflect the BAT chemical precipitation technology basis. EPA does not consider systems with periods of treatment upsets or shutdowns to be well-designed and well-operated.

Sampling data for Big Bend and Homer City were collected in 2007 during EPA's detailed study of the industry. At the time of sampling, neither of these plants was using sulfide precipitation in the FGD wastewater treatment system. Therefore, EPA excluded the data from these plants because they did not operate the BAT basis.

Commenter Name: Cari Boyce
Commenter Affiliation: Duke Energy
Document Control Number: EPA-HQ-OW-2009-0819-4305-A3
Comment Excerpt Number: 49
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

In addition, data were collected from the chemical precipitation effluent at Duke Energy Carolina's Allen and Belews Creek Steam Station, We Energies' Pleasant Prairie Power Plant, and Mirant Mid-Atlantic, LLC's Dickerson Generating Station, however, EPA chose to only use data from Duke Energy's Miami Fort Station, RRI Energy's Keystone Generating Station, and Allegheny Energy's Hatfield's Ferry Power Station to calculate the average effluent from a chemical precipitation system. This oversight resulted in EPA underestimating the performance and pollutants removed in a chemical precipitation system.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4305-A3, Excerpt Number 53 regarding EPA's treatment performance dataset for chemical precipitation for the final rule. EPA disagrees with the commenter that its analyses for the final rule underestimated the performance and pollutants removed in a chemical precipitation system.

See response to DCN EPA-HQ-OW-2009-0819-4305-A3, Except Number 53 regarding EPA's continued exclusion of chemical precipitation data from Belews Creek and Allen for the final rule. See response to DCN EPA-HQ-OW-2009-0819-4631-A1, Excerpt Number 30 regarding

EPA's continued exclusion of chemical precipitation data from Dickerson and the addition of chemical precipitation data from Pleasant Prairie Power Plant for the final rule.

Commenter Name: Chris M. Hobson
Commenter Affiliation: Southern Company
Document Control Number: EPA-HQ-OW-2009-0819-4379-A1
Comment Excerpt Number: 60
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

To estimate post-compliance loadings for the chemical precipitation option, EPA used its average concentrations for one-stage chemical precipitation systems (2013 TDD at 10-9 to 10-10, Table 10-4 at 10-10). EPA developed these "average" concentrations with data from only three facilities, Hatfield's Ferry, Miami Fort, and Keystone.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4305-A3, Excerpt Number 53.

Commenter Name: Elizabeth E. Aldridge, Hunton & Williams
Commenter Affiliation: UWAG
Document Control Number: EPA-HQ-OW-2009-0819-4655
Comment Excerpt Number: 89
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

To estimate post-compliance loadings for the chemical precipitation option, EPA used its average concentrations for one-stage chemical precipitation systems. 2013 TDD, Table 10-4 at 10-10. EPA developed these "average" concentrations with data from only three facilities, Hatfield's Ferry, Miami Fort, and Keystone.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4305-A3, Excerpt Number 53.

10. FGD Biological Treatment

Commenter Name: Tom DeLawrence
Commenter Affiliation: PowerSouth Energy Cooperative
Document Control Number: EPA-HQ-OW-2009-0819-4460-A1
Comment Excerpt Number: 42
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Biological Treatment is Not a Cost-Effective Method of Treating FGD Wastewater.

All technology-based limits established by EPA under the CWA must be economically achievable. Specifically, EPA must consider costs to implement and effectively operate the technology when setting national BAT standards. See 33 U.S.C. § 1314(b)(2)(B). Those costs must be reasonable. EPA has never exceeded a $404/TWPE cost-effectiveness threshold in previous rulemakings. See 78 Fed. Reg. at 34,504 (providing that "[a] review of approximately 25 of the most recently promulgated or revised BAT limitations shows BAT cost-effectiveness ranging from less than $1/lb-eq (Inorganic Chemicals) to $404/lb-eq (Electrical and Electronic Components), in 1981 dollars"). It should not do so now. The cost-effective analysis advanced by the agency in the Draft Rule is flawed. It not only grossly underestimates the costs associated with installing, operating, and maintaining a biological treatment system, it also inflates the overall effectiveness of the treatment technology by erroneously asserting that certain pollutant reductions are attributed to its operation.

UWAG and NERA Consulting conducted their own study concerning the industry-wide costs for implementing the three principal control technologies being considered for FGD wastewater treatment: chemical precipitation, biological treatment, and zero liquid discharge. See UWAG Comments at Section VI, F-G. UWAG and NERA estimate that adding and operating a biological treatment system on top of existing chemical precipitation would cost the industry approximately $1,346 (1981 $) per TWPE. EPA, on the other hand, estimated the incremental TWPE cost for physical/chemical treatment and biological treatment as a mere $60 (1981 $), although the agency did not evaluate the incremental cost-effectiveness of biological treatment alone. The difference between these two estimates is greater than 20-fold. A thorough review of EPA's methodologies demonstrates why its TWPE analysis is grossly understated.

First, EPA improperly attributed the treatment benefits of chemical precipitation (without biological treatment) to the TWPE removal benefits associated with incremental biological treatment, yet did not do so for the cost side of the equation. Only the incremental TWPE benefits attributable to biological treatment can properly be considered in a cost-effectiveness of that technology, however. This drastically affects EPA's calculations because much of the TWPE removal is achieved from chemical precipitation alone. This drastically deflated the per-unit removal cost of biological systems. Second, EPA improperly attributed to biological treatment various TWPE removals of pollutants not capable of being removed by biological treatment technologies. Specifically, EPA incorporated TWPE removals of cyanide, boron, manganese, and magnesium in its cost-per-TWPE removal when these constituents are not affected by biological treatment in any material way. What is more, the four aforementioned pollutants comprised 87% of the TWPE removal EPA attributed to the biological treatment technology. This obviously inflates the benefits of biological treatment and EPA's inclusion of these false TWPE removal levels substantially and improperly skewed the per-TWPE removal costs associated with incremental biological treatment.

In the end, the $1,346/TWPE number calculated by UWAG and NERA is well-reasoned and supported by available pollutant-removal data correctly allocated to the treatment system. It, along with the aforementioned explanation of the fallacies in EPA's conclusions, requires a conclusion that the incremental benefits of biological treatment are clearly not cost effective using EPA's high-end range of $404/TWPE.

Comment Response:

Regarding the commenter's claims that EPA has underestimated costs, see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 30 in Comment Code 10.b.

Regarding revisions to the pollutant loadings estimates, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 95 in Comment Code 10.c.

As described in the comment responses referenced above, EPA has revised its cost estimates and pollutant removals analyses. These revised estimates were used to recalculate the cost effectiveness analysis of the chemical precipitation followed by biological treatment system for the final rule (see section preamble section XV). EPA's cost-effectiveness ratios for the final rule remain well within the range of cost-effectiveness ratios for BAT of other industries.

EPA disagrees with the commenter's analysis evaluating the incremental cost effectiveness for the biological treatment system, see responses to DCN EPA-HQ-OW-2009-0819-4305-A3, Excerpt Number 52 and 54 in Comment Code 10.c.

Additionally, EPA notes that a cost-effectiveness analysis is not required by the CWA and is not a determining factor for establishing BAT and PSES. For the role of cost-effectiveness in EPA's decisions for the final rule, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 27 in Comment Code 6.h.

The final rule establishes BAT limitations based on chemical precipitation and biological treatment for FGD wastewater, which include numeric limitations on selenium and nitrate/nitrite. For these two pollutants, it is the combination of chemical precipitation and biological treatment that represents treatment at the BAT level (see preamble section VIII). The biological component of BAT is necessary to achieving effective removals of selenium and nitrate/nitrate and thus it represents a critical component of the BAT basis rather than simply a technology that achieves "incremental removal."

EPA notes that it did consider costs of the final rule, as directed by the statute, and it determined that the final rule is economically achievable (i.e., affordable) for the industry as a whole. See preamble Section VIII and the RIA.

Commenter Name: Bruce W. Ramme
Commenter Affiliation: We Energies
Document Control Number: EPA-HQ-OW-2009-0819-4475-A1
Comment Excerpt Number: 29
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

EPA Should Consider the *Incremental* Cost-Effectiveness for Adding Biological Treatment to Determine Whether it is Economically Achievable.

EPA conducted a cost-effectiveness evaluation for the technology options being considered as BAT for treating FGD wastewater, including chemical precipitation ("CP") and chemical precipitation followed by biological treatment ("CP+BIO"). We Energies is concerned that EPA did not evaluate the *incremental* cost-effectiveness for adding biological treatment and only evaluated the cost-effectiveness of the full technology option, CP+BIO. A majority (EPRI estimates 86%) of the pollutants removed from FGD effluent are removed in the chemical precipitation phase. Thus the incremental cost per TWPE removed is much higher when biological treatment is evaluated on its own.

EPRI calculated the *incremental* cost-effectiveness for adding biological treatment to be $1939/lb-eq (2010 dollars). This estimate is over thirteen times higher than EPA's estimate (derived as $149/lb-eq in 2010 dollars by subtracting the CP cost-effectiveness calculation from the CP+BIO calculation). The differences between EPA and EPRI estimates are based on assumptions made to derive costs for the treatment system and which data was used to derive the pollutant removal estimates.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4460-A1, Excerpt Number 42.

Commenter Name: Nysa Hogue
Commenter Affiliation: Indianapolis Power & Light Company (IPL)
Document Control Number: EPA-HQ-OW-2009-0819-4454-A2
Comment Excerpt Number: 13
External Review Flag: Statistics
External Review Incorporated into Response: No

Comment Excerpt:

The proposed ELG includes limits on FGD wastewater based on what EPA defines as BAT physical/chemical plus biological treatment. This appears to be the most likely BAT for existing sources (such as IPL's Harding Street and Petersburg Stations). Limits are set on mercury, arsenic, selenium, and nitrates/nitrites. IPL requests that EPA raise or eliminate limits:

- Selenium: raise limit in recognition that the proposed treatment does not consistently meet the selenium limits, even at some of the facilities used by EPA to set the limits. EPA selected data from only two plants (Belews Creek and Allen) to characterize performance of biological treatment, but the selected data do not represent the full range of industry FGD wastewater because Belews Creek and Allen bum similar coals and have a low level of solids in their influent to the treatment system. For example, other facilities have much higher solids levels that are much harder to treat. Furthermore, the type of systems' data evaluate by EPA are not the same type of GE system "generation" compared to what GE is now recommending facilities use. In addition, it is IPL's understand that the Belew's data includes a dilution source which would not be allowed under the proposed rule.
- Arsenic: raise limit in recognition that the proposed treatment does not remove soluble arsenic, and some facilities have higher soluble arsenic then the plants used by EPA to define the BAT limits.
- Nitrate/nitrite: eliminate limit in recognition of fact that setting limit at 0.1 3 mg/L may not be consistently achievable at most plants, would provide minimal benefit to the environment, and because nitrate/nitrite will be removed to low levels regardless of limits because it must be converted before bacteria use selenate so a specific limit is not needed.

Comment Response:

Regarding the representativeness of the Belews Creek and Allen plants, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107 in Comment Code 10.a.

EPA does not agree that plants will not be able to meet the effluent limitations for any of the pollutants regulated for FGD wastewater. See the Statistical Support Document for Effluent Limitations. In addition, see DCN SE05846 (memorandum *Variability in Flue Gas Desulfurization Wastewater: Monitoring and Response*).

EPA acknowledges the commenter's assertion that GE may be marketing a newer "generation" of the biological treatment system than is the basis for the technology option; however, EPA notes that this newer "generation" is an improvement on the system (which improves operational aspects and at a reduced capital cost) and the biological mechanism of the system (e.g., the biological process and biological material that reduces and captures the selenium) is unchanged. Therefore, this does not change EPA's determination that the selenium limit is achievable.

Regarding the treatment of dissolved arsenic in FGD wastewater, see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 56 in Comment Code 9.a.

Regarding whether plants have higher levels of dissolved arsenic, see response to DCN EPA-HQ-OW-2009-0819-4448-A1, Excerpt Number 24 in Comment Code 9.a.

Based on data received through public comment on the proposed rule, for the final rule, EPA used an expanded dataset to calculate revised effluent limitations for nitrate-nitrite. EPA does not agree that limitations for this pollutant are not needed. It is a pollutant of concern in FGD wastewater and there is no assurance it would be effectively controlled if plants opt to install one of the non-biological treatment technologies under development. Thus, EPA disagrees that it will be "removed to low levels regardless" of the final rule.

Commenter Name: Chris M. Hobson
Commenter Affiliation: Southern Company
Document Control Number: EPA-HQ-OW-2009-0819-4379-A1
Comment Excerpt Number: 10
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

EPA's choice for three out of four preferred flue gas desulfurization (FGD) wastewater options is chemical precipitation plus biological treatment. Because of shortcomings in data and cost estimates, EPA has not justified chemical precipitation or incremental biological treatment as a national standard for FGD wastewater. Incremental biological treatment is not cost-effective for any plant given the limited TWPEs removed in the biological treatment process.

Comment Response:

Regarding underestimating costs for the biological treatment system, see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 30 in Comment Code 10.b.

Regarding revisions to the pollutant loadings estimates, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 95 in Comment Code 10.c.

Regarding the cost effectiveness of incremental biological treatment, see response to DCN EPA-HQ-OW-2009-0819-4460-A1, Excerpt Number 42.

Commenter Name: Theresa Pugh
Commenter Affiliation: American Public Power Association (APPA)
Document Control Number: EPA-HQ-OW-2009-0819-5140-A2
Comment Excerpt Number: 61
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Power price volatility can lead to adverse cost impacts. EPA should allow a utility to continue operating after biological failure until the delivery of a new biological system has occurred, as long as the utility makes the purchase order for new biological elements within 24 hours of the time when failure is discovered. Further, "bug" replacement by most vendors is shipped via truck. APPA believes that if EPA selects a regulatory option necessitating biological systems, then the utility should be given leniency toward "bug" replacement during extreme weather events (including snow, rain, ice, or road closures) that slow down or stop truck deliveries. APPA is not questioning the effectiveness of a biological treatment technology company's supply or delivery system. We are merely pointing out that biological systems are living organisms and are different than ordinary filters or membranes. If the trucks cannot make deliveries, the utility should not be forced to shut down during extreme weather events.

Comment Response:

EPA does not agree that the ELG should include a provision that allows plants to discharge wastewater that does not meet the effluent limitations, even if the plant were to suffer a treatment system upset that results in failure of the biological treatment stage. See response to DCN EPA-HQ-OW-2009-0819-5140-A2, Excerpt Number 60.

Commenter Name: W. Creal
Commenter Affiliation: Michigan Department of Environmental Quality
Document Control Number: EPA-HQ-OW-2009-0819-5510-A2
Comment Excerpt Number: 4
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

For most of the preferred alternatives, the technology used as the basis for FGD wastewater treatment is chemical precipitation followed by anaerobic biological treatment. While Michigan supports the establishment of BAT controls for FGD wastewater, Michigan does have some concerns about the inclusion of biological treatment in setting BAT. The USEPA's evaluation included 40 facilities that relied on chemical precipitation and 6 facilities that utilize biological treatment, although 4 of these facilities precede biological treatment with chemical precipitation. Therefore, only two of the facilities were evaluated solely on the use of biological treatment. Although it appears that chemical precipitation is easily capable of achieving low effluent concentrations of many metals, the USEPA's evaluation states that biological treatment is included only for the additional removal of selenium and nitrate/nitrite from FGD wastewater following chemical precipitation. With restrictive water quality-based effluent limitations already being used for selenium, and control programs that effectively result in discharge of nitrates (i.e., oxidation of ammonia to nitrate to protect against un-ionized ammonia toxicity and/or dissolved oxygen-based concerns instream), Michigan is not sure that there is enough of a concern about these two pollutants to warrant the additional costs for installing and operating these highly sensitive treatment systems industrywide. It may be more appropriate to set chemical precipitation as BAT for the industry and allow site-specific water quality evaluations to determine the need for additional selenium and/or nitrate/nitrite control.

Comment Response:

While EPA acknowledges there are existing state programs that may address issues with the discharge of pollutants like nitrates and selenium, the CWA requires EPA to establish technology-based effluent limitations for categories and classes of point sources, including the steam electric power generating point source. These limitations are not based on the water quality of the receiving waters. See preamble section III for more information on the purpose of the rule, the CWA factors EPA is required to consider when establishing BAT, and EPA's rationale for the BAT determination. See also responses to comments in comment code 6.c. regarding the difference between technology-based and water quality-based effluent limitations.

Commenter Name: Chris M. Hobson
Commenter Affiliation: Southern Company
Document Control Number: EPA-HQ-OW-2009-0819-4379-A1
Comment Excerpt Number: 68
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Chemical Precipitation Removes the Great Majority of Pollutants

EPA's analysis masks the relative effectiveness between chemical precipitation and biological treatment. Chemical precipitation accounts for 93% of the total TWPE removed and incremental biological treatment accounts for 7% based on EPA's own sampling data. However, Southern excluded *artificial* removals by evaluating the plant-specific removals for each treatment system. This is described in the following section.

EPA's mode of presenting only the combined TWPEs for chemical precipitation and biological treatment conceals the vast disparity in treatment effectiveness between the two systems. In reality, installing biological treatment following a chemical precipitation system provides a very small additional removal.

Southern urges EPA to consider the two systems separately. Their costs, modes of operation, and limitations – as well as their relative effectiveness – differ greatly and deserve separate analysis.

Comment Response:

Regarding revisions to the pollutant loadings estimates, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 95 in Comment Code 10.c.

Regarding the cost effectiveness of incremental biological treatment, see response to DCN EPA-HQ-OW-2009-0819-4460-A1, Excerpt Number 42.

Commenter Name: Dennis Leonard
Commenter Affiliation: DTE Energy Company
Document Control Number: EPA-HQ-OW-2009-0819-4517-A2
Comment Excerpt Number: 4
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

The proposed ELG identified 4 preferred options for the treatment of Flue Gas Desulfurization Blowdown. Most of the preferred options relied on physical chemical treatment, but the proposed criteria require not just physical chemical treatment but, ***also biological treatment.*** DTE's FGD wastewater treatment at its Monroe Power plant utilizes physical chemical treatment. As explained below, DTE believes that EPA has vastly underestimated the cost of biological treatment and has over estimated the effectiveness of biological treatment, particularly at power plants like DTE's Monroe station which practices fuel flexing.

Comment Response:

Regarding underestimating costs for the biological treatment system, see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 30 in Comment Code 10.b.

Regarding revisions to the pollutant loadings estimates, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 95 in Comment Code 10.c.

Regarding the cost effectiveness of incremental biological treatment, see response to DCN EPA-HQ-OW-2009-0819-4460-A1, Excerpt Number 42.

Regarding consideration of fuel flexing, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107 in Comment Code 10.a.

Commenter Name: Paul Carpmone
Commenter Affiliation: Tampa Electric Company (TEC)
Document Control Number: EPA-HQ-OW-2009-0819-4520-A2
Comment Excerpt Number: 8

External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Furthermore, requiring a treatment technology that is only presently available from a single source will be very costly and realistically cannot be implemented within the proposed compliance schedule. Selecting this technology could create potential backlog as the single vendor works with industries nationwide. TEC believes that the installation of biological treatment does not provide proportional benefits compared to the high cost to purchase and implement the technology.

Comment Response:

Regarding the market availability of biological treatment systems, see response to DCN EPA-HQ-OW-2009-0819-4607-A1, Excerpt Number 13 in Comment Code 10.a. and DCN EPA-HQ-OW-2009-0819-5552-A2, Excerpt Number 7

Regarding the cost effectiveness of biological treatment system, see response to DCN EPA-HQ-OW-2009-0819-4460-A1, Excerpt Number 42.

Commenter Name: Kevin D. Frizzell
Commenter Affiliation: Owensboro Municipal Utilities (OMU) Elmer Smith Station (ESS)
Document Control Number: EPA-HQ-OW-2009-0819-4683-A2
Comment Excerpt Number: 9
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

7. Biological treatment of FGD wastewater:

Biological treatment is not cost-effective for small units such as those at OMU ESS. As previously stated, a small unit threshold is needed to address FGD discharges from small units.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4477-A1, Excerpt Number 15 in Comment Code 5.c.

For the role of cost-effectiveness in EPA's decisions for the final rule, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 27 in Comment Code 6.h.

Commenter Name: Tom DeLawrence
Commenter Affiliation: Alabama Power Company
Document Control Number: EPA-HQ-OW-2009-0819-4489-A1
Comment Excerpt Number: 17
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

4. The Cost-Effectiveness Ratio for Incremental Biological Treatment is Higher Than EPA's Range for BAT for Other Industries

EPA's evaluation of biological treatment as an additional treatment option of FGD wastewater grossly underestimates the cost of installing, operating, and maintaining these systems. UWAG and NERA Consulting, Inc. conducted their own study concerning the industry-wide costs for implementing the three principal control technologies being considered for FGD wastewater treatment: chemical precipitation, biological treatment, and ZLD. UWAG and NERA estimate that adding and operating a biological treatment system on top of existing chemical precipitation would cost the industry approximately $1,346 (1981 dollars) per TWPE. EPA, on the other hand, estimated the incremental TWPE cost for physical/chemical treatment and biological treatment as a mere $60 (1981 dollars). The difference between these two estimates is greater than 20-fold. A thorough review of EPA's methodologies demonstrates that the agency's TWPE analysis is grossly understated because of two major errors.

First, EPA improperly attributed the treatment benefits of chemical precipitation (without biological treatment) to the TWPE removal benefits associated with incremental biological treatment, but did not attribute the treatment costs of chemical precipitation on the other side of the ledger. EPA should have considered only the incremental TWPE benefits, rather than the benefits from the two treatment systems used in tandem, because much of the combined benefit is achieved from chemical precipitation alone. EPA's confusion of the total removal benefits from chemical precipitation plus biological treatment with those incremental benefits resulting from the addition of a biological treatment system to an FGD waste chemical precipitation system inaccurately and improperly deflated the per-unit removal cost of biological systems.

Second, EPA improperly attributed to biological treatment various TWPE removals of pollutants that biological treatment does not remove from FGD wastewater. Examples include EPA's counting the removal of cyanide, boron, manganese, and magnesium in its cost-per- TWPE removal when they are in fact not benefits of incremental biological treatment at all. EPA's data show that the Duke Energy systems removed little if any of these constituents from the FGD waste streams. This significantly inflates the benefits of biological treatment and deflates the per-unit costs associated therewith, as those four pollutants account for approximately 87% of the TWPE removal attributed by EPA to biological treatment. EPA's inclusion of these false TWPE removal levels substantially and improperly skewed the per- TWPE removal costs associated with incremental biological treatment.

In the end, the $1,346/TWPE number calculated by UWAG and NERA is well-reasoned and supported by available pollutant-removal data correctly allocated to the treatment system. It, along with the aforementioned explanation of the fallacies in EPA's assessment requires a conclusion that the incremental benefits of biological treatment are clearly not cost effective based on EPA's high-end range of $404/TWPE.

Comment Response:

Regarding underestimating costs for the biological treatment system, see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 30 in Comment Code 10.b.

Regarding revisions to the pollutant loadings estimates, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 95 in Comment Code 10.c.

Regarding the cost effectiveness of incremental biological treatment, see response to DCN EPA-HQ-OW-2009-0819-4460-A1, Excerpt Number 42.

Commenter Name: Tom DeLawrence
Commenter Affiliation: Public Service Company of New Hampshire(PSNH)
Document Control Number: EPA-HQ-OW-2009-0819-4633-A1
Comment Excerpt Number: 33
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

EPA conflates the effectiveness of chemical precipitation technology with that of biological treatment. EPA must consider the two treatment options separately. Their costs, modes of operation, and limitations—as well as their relative effectiveness—differ greatly and deserve separate analysis. By considering these two technologies in conjunction, the agency has masked the relative effectiveness of each. A review of EPA's own data—after excluding speculative removals not associated with these technologies—reveals that chemical precipitation accounts for 93% of the total TWPE removed; whereas the incremental biological treatment accounts for only 7% of TWPE removed. Stated differently: installing biological treatment following a chemical precipitation system provides only a small additional removal. These removal percentages are reflective of the cost-effectiveness numbers generated by UWAG's consultant, NERA Consulting, Inc. See UWAG Comments at Section VI, F-G. As stated above, the incremental cost of implementing biological treatment in the industry is $1,346/TWPE (1981 dollars). Comparatively, chemical precipitation would cost $311/TWPE, according to NERA's calculations based on data made available by EPA through this rulemaking. Yet, even this latter cost number could dramatically increase if EPA had collected analytical data that was truly representative of the industry. Unfortunately, EPA's current data set is insufficient and cannot provide the foundation upon which the agency can impose this technological option on the industry in accordance with the CWA and enumerated BAT factors. Accordingly, the agency should re-open the record to collect additional data from a sufficient cross-section of the industry to better understand the overall effectiveness and actual costs to the industry prior to imposing it as BAT for FGD waste waters.

Comment Response:

Regarding underestimating costs for the biological treatment system, see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 30 in Comment Code 10.b.

Regarding revisions to the pollutant loadings estimates, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 95 in Comment Code 10.c.

Regarding the cost effectiveness of incremental biological treatment, see response to DCN EPA-HQ-OW-2009-0819-4460-A1, Excerpt Number 42.

EPA disagrees with the commenter that "EPA's current data set is insufficient and cannot provide the foundation upon which the agency can impose this technological option on the industry." EPA's data set is representative of the treatment performance achievable by the BAT technology, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107 in Comment Code 10.a.

Commenter Name: Tom DeLawrence
Commenter Affiliation: Public Service Company of New Hampshire(PSNH)
Document Control Number: EPA-HQ-OW-2009-0819-4633-A1
Comment Excerpt Number: 23
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

EPA lists chemical precipitation plus biological treatment as the model technology option for FGD waste water in BAT options 3b (scrubber capacity >2,000 MW), 3, and 4a. EPA's proposed limits for FGD waste water based on these technologies are as follows.

Pollutant	Daily Max	Monthly Avg.
As	8 ppb	6 ppb
Se	16 ppb	10 ppb
Hg	242	119
Nitrate/Nitrite-N	0.17 ppm	0.13 ppm

Biological treatment is not an "available," proven, affordable, or effective technology, and therefore it should not have been considered as a technology option in the Proposed Rule. The sparse analysis EPA has conducted on the feasibility of biological treatment is wholly unrepresentative of the utility industry and is not indicative of how effective this technology is at treating FGD waste water. EPA's limited analysis also ignores the significant limitations of this technology which would be experienced by most facilities across the industry should they be required to utilize biological treatment. Moreover, the effluent limitations that EPA proposes to establish based on the use of biological treatment are neither technologically nor economically achievable at most facilities across the industry, in particular PSNH's generating stations. Additionally, due in large part to flaws in its cost-benefit analysis, EPA has grossly misstated the actual costs to the industry of implementing, operating, and maintaining this technology.

Comment Response:

Regarding whether the biological treatment system is proven, whether EPA's analysis is representative of the industry, and whether the effluent limitations are achievable, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107 in Comment Code 10.a.

Regarding underestimating costs for the biological treatment system, see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 30 in Comment Code 10.b.

Regarding the cost effectiveness of incremental biological treatment, see response to DCN EPA-HQ-OW-2009-0819-4460-A1, Excerpt Number 42.

Additionally, EPA notes that the commenter has not provided any data to support its assertion that "the effluent limitations that EPA proposes to establish based on the use of biological treatment are neither technologically nor economically achievable at most facilities across the industry."

Commenter Name: John McManus
Commenter Affiliation: American Electric Power System (AEP)
Document Control Number: EPA-HQ-OW-2009-0819-4448-A1
Comment Excerpt Number: 21
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

e. Additional wastewater characterization and treatment performance data need to be included in the EPA FGD wastewater treatment cost effectiveness analysis.

EPA calculated $/TWPE removed for the various FGD options (Table 2). EPA determined that "the cost effectiveness of chemical precipitation alone is $70 per TWPE removed, with the cost effectiveness of chemical precipitation plus anaerobic biological treatment…[being] $60 per TWPE removed" (78 FR at 34474). This analysis was based primarily on two power plants, Duke Energy's Belews Creek and Allen Stations. This is not a sufficient database upon which to base the cost effectiveness of such an important treatment technology proposal across an entire industry, and could explain why the results of EPA's analysis differ in respect to those of the AEP analysis.

Comment Response:

Regarding the representativeness of the Belew's Creek and Allen plants, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107 in Comment Code 10.a.

Regarding the cost effectiveness of incremental biological treatment, see response to DCN EPA-HQ-OW-2009-0819-4460-A1, Excerpt Number 42.

Commenter Name: Tom DeLawrence
Commenter Affiliation: Public Service Company of New Hampshire(PSNH)
Document Control Number: EPA-HQ-OW-2009-0819-4633-A1
Comment Excerpt Number: 30
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

The cost of installing and maintaining a biological treatment system over the long-term is cost-prohibitive and not economically achievable. All technology-based limits set by EPA under the CWA must be economically achievable. Specifically, EPA must consider costs of the technology in setting technology based limits. See CWA § 304(b)(2)(B). Those costs must be reasonable. The unpredictability of biological treatment systems creates concerns about meeting the FGD waste water BAT limits, as well as any pretreatment standards for existing sources ("PSES") standards. The reliability of biological systems is unproven, especially when intermittent and variable pollutant loadings to the treatment system are taken into account.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107 in Comment Code 10.a. The final rule is economically achievable, see the preamble and RIA for the final rule.

Commenter Name: Bruce W. Ramme
Commenter Affiliation: We Energies
Document Control Number: EPA-HQ-OW-2009-0819-4475-A1
Comment Excerpt Number: 77
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

EPA should consider the *incremental* cost-effectiveness for adding biological treatment after chemical precipitation to treat FGD Wastewater.

- A majority of pollutants removed from FGD effluent are removed in the chemical precipitation phase.
- EPRI's calculated *incremental* cost-effectiveness for adding biological treatment is over thirteen times higher than EPA's estimate because EPA underestimated the cost (contingency and other standard engineering cost factors were not included) and overestimated the pollutant removal estimates (artificial pollutant removals associated with a misapplication of a mixed dataset were included).

Comment Response:

Regarding underestimating costs for the biological treatment system, see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 30 in Comment Code 10.b.

Regarding revisions to the pollutant loadings estimates, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 95 in Comment Code 10.c.

Regarding the cost effectiveness of incremental biological treatment, see response to DCN EPA-HQ-OW-2009-0819-4460-A1, Excerpt Number 42.

Commenter Name: Nysa Hogue
Commenter Affiliation: Indianapolis Power & Light Company (IPL)
Document Control Number: EPA-HQ-OW-2009-0819-4454-A2
Comment Excerpt Number: 12
External Review Flag: Statistics
External Review Incorporated into Response: No

Comment Excerpt:

The limits in the physical/chemical plus biological treatment FGD BAT section are so stringent that they may not even be met by evaporator distillate, as seen in the EPA's data from the Brindisi station for nitrate/nitrite which had occurrences above the monthly 0.13 mg/L limit of the draft ELG, as shown in the Table below.

<u>*Table 1*</u>

Nitrate-Nitrate Levels in Distillate of Brindisi Brine Concentrator (EPA, 2012)

	Day 1	Day 2	Day 3	3-Day Average

Nitrate-Nitrite (mg/L)	0.110	0.130	0.160 (Estimated)	0.133

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 63 in Comment Code 11.

Commenter Name: Theresa Pugh
Commenter Affiliation: American Public Power Association (APPA)
Document Control Number: EPA-HQ-OW-2009-0819-5140-A2
Comment Excerpt Number: 72
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Historically, permit writers and power plant operators have worked together to address upsets and bypass issues at power plants. Biological treatment technologies necessitate additional bypass and upset accommodations. Biological treatment systems are subject to organism die-offs and must be constantly monitored and adjusted. For these reasons, chemical precipitation plus biological treatment is not feasible or available and should not be applied industry wide.

Comment Response:

EPA does not agree that biological treatment technologies necessitate additional upset and bypass accommodations. See response to DCN EPA-HQ-OW-2009-0819-5140-A2, Excerpt Number 60. EPA notes that the commenter has not provided any additional data or information to support its claim that "Biological treatment technologies necessitate additional bypass and upset accommodations" that are not already addressed by existing upset and bypass provisions.

Commenter Name: Winslow Sargeant
Commenter Affiliation: U.S. Small Business Administration, Office of Advocacy
Document Control Number: EPA-HQ-OW-2009-0819-4477-A1
Comment Excerpt Number: 16
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

There has been considerable criticism of the practicability, high costs, and feasibility of the biological treatment option for FGD wastewaters.[30] Advocacy recommends that biological treatment be required only by local permit authorities that are trying to address localized water quality issues, such as excessive selenium, rather than impose this technology across the board.

---

[30] See comments of UWAG and NRECA.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-5510-A2, Excerpt Number 4.

Commenter Name: Lisa M. Jaeger
Commenter Affiliation: Council of Industrial Boiler Owners (CIBO)
Document Control Number: EPA-HQ-OW-2009-0819-4486-A2
Comment Excerpt Number: 11
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Finally, regarding anaerobic biological systems, EPA should not further constrain this technology to the fixed-bed system of the power plants that EPA reviewed when considering technology for Se removal from FGD wastewaters. Instead, EPA should clearly state that suspended growth anaerobic systems, or fluidized bed anaerobic systems or other variants of anaerobic biological treatment and removal for selenium wastewaters are suitable.

Comment Response:

The ELGs do not require facilities to implement the specific technologies that form the bases of the technology option, but only that the appropriate effluent limitations and standards be achieved. Facilities are allowed to use any technology as long as the plant is able to comply with the limitations and standards established in the final rule.

See section V.C of the preamble for more information on the advancement of technologies for the treatment of FGD wastewater.

Commenter Name: Chris M. Hobson
Commenter Affiliation: Southern Company
Document Control Number: EPA-HQ-OW-2009-0819-4379-A1
Comment Excerpt Number: 87
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Based on the industry's cost-effectiveness analysis, incremental biological treatment (*i.e.*, biological treatment added on to chemical precipitation) is not cost effective under either the model plant approach (with a range of $1,124 to $10,884) (1981) per TWPE) or in the industry-wide analysis ($1,346 (1981) per TWPE). Since EPA's high-end cost range is $404 per TWPE, incremental biological is clearly not cost effective.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4460-A1, Excerpt Number 42.

Commenter Name: Elizabeth E. Aldridge, Hunton & Williams
Commenter Affiliation: UWAG
Document Control Number: EPA-HQ-OW-2009-0819-4655
Comment Excerpt Number: 126
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Based on UWAG's cost-effectiveness analysis, incremental biological treatment (*i.e.,* biological treatment added on to chemical precipitation) is not cost effective under either UWAG's model plant approach (with a range of $1,124 to $10,884) (1981) per TWPE) or in the industrywide analysis ($1,346 (1981) per TWPE). Since EPA's high-end cost range is $404 per TWPE, incremental biological is clearly not cost effective.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4460-A1, Excerpt Number 42.

Commenter Name: Pamela F. Faggert
Commenter Affiliation: Dominion Resources, Inc.
Document Control Number: EPA-HQ-OW-2009-0819-4631-A1
Comment Excerpt Number: 40
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

For these reasons, we request that EPA reevaluate its estimation of biological treatment effectiveness and costs. Without supplementation with additional data and analysis, the record lacks any basis for requiring biological treatment on a nationwide basis. Therefore, the proposal to include biological treatment as BAT for FGD wastewater cannot be supported at this time.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4631-A1, Excerpt Numbers 38 in Comment Code 10.c and 39 in Comment Code 10.a regarding the representation of the BAT system and EPA's revision to the pollutant loadings calculations.

Commenter Name: Bruce W. Ramme
Commenter Affiliation: We Energies
Document Control Number: EPA-HQ-OW-2009-0819-4475-A1
Comment Excerpt Number: 10
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

EPA should consider the *Incremental* Cost-Effectiveness for adding Biological Treatment. The majority of pollutant removal from FGD wastewater is achieved through chemical precipitation treatment. The low incremental pollutant removal accomplished by biological treatment, coupled with the high cost, demonstrates that this technology is not cost-effective.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4460-A1, Excerpt Number 42.

Commenter Name: Bruce W. Ramme
Commenter Affiliation: We Energies
Document Control Number: EPA-HQ-OW-2009-0819-4475-A1
Comment Excerpt Number: 32
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

We Energies urges EPA to re-evaluate its cost and pollutant removal estimates based on information provided by EPRI. Additionally, We Energies believes EPA should consider the *incremental* cost-effectiveness for adding biological treatment to determine if it is cost-effective.

Comment Response:

Regarding underestimating costs for the biological treatment system, see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 30 in Comment Code 10.b.

Regarding revisions to the pollutant loadings estimates, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 95 in Comment Code 10.c.

Regarding the cost effectiveness of incremental biological treatment, see response to DCN EPA-HQ-OW-2009-0819-4460-A1, Excerpt Number 42.

Commenter Name: S. L. Phillips
Commenter Affiliation: Louisiana Department of Environmental Quality
Document Control Number: EPA-HQ-OW-2009-0819-5509-A2
Comment Excerpt Number: 6
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Biological treatment systems applied to this wastewater do not perform as EPA expects and should not be required. EPA comes to erroneous conclusions about the effectiveness of biological treatment based on inadequate data sets.

Comment Response:

Regarding the performance of the biological treatment system, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107 in Comment Code 10.a.

Regarding the effectiveness of the biological treatment system related to pollutant removals, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 95 in Comment Code 10.c.

Commenter Name: J. Michael Brown
Commenter Affiliation: Ohio Valley Electric Corporation (OVEC)
Document Control Number: EPA-HQ-OW-2009-0819-4182-A2
Comment Excerpt Number: 3
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

The use of biological treatment for flue gas desulfurization (FGD) waste water is neither cost-effective nor does it provide a consistent, reliable option for the reduction of waste water constituents.

Comment Response:

Regarding the reliability of the biological treatment system, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107 in Comment Code 10.a.

Regarding the effectiveness of the biological treatment system related to pollutant removals, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 95 in Comment Code 10.c.

Regarding the cost effectiveness of incremental biological treatment, see response to DCN EPA-HQ-OW-2009-0819-4460-A1, Excerpt Number 42.

Commenter Name: Cari Boyce
Commenter Affiliation: Duke Energy
Document Control Number: EPA-HQ-OW-2009-0819-4305-A3
Comment Excerpt Number: 5
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

EPA has not proven that incremental biological treatment is cost-effective or feasible over a wide range of plants.

Comment Response:

Regarding the representativeness of plants used in EPA's analyses, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Numbers 107 in Comment Code 10.a and 124 in Comment Code 4.b.

Regarding the cost effectiveness of incremental biological treatment, see response to DCN EPA-HQ-OW-2009-0819-4460-A1, Excerpt Number 42.

Commenter Name: Raven Power Holdings, LLC
Commenter Affiliation: Raven Power Holdings, LLC
Document Control Number: EPA-HQ-OW-2009-0819-4467-A1
Comment Excerpt Number: 7
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

EPA has not proven that biological treatment for non-nutrient constituents is cost-effective.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4460-A1, Excerpt Number 42.

Commenter Name: Theresa Pugh
Commenter Affiliation: American Public Power Association (APPA)
Document Control Number: EPA-HQ-OW-2009-0819-5140-A2
Comment Excerpt Number: 32
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Biological treatment is also not cost-effective at all for smaller size utilities.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4477-A1, Excerpt Number 15 in Comment Code 5.c for EPA's evaluation of thresholds for FGD wastewater.

For the role of cost-effectiveness in EPA's decisions for the final rule, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 27 in Comment Code 6.h.

Commenter Name: Elizabeth E. Aldridge, Hunton & Williams
Commenter Affiliation: UWAG
Document Control Number: EPA-HQ-OW-2009-0819-4655
Comment Excerpt Number: 13
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

biological treatment is not cost-effective for units of any size.

Comment Response:

Regarding the cost effectiveness of incremental biological treatment, see response to DCN EPA-HQ-OW-2009-0819-4460-A1, Excerpt Number 42.

Commenter Name: Tom DeLawrence
Commenter Affiliation: Public Service Company of New Hampshire(PSNH)
Document Control Number: EPA-HQ-OW-2009-0819-4633-A1
Comment Excerpt Number: 31
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

(a) EPA's TWPE cost-benefit analysis for biological treatment is completely inaccurate

EPA's evaluation of biological treatment as an additional treatment option of FGD waste water grossly underestimates the cost of installing, operating, and maintaining these systems. UWAG and NERA Consulting conducted their own study concerning the industry-wide costs for implementing the three principal control technologies being considered for FGD waste water treatment: chemical precipitation, biological treatment, and ZLD. UWAG estimates that the incremental cost of adding and operating a biological treatment system on top of existing chemical precipitation would be $1,346 (1981 dollars) per TWPE, which far exceeds any acceptable cost-effectiveness numbers EPA has ever previously accepted in a BAT analysis.

The glaring disparities between EPA's cost estimates for biological treatment and those performed by the industry itself are a result of the significant flaws contained in EPA's TWPE cost analysis for FGD waste water. First, EPA improperly attributed the treatment benefits of chemical precipitation (without biological treatment) to the TWPE removal benefits associated with incremental biological treatment, yet did not do so for the cost side of the equation. EPA should have considered only the incremental TWPE benefits rather than the benefits from the two treatment systems used in tandem because much of that benefit is achieved from chemical precipitation alone. EPA's confusion between total removal benefits from chemical precipitation, plus biological treatment, with those incremental benefits resulting from the addition of a biological treatment system to an FGD waste chemical precipitation system inaccurately and improperly deflated the per-unit removal cost of biological systems.

Second, EPA improperly attributed to biological treatment various TWPE removals of pollutants that biological treatment does not remove from FGD waste water. Examples include EPA's counting the removal of cyanide, boron, manganese, and magnesium in its cost-per- TWPE removal when they are in fact not benefits of incremental biological treatment at all. This, too, significantly inflates the benefits of biological treatment and thereby deflates the per- unit costs associated therewith. And these were not insignificant miscalculations by EPA. According to EPA's sampling data, those four pollutants account for approximately 87% of the TWPE removal attributed by EPA to biological treatment, when in fact EPA's data show that the Duke Energy systems removed little if any of these constituents from the FGD waste streams. EPA's inclusion of these false TWPE removal levels substantially and improperly skewed the per-TWPE removal costs associated with incremental biological treatment.

(b) EPA fails to consider other costs associated with biological treatment

EPA's consideration of costs associated with installation of biological treatment in the Proposed Rule is incomplete as well as inaccurate. EPA does not appear to have taken into account the costs associated with the periodic backwashing of the biological treatment system, costs associated with the handling and disposal of the treated waste once it has been processed by the biological treatment system, and the necessity to enclose the entire biological treatment facility in a building with HVAC.

As the permitting authority in New Hampshire, EPA has recently undertaken a cost analysis of incremental biological treatment in connection with its proposed NPDES permit for PSNH's Merrimack Station. As PSNH and UWAG both explained in public comments on the proposed permit, EPA's cost analysis for biological treatment was wholly inadequate. The agency erroneously estimated it would cost only $4.95 million to construct this technology based on limited and/or incorrect information; whereas, PSNH projected that the addition of a biological system would cost approximately $23 million. PSNH incorporates by reference its comments to EPA Region 1's proposed NPDES permit for PSNH's Merrimack Station relating to the actual anticipated costs associated with installing and operating a biological treatment system.

Comment Response:

Regarding underestimating costs for the biological treatment system, see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 30 in Comment Code 10.b.

Regarding revisions to the pollutant loadings estimates, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 95 in Comment Code 10.c.

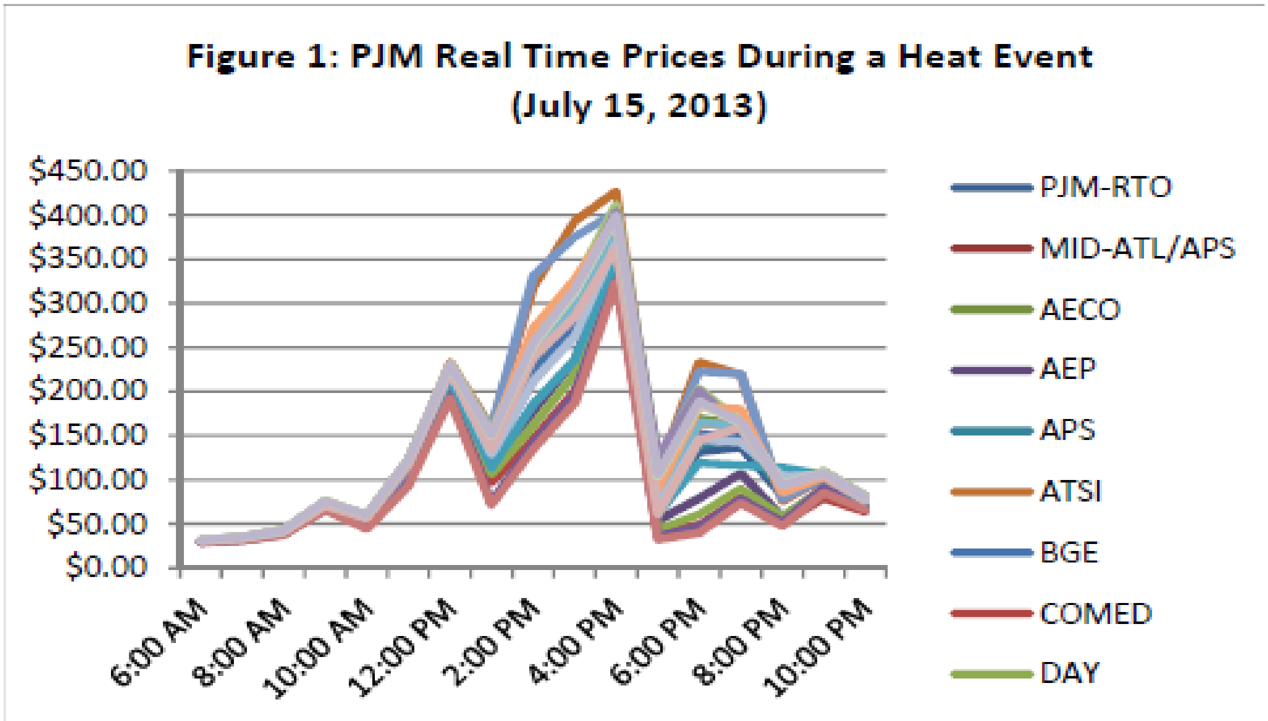
Regarding the need for enclosing the biological system in a building, see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 34 in Comment Code 10.b.

Commenter Name: Theresa Pugh
Commenter Affiliation: American Public Power Association (APPA)
Document Control Number: EPA-HQ-OW-2009-0819-5140-A2
Comment Excerpt Number: 60
External Review Flag: Economics/Benefits
External Review Incorporated into Response: No

Comment Excerpt:

It is very important to note that the costs incurred by a public power utility when a biological system fails, or "bugs" die off. This is likely to happen during an extreme hot or cold weather event. If a utility with a single plant has to cease operations because of biological die off, it will have to purchase electricity off the market. It is also likely that power prices will be higher because prices are often driven by temperature and weather.

Biological systems could help create the perfect storm. Just when a utility is likely to be experiencing a biological system failure, power prices are likely to be extremely high. Figure 1 shows how a weather event drove power prices in the mid-Atlantic to over $400 MWh. To avoid excessive cost burden, EPA should craft language to ensure that if biological systems fail due to acts of nature, electric utilities should not be held hostage to the high power prices that are likely to be occurring at the same time.



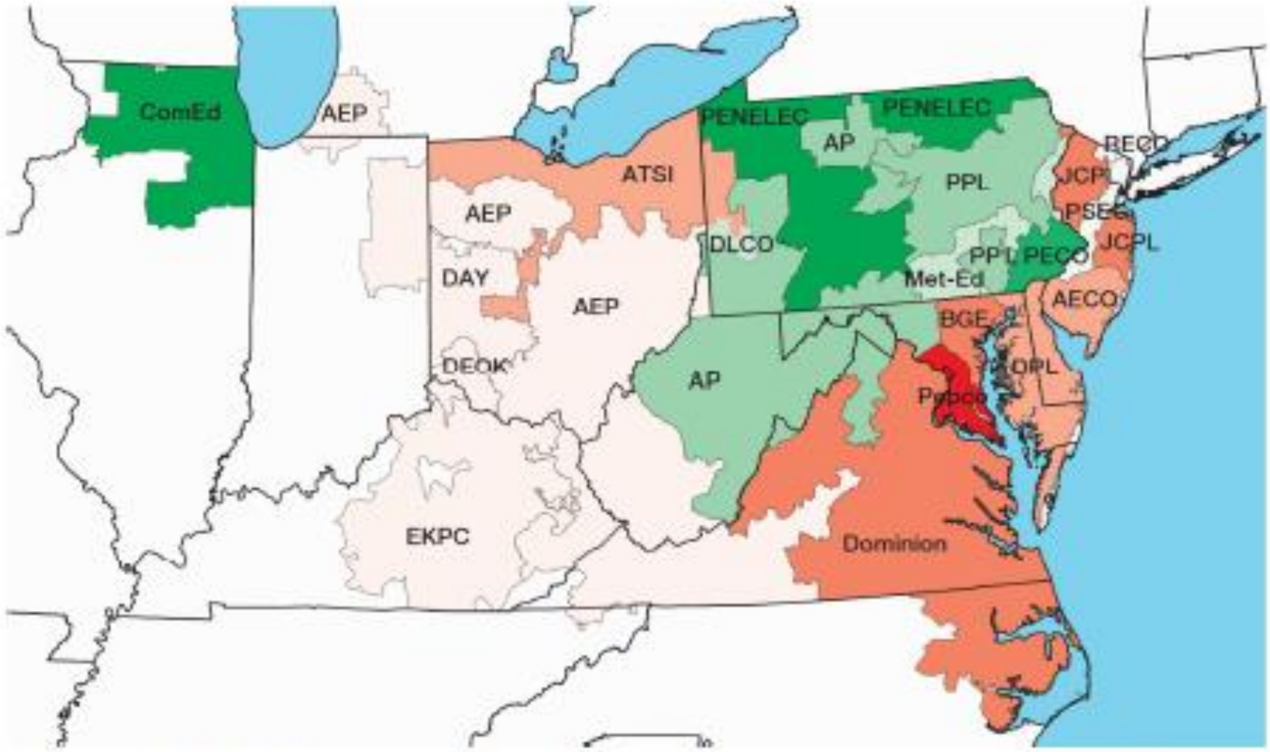


Figure 2: PJM Regions. Red Regions Import Power. Green Regions Export Power

Comment Response:

EPA disagrees with the commenter that "[a biological system failure, "bug" die off,] is likely to happen during an extreme hot or cold weather event." EPA acknowledges that the biological treatment system operates optimally within a given temperature range, however, plants can control the temperature of the wastewater entering the biological treatment system in extreme hot and cold weather events. Based on EPA's discussions with the vendor GE, biological treatment is effective at temperatures as low as 40°F and as high as 105°F. EPA incorporated additional costs for housing the biological treatment system in cold weather climates and for maintaining the temperature of FGD wastewater using heat exchanges in warm weather climates. See section 6.5 of the *Incremental Costs and Pollutant Removals for the Final Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category* (Cost & Loads Report) (DCN SE05831/SE05832) for more information on EPA's revised methodology for estimating post-compliance pollutant loadings for biological treatment that account for the two extreme weather conditions. Also see response to DCN EPA-HQ-OW-2009-0819-4655 Excerpt Number 107 in Comment Code 10.a

EPA does not agree that the ELG should include a provision allowing plants to continue discharging FGD wastewater at levels that do not meet the effluent limitations, should there be an upset condition for the biological treatment stage. Duke Energy's Belews Creek Station has operated the biological treatment system for over 7 years; Allen Station has operated the system for more than 6 years. AEP's Mountaineer plant has operated the biological treatment technology for more than 3 years. These plants have operated the technology in both cold and hot weather, under changing conditions related to fluctuations in electricity generation, type and source of coal, and other factors. In addition, these systems have effectively treated the wastewater following frequent, and in some cases extended, shutdown periods. Based on this information, EPA determined that there is no need to include a provision such as the commenter requests.

10.a. FGD Bio – Demonstration/Performance

Commenter Name: David Y. Chung
Commenter Affiliation: Homer City Generation, L.P
Document Control Number: EPA-HQ-OW-2009-0819-5552-A2
Comment Excerpt Number: 2
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

I. EPA's BAT Limitations For FGD Wastewater Are The Product Of Inadequate Analyses And Are Not Cost Effective

Homer City opposes EPA's proposed BAT limits for flue-gas desulfurization ("FGD") wastewater, which are based on chemical precipitation and biological treatment technology options. EPA analyzed these technologies using a data set that is far too limited, thereby resulting in overly stringent limits that likely cannot be achieved by many power stations, including the Homer City Generating Station.

Comment Response:

EPA does not agree that the data used to establish the BAT effluent limitations for FGD wastewater are too limited, nor that plants will be unable to achieve the limitations established in the ELGs. EPA based the limits for arsenic and mercury on treatment system effluent data for four plants, with 183 observations for arsenic and 670 observations for mercury. These data represent approximately 4½ years of operation for these plants. The selenium and nitrate-nitrite limits are based on treatment system effluent data for two plants, with 398 observations for selenium and 70 observations for nitrate-nitrite. These data represent more than 5 years of data for one plant and more than 4 years of data for the other.

The data for these plants include both baseload and cycling power generation operations and reflect wastewater generation and associated treatment system performance under steady power output, increasing and decreasing power output, shutdown and restart of one or more generating units at a site, and complete plant-wide shutdown followed by restart of one or more generating units. In addition, the long periods of time covered by the data from these plants reflect operation during different seasons and therefore reflect the effects of both hot and cold weather on both power output and the wastewater treatment systems themselves. As such, the data used by EPA to establish effluent limitations take into account the variety of conditions encountered at power plants. See the Statistical Support Document for Effluent Limitations for additional information about the data used to calculate the effluent limitations and EPA's evaluation of these data and determination that plants will be able to meet the effluent limitations. Also see DCN SE05846 (memorandum *Variability in Flue Gas Desulfurization Wastewater: Monitoring and Response*).

EPA notes that the ELGs do not specify which technology plants must use to comply with the effluent limitations and that there other technologies available to plants which would enable them to meet the limitations, including vapor-compression evaporation, fixation processes that mix the FGD wastewater with ash or other materials and result in a solid waste for landfill. In addition, some companies are considering using the FGD wastewater as makeup for a dry scrubber, which results in complete elimination of the wastewater discharge.

Also see the response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107, as well as DCN EPA-HQ-OW-2009-0819-4655-A2, Excerpt Number 20.

Commenter Name: David Y. Chung
Commenter Affiliation: Homer City Generation, L.P
Document Control Number: EPA-HQ-OW-2009-0819-5552-A2
Comment Excerpt Number: 7
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

The efficacy of biological treatment systems can also vary because the bacteria used in the system are sensitive to certain changes in FGD wastewater composition. Many FGD systems within the industry, including Homer City's, have been designed to operate with chloride concentrations between 10,000 and 20,000 mg/L. This results in much lower purge rates and smaller FGD WWTP overall. EPA's preferred regulatory options for FGD wastewater incorporate the use of flow minimization for plants with high FGD discharge flow rates (*i.e.*, greater than 1,000 gpm) and FGD system metallurgy and operating practices that can accommodate an increase in chlorides. Implementation of flow minimization would increase chloride, sodium, and every other constituent concentration, which could inhibit the effectiveness of biological treatment. Moreover, bacteria may not be able to withstand spikes in chloride levels in FGD wastewater. At Homer City, chloride levels vary by season and can increase dramatically in winter months (*e.g.*, up to approximately 15,600 ppm). Similarly, at other stations, chloride levels can increase to well over 20,000 ppm. These increases in chloride levels can be caused by a number of different factors, such as road salts being pulled into the influent at the Station. The bacteria in any biological treatment system are likely to be adversely impacted by such fluctuations in chloride levels, thereby calling into question whether a limit of 10 ppb selenium is achievable under such conditions. To minimize impacts on the bacteria in these systems, plants may have to dilute FGD purge water. But this could overload other existing wastewater treatment system units, thereby increasing costs. Prior to finalizing any FGD wastewater limits based on biological treatment systems, EPA should provide long-term effluent data that supports use of such systems at higher chloride concentrations.

Finally, EPA is imposing a low limit for selenium in FGD wastewater that incidentally only one technological system (GE ABMet) appears to be capable of meeting. Yet EPA has, in the past, suggested that it is improper to impose any particular technology on a discharger when promulgating ELGs. *See, e.g.*, *Iowa League of Cities v. EPA*, 711 F.3d 84, 856 (8th Cir. 2013) ("The EPA has interpreted this [ELG] regime as precluding it from imposing any particular technology on a discharger."); NPDES Permit Writers' Manual at 5-14 to 5-15 ("[E]ach facility has the discretion to select any technology design and process changes necessary to meet the performance-based discharge limitations and standards specified by the effluent guidelines."). Regardless of whether the ABMet technology is demonstrated at a small number of plants, there is an inadequate basis in the record for EPA to conclude that such technology would work at plants, such as the Homer City Generating Station, with different influents and operating parameters. And while there may be ongoing research efforts with respect to other systems, no other technology has been demonstrated to achieve selenium levels as low as 10 ppb.

Comment Response:

EPA does not agree that the characteristics of FGD wastewater are such that concentrations of chlorides and certain other pollutants could inhibit the effectiveness of biological treatment. The data in the record demonstrate effective long-term operation of the biological treatment technology under varying conditions of temperature, pollutant loading, wastewater flow rate, seasonal effects, and other factors. The viability of the microorganisms has been demonstrated at higher chloride concentrations than noted by the commenter. Also, in addition to the demonstrated performance at sites operating full-scale biological treatment systems, EPA reviewed the data for a pilot-scale test of the biological technology at IPL's Petersburg plant where the TDS of the wastewater ranged as high as 27,000 mg/L (Higgins, T., et al. "Recent Applications of Meeting Compliance Challenges through Flue Gas Desulfurization (FGD) Wastewater).

The commenter questions whether a limit of 10 ppb selenium is achievable. EPA counters that the more relevant metric is whether plants can meet the final effluent limitations established for the ELGs (23 ug/L daily maximum; 12 ug/L monthly average), and EPA's analysis shows that they will be able to do so. EPA notes that the long-term average selenium concentration for both of the plants used to establish the final effluent limitation was lower than 8 ug/L. In addition, all effluent samples for the IPL Petersburg pilot test were below the selenium limits in the final ELGs. Furthermore, the biological treatment system at a third plant for which EPA has data consistently achieved lower than 5 ug/L for approximately 98% of the samples collected over a two-year period.

EPA does not agree that there is only one technology capable of meeting the effluent limitations. There are at least three technology vendors actively marketing biological treatment systems to the power industry for removing selenium and nitrate-nitrite from FGD wastewater (Infilco Degremont, GE Water, and Frontier Water). Very few plants have effluent limits, or even monitoring requirements, for selenium in discharges of FGD wastewater; because of this, to date there has not been a clearly defined performance level for plants and equipment vendors to target. There are many similarities between the physical and biological processes inherent in the biological treatment technologies designed to remove nitrates and selenium and, therefore, it is reasonable to expect that these other technologies are capable of meeting the final effluent limitations, or can be modified to optimize performance so they can do so by the time plants will be required to meet the final effluent limitations (see the preamble for the final ELGs for a discussion of when plants will need to comply with the BAT effluent limitations). Other technology vendors are developing non-biological treatment technologies for removing selenium in FGD wastewater, which if successful can be used in conjunction with traditional denitrification technology marketed by a number of vendors, including Veolia. But there are other technology solutions available today that are capable of meeting the final ELGs, including evaporation technologies (e.g., Veolia, GE Water, Aquatech, and GEA), fixation technologies that mix FGD wastewater with fly ash and fixating agents to produce a solid material for landfill disposal (with no discharge of FGD wastewater), and evaporating the purge from a wet scrubber in a dry FGD or spray dryer. Although EPA did not select these technologies as the BAT basis for control of FGD wastewater discharges, one or more of these technologies may be available to individual plants to comply with the effluent limitations. As this shows, there are a number of potential compliance approaches available to the industry, and extensive engineering and treatment technology resources available to plants.

See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107.

Commenter Name: Elizabeth E. Aldridge, Hunton & Williams
Commenter Affiliation: UWAG
Document Control Number: EPA-HQ-OW-2009-0819-4655
Comment Excerpt Number: 107
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

I. Engineering Assessment of FGD Wastewater Treatment Systems

EPA lists chemical precipitation plus biological treatment as the model technology option for FGD wastewater in BAT Options 3b (scrubber capacity >2,000 MW), 3, and 4a. EPA's proposed limits for FGD wastewater are as follows.

Pollutant	Daily Max	Monthly Avg.
As	8 ug/L	6 ug/L
Se	16 ug/L	10 ug/L
Hg	242	119
Nitrate/Nitrite-N	0.17 mg/L	0.13 mg/L

As already noted, EPA based the BAT limits for selenium and nitrate/nitrite-N on data collected at Belews Creek and Allen. But biological treatment itself has application limits that make it very difficult to apply on an industrywide basis. Belews Creek and Allen are not representative of the entire coal-fired industry; requiring biological treatment systems at other plants is unlikely to result in compliance with the proposed limits.

In the sections below, we address some of the limitations of biological treatment.

1. Organisms in Biotreatment Systems Are Sensitive to Chlorides and Other Components of Total Dissolved Solids

Jill Sonstegard, et al. claim that the GE ABMet biological treatment systems were "designed to handle chloride levels up to 20,000 ppm, suspended solids up to 100 ppm, nitrate-N loading less than 100 ppm."[42] Both the Belews Creek and Allen biological treatment systems were built before 2010; therefore, both plants' biological treatment systems were designed for FGD wastewater with less than 20,000 ppm chlorides. For the past few years, both plants have treated FGD wastewater with chloride levels less than 10,000 ppm. GE says its system can treat wastewater with chlorides levels as high as 25,000 ppm,[43] but this has not been demonstrated. The organisms within biological systems are not as "resilient" as EPA claims. 78 Fed. Reg. at 34,463 col. 2. Variations in chloride levels – as well as high chloride levels – can affect treatment levels, as can total dissolved solids and temperature fluctuations. The organisms are also sensitive to nitrate/nitrite and oxidation reduction potential (ORP) levels.

Based on EPA's ICR data, the chloride range in power plants with wet FGDs is 136 to 40,000 ppm, and the average is 7,740 ppm (2013 TDD at 6-5). In addition, EPA calls for flow minimization, asserting that "[t]he flow minimization at these plants would be achieved by either reducing the FGD purge rate or recycling a portion of their FGD wastewater." 78 Fed. Reg. at 34,459 col. 3. Using flow minimization strategy could tremendously increase chlorides levels in FGD wastewater.

About 11% of power plants already cycle up their scrubbers to greater than or equal to 20,000 ppm. If power plants install biological treatment systems, they would have to lower the chloride levels in the FGD scrubber to avoid harming the organisms in the biological treatment system. Lowering the chloride levels would increase the FGD purge stream flow and the water treatment flow rates. As a result, the plants would require larger wastewater treatment systems with increased capital and O&M costs.

2. Organisms are Sensitive to Temperature

For biological treatment systems, water temperature has to be well controlled to ensure good selenium and nitrate-N removal. By 2010, there were four GE ABMet systems in operation. Two of those systems, Belews Creek and Allen, have chemical precipitation pretreatment and heat exchangers to control the water temperature. The other two biological systems use ponds as pretreatment and do not have temperature control equipment. The two biological treatment systems without temperature control have not performed as well as Belews Creek.[44]

Variation of water temperature can impact the bacteria's behavior. Usually temperature impacts the biological reaction rate as follows:

$$\frac{K2}{K1} = \theta^{(T2-T1)}$$

Where, K = reaction rate constant

T = temperature, °*C*

θ = temperature coefficient, usually between 1.06-1.15.

$$K2 = K1(1.1)^{-10°C} = K1 \times 40\%$$

$$K2 = K1(1.1)^{-20°C} = K1 \times 14\%$$

Research shows that the denitrification reaction rate could decrease by 50% with a 10°C temperature drop, and by 80% with a 20°C temperature drop.[45, 46] Also, one vendor observed a reaction rate decrease of 50% with every 10°C temperature drop for a biological treatment system treating FGD wastewater (verbal communications). Therefore, biological systems must be designed to keep water temperatures stable in order to keep the reaction rate stable, especially in high latitudes and altitudes. The need for stable temperatures will significantly increase the cost to maintain and operate the system, and will likely cause compliance issues with the limits EPA has proposed.

3. Organisms are Sensitive to Nitrate/Nitrite Levels

The biological treatment systems that EPA evaluated as BAT (Belews Creek and Allen) were designed for selenium removal, not nitrate/nitrite-N and selenium removal. As already noted, the Belews Creek biological system is designed to handle suspended solids up to 100 ppm and nitrate-N loading less than 100 ppm. Both Belews Creek and Allen have nitrate/nitrite-N levels lower than 100 ppm. Literature shows that higher nitrate-N loading needs more microbes and longer retention time to remove the nitrate-N levels. This series of steps may not be possible with the current residence time and nutrient feed at Belews Creek and Allen, particularly if higher nitrogen levels were present in the influent.

Thermodynamically, the nitrate/nitrite must be removed prior to initiation of selenium removal (selenate and selenite).[47] Without well-controlled denitrification, selenium removal may be affected. Under certain conditions, such as a fuel change or a change in the FGD recycle rate, the nitrate in the FGD wastewater can significantly increase over several days, and the denitrification process can be severely affected. With higher nitrate levels in the influent, the microbes in the biological treatment system will consume the nitrate, and as a consequence the selenium removal will decrease. To avoid this result, more nutrients would be required by the biological system to enhance microbe growth. However, because microbe growth is not immediate, larger bioreactors may be needed to achieve the target nitrate and selenium levels. Under such conditions, nutrients usually would be overfed and residual chemical oxygen demand, excessive biomass and soluble microbial products could be generated during the process.[48] This usually requires further aerobic biological treatment to remove the organics, which could significantly increase the capital and O&M costs.

There is very limited data to support the proposed nitrate/nitrite-N limits because the bioreactor influent levels at both Belews Creek and Allen, 15 mg/L and 32 mg/L, respectively, are very low as compared to potential nitrate/nitrite-N levels up to 300 mg/L[49] in other FGD wastewaters. In addition, there is insufficient long-term data available to determine the effectiveness of nitrate removal.

4. Organisms are Sensitive to FGD Wastewater Oxidation Reduction Potential

High oxidation reduction potential (ORP) in FGD wastewater can also cause problems for the biological system. Biological treatment systems for denitrification and selenium removal are anoxic-anaerobic processes. First, biological systems have to consume the oxygen or other oxidants, such as free available oxidants and then nitrate/nitrite, and finally selenite/selenate. A very high ORP means that the FGD wastewater has high concentrations of these oxidants which will consume the biological system's treatment capability, subsequently reducing its capability to remove nitrate/nitrite and selenite/selenate.

As Duke noted in its comments on the draft permit for the Merrimack Station, "[m]any factors affect ORP, including the use of selective catalytic reduction (SCR) equipment, the generating load, the amount of sulfur in the coal, the pH, the quality of makeup water for the scrubber." Duke's Comments on Merrimack Permit, p. 2. Because of these many factors, Duke finds that ORP "routinely fluctuates and cannot be well controlled" and therefore the metals in the wastewater exiting the scrubber also vary. *Id*.

Duke described just such as incident for its Allen Station during a 30-day test burn of a high sulfur blend Illinois River Basin coal:

During the test burn, increased ORP values within the influent to the FGD wastewater treatment system and within the FGD scrubber were observed. With the increased oxidizing environment within the scrubber, a noticeable chlorine smell was observed and an increase in free available oxidant (FAO) was detected within the influent to the FGD wastewater treatment system. To prevent damage to the microbes within the bioreactors, the test burn was stopped immediately and flow to the bioreactors was interrupted for several days…

Id. Duke explains that, within the higher oxidizing environment, concentrations of selenium and mercury in the effluent from the chemical precipitation system increased. Also, concentrations of selenium were elevated in the bioreactor effluent. *Id*. at 3.

Duke further explains that it stopped the test burn because it feared the increased oxidizing environment would "cause substantial harm to the organisms in the bioreactors." *Id*. Duke concluded that:

…the wastewater matrix generated during this test burn was completely different than any previously observed FGD wastewater matrix at Allen or Belews Creek. Due to the shift, Duke

Energy is questioning the validity of all the data previously collected at these two stations to evaluate the effectiveness of FGD wastewater treatment systems.

Id.

Controlling ORP levels is extremely difficult because of the many possible factors affecting ORP. This is an area of continuing research, and in the meantime plants are unable to ensure treatment levels when ORP fluctuates.

5. Future Coal Plant Operations Could be Problematic for Biological Treatment Systems

A stable, consistent FGD wastewater influent stream is key for biological systems to maintain consistent treatment performance. This can be very difficult to do considering the normal fluctuations within plant operations, but particularly when plants look for ways to remain viable and yet comply with more stringent regulations. With lower natural gas prices, less coal-fired power generation is likely to occur. Companies may convert coal-fired generation to natural gas but keep coal capabilities as a backup. Without continuous, steady FGD wastewater feed to the treatment system, it could be very difficult to keep consistent performance of biological treatment systems. Also, as one or more of the coal units come on line to meet demand, it is questionable that the biological system could start up and meet the limits immediately after startup.

6. The Biological Treatment Process Produces Ammonia

In some circumstances, ammonia can be produced as a byproduct of the biological treatment system. Within the anaerobic biological process, nitrate is converted to nitrogen gas, and in the process ammonia can be produced. Ammonia levels in the treated effluent can vary by plant and can be affected by temperature, ORP, and microbial activity. Any facilities facing discharge limits for ammonia or whole effluent toxicity limits (*i.e.*, WET testing) could potentially require further treatment and incur additional costs. EPA has not considered the type of treatment or the level of cost for removal of ammonia. Adding such costs would further increase the overall industry costs of biological treatment systems.

7. The Performance of Biological Treatment Systems at Belews Creek and Allen Should Not Be Applied to the Entire Industry

As discussed above, biological treatment systems can be affected by high chloride levels, high and low temperatures, high nitrate levels, and high ORP. The biological treatment performance at Belews Creek and Allen does not represent the level of treatment that biological systems could achieve at other power plants. The table below provides a comparison of Belews Creek and Allen chemical precipitation effluent (bioreactor influent) data to data from other EPA-sampled plants and an industry range for each parameter.

Table 16: Comparison of Belews Creek and Allen CP Effluent (Bioreactor Influent) to Other EPA-Sampled Plants and Industry Ranges

Parameter	Belews Creek	Allen	Other Plants	Industry Range
TDS, mg/L	15,000	9,800	15,000 - 29,000	4,000 - 50,000 [50]
Chloride, mg/L	8,300	4,500	2,300 - 14,000	136 - 40,000 [51]
Selenium, Total, µg/L	490	200	140 - 2,600	140 - 10,000 [52]
Nitrate/nitrite-N, mg/L	16	28	21- 180	10 - 1,000 [53]

Both biological treatments systems at Belews Creek and Allen were designed for FGD wastewater with less than 20,000 mg/L chlorides. Chloride levels in many other plants could be significantly higher than this value, and even higher than the guaranteed value of <25,000 mg/L. Therefore the performance achieved at Belews Creek and Allen may not apply to high chloride wastewaters.

Belews Creek and Allen biological treatment influent contains on average 345 µg/L total selenium and 22 mg/L nitrate/nitrite-N, respectively.[54] These levels are well below the levels at the other EPA-sampled plants and at the low end of the industry range. The GE feed water quality requirements for influent to the system is <8,000 µg/L dissolved selenium (oxidized forms only, no reduced species).[55] The low levels of nitrate/nitrite at Belews Creek and Allen means that their biological treatment systems should more easily meet the proposed nitrate/nitrite-N and selenium limits; however, the exceedance frequency analysis nonetheless indicates that even Belews Creek and Allen could not reliably meet the proposed limits.

In summary, the removal of nitrate/nitrite-N and selenium to the proposed limits has not been demonstrated at other plants where levels of TDS, chloride, nitrate/nitrite and dissolved selenium levels are significantly higher than at Belews Creek and Allen.

8. Biological Treatment of FGD Wastewater Can Interfere with Switching From One Type of Coal to Another

Some power plants burn different types of coal at different times in order to generate power most efficiently. This practice is called "fuel flexing." A biological treatment system for FGD wastewater could interfere with this practice.

For example, the four boilers at the Monroe Power Plant were designed to burn bituminous coal and can achieve their rated capacity only when they burn bituminous coal. During periods of low power demand (which can last for months), however, the plant will burn 100% subbituminous coal and be derated. Burning a lower cost fuel, even with the associated derating, makes the plant more profitable when the clearing price of power is low.

During periods when the clearing price of power is high, the plant is most profitable when it burns a blend of eastern bituminous coal and western subbituminous coal. A typical blend that achieves full rated capacity of the units is 55% subbituminous, 45% bituminous.

While at certain times the units may burn the same fuel for weeks or even months at a time, the units will switch at other times to a completely different fuel with only 24 hours' notice. For example, this can occur when there is an unexpected outage on one or several large units on the Midwest Independent Transmission System Operator (MISO) system. This fuel flexing has major ramifications for the character and treatability of FGD blowdown. Also, if the temperature changes radically over a short time, power demand and prices can spike and require abrupt changes in fuel.

When the plant has an extended run of subbituminous fuel, very little chloride builds up in the recirculating scrubber liquor, and there is little need for blowdown to occur. During this time, the scrubber wastewater discharge can cease for as long as 36 hours, even though the system has a substantial amount of holding capacity and even though blowdown is occurring for control of fines, rather than chloride control. If it were not for the system's holding capacity and the drawing down of holding tanks, the time without a discharge would be even longer.

Wastewater in the reaction vessel is agitated during this 36-hour no-flow period to maintain a floc of sufficient size. If the size of the floc deteriorates, the ability of the system to remove arsenic, mercury, and selenium also deteriorates. Consequently, it is imperative to keep wastewater in the chemical reaction vessels and to agitate the vessels to maintain floc size and not discharge during such times. During this time, the concentration of nitrate builds up to over 200 mg/L, but there is little to no mass of nitrate being discharged, because there is little to no blowdown occurring (being discharged).

When the plant has an extended run with the blend of 45% bituminous/ 55% subbituminous fuel, the nitrate concentration will fall, and the blowdown rate will greatly increase. Over the entire range of operating conditions the flow will vary from 0 gpd for 36 hours to 435,000 gpd (2 of 4 units are presently scrubbed, and this flow will increase to 870,000 gpd when all 4 units are scrubbed), ORP will vary from less than 300 mV to more than 500 mV, and nitrate will vary from 130 to 250 mg/L. This combination of varying flow, ORP, and nitrate levels will interfere with biological treatment.

J. Monitoring FGD Systems Is Not a Solution to Excursions

EPA says that plants that "actively monitor" their FGD systems can identify excursions and adjust for them:

In some cases, plants may experience a spike in concentrations for certain metals in their untreated FGD wastewater, likely based on changes in fuels or operating conditions within the FGD scrubber. EPA's data demonstrate that well operated systems maintain their chemical precipitation effluent concentrations because they actively monitor their untreated wastewater for target concentrations of certain metals allowing them to adjust the operation of the chemical precipitation system, as necessary. Plants that actively monitor their untreated FGD wastewater would be able to identify these excursions and adjust the chemical addition rates to treat the wastewater to the required permit limitation. Some plants actively monitor the influent to the treatment system and adjust chemical addition by including an equalization tank with a 24-hour holding time as the first step in the treatment system. Alternatively, plants could monitor the effluent prior to discharge to make sure that they are in compliance before discharge. For example, Pleasant Prairie monitors the effluent from the system daily by collecting and analyzing samples using an in-house Method DMA 80 mercury analyzer.

TDD at 7-6 to 7-7. This conclusion is wrong.

Several things affect the quality of effluent, in particular the type of coal burned and the oxidation-reduction potential in the scrubber. For example, as already noted, when a plant changes from low-sulfur coal to higher sulfur coal, the ORP rises. Under these high oxidizing conditions, the FGD wastewater treatment performance can be changed.

Both Allen and Belews Creek burn eastern bituminous coal, typically Central Appalachian. When Allen on occasion burns *Northern* Appalachian coal, the effluent changes: ORP rises, the dissolved fraction of metals increases, and the treatment system may become less efficient. The chemical composition of coal varies both between and within seams in the same geographic region. For example, Tewalt et al. (2001)[56] reported that the mean mercury content of coal from Northern Appalachian seam samples was 18.8 lb/10^{12} BTU, whereas the mean content of mercury in Central Appalachian coal seam samples was 11.3 lb/10^{12} BTU – a difference of 40%. Neuzil et al. (2005)[57] noted the spatial variation in selenium concentrations in coal samples over the entire Appalachian Plateau:

The selenium concentration in coal beds with more than 30 samples ranges from a low average and median in the Pittsburgh coal bed of 1.7 and 1.4 ppm Se, respectively, to a high average and median in the No. 5 Block coal bed of 7.1 and 6.4 ppm Se, respectively (table 4a). *The increase from low to high selenium values by coal bed, for either average or median selenium concentration, is approximately a factor of four.*

Neuzil et al. (2005) at 11 (emphasis added).

Varying characteristics of coal even from the same source can affect the FGD wastewater stream. Moreover, it is common to blend coal; the ratios of the different kinds of coal blended add uncertainty to the wastewater characteristics.

Other factors, too, change the wastestream: the way the coal is burned (low-load versus high-load operation, cyclone burners versus pulverized coal boilers), operation of selective catalytic reduction, and others.

Therefore, EPA cannot rely on Allen and Belews Creek in setting limits for other plants unless they are similar in the important characteristics that affect FGD wastewater. To be scientifically sound, EPA must identify and characterize the factors (such as those mentioned above) that affect effluent quality.

a. Mercury Concentrations in FGD Wastewater are More Variable than EPA Represents

Recent studies of mercury chemistry in FGD scrubbers reveal why mercury routinely changes phase and thus why FGD wastewater systems have variable results after treatment. Data from 15 different scrubbers show that, when the oxidation-reduction potential in a scrubber is high, there is more mercury in the dissolved phase than bound to particulates.[58] The more highly oxidizing the system, the greater the concentration of dissolved mercury. Because ORP in a scrubber routinely fluctuates, the mercury phase in the wastewater leaving the scrubber varies too. Therefore, the level of treatment possible with an FGD wastewater treatment system also varies over time.

EPA's sampling demonstrates the variability of FGD wastewater under normal, though varying, operating conditions.[59] EPA took samples at Allen and Belews Creek over a four-day period at each plant. Then additional samples were taken on a single day in each of four consecutive months.

According to EPA, the primary goal of the sampling program was to characterize both the untreated FGD wastewaters and the effluent quality after treatment.

As noted above, the effectiveness of the Belews Creek FGD wastewater treatment system can change dramatically based on the constituents of the coal, the effectiveness of the air pollutant control technology (such as the performance of the FGD scrubber and electrostatic precipitator), and other factors. Furthermore, future changes in operation, such as use of different types of coal or the addition of additives to remove more contaminants from the flue gas, could also change the performance of the system.

Within an FGD absorber module itself, certain conditions can promote the re-emission of mercury from liquid to gaseous form. Scheutze et al. (2012)[60] reported that the volatilization of mercury in FGD systems is enhanced at pH levels greater than 7.0 s.u., elevated gypsum levels, and iron in the form of ferrous form (Fe^{+2}). Thus, the partitioning of mercury (and possible other volatile trace elements) between the liquid and gaseous phase can be dynamic, which ultimately affects the mass and speciation of mercury that enters the FGD wastewater treatment system. Changes in the performance of the FGD wastewater treatment system can occur suddenly, based on operating conditions. These changes in effluent quality may not be immediately detected.

The variability of the Belews Creek system is evident from EPA's sampling on Day 1 of the four-day sampling episode (June 1). EPA measured the influent to the FGD wastewater system (SP1) as having dissolved mercury at 49.3 µg/L, much higher than the 0.119 µg/L and 0.142 µg/L for EPA's Day 2 and 3 samples.

This variability is not unusual, as shown by the self-monitoring data from the bioreactor influent on June 9, July 14, and August 11, 2010, when mercury was detected at 59.3 µg/L, 49.9 µg/L, and 47.7 µg/L, compared to the mercury concentrations detected on September 8 and October 7, 2010, of 0.150 µg/L and 0.892 µg/L. These sampling episodes demonstrate that the monitoring data do not adequately characterize the performance of the treatment system under all operating scenarios.

In response to these monitoring results, EPA posed the following question to Duke Energy:

Several mercury results appear inconsistent with self-monitoring data Duke Energy has provided for Belews Creek. Please describe any unusual conditions that were occurring with the FGD system or FGD wastewater treatment system at the time of sampling, or that may have occurred in the preceding days that may have affected sampling results. Please provide all total and dissolved arsenic, mercury, and selenium data for the split samples collected by Duke Energy/UWAG (on behalf of Duke Energy), for each day and sample point.

SER, Duke Energy Carolinas' Belews Creek Steam Station, EPA-HQ-OW-2009-0819-0738 at 4-2.

Thus, EPA assumed that higher measurements of arsenic, mercury, and selenium reflected not normal variability but rather some unusual upset.

To the contrary, the results EPA obtained during the four-day sampling event in 2010 are not inconsistent with the self-monitoring data Duke Energy provided for Belews Creek. As shown in the table below, Duke Energy's self-monitoring data collected during the four days are consistent with the results EPA obtained during the four-day sampling event. Duke Energy says it is not aware of unusual conditions with the FGD system or the FGD wastewater treatment system at the time of sampling or on the preceding days. During this time, a blend of Northern Appalachian with Central Appalachian coal was burned, and this could have been a cause of the increased mercury results compared with data from previous years. Duke Energy believes this is indicative of normal and potential future operations.

Belews Creek Self-monitoring Data

Sample Day	**FGD Purge**	**Bioreactor Influent(1)**
	total recoverable mercury (ppb)	
06/09/10	114	59.3
07/14/10	228	49.9
08/11/10	378	47.7
09/08/10	197	0.150
10/07/10	213	0.892

(1): The bioreactor influent total mercury results for June 9, July 14 and August 11, 2010 were reported incorrectly in the original data submittal. The table above provides the correct results.

Table BC-1 at 9, letter from Duke Energy to Ronald P. Jordan, EPA, EPA-HQ-OW-2009-0819-0743 (January 31, 2012).

In short, the data summarized above do not characterize the performance of biological treatment options. In setting national guidelines, EPA should consider the variability of the performance of the system, especially for mercury.

[42] Sonstegard, J., J. Harwood, and T. Pickett. 2010. "ABMet: Setting the Standard for Selenium Removal," 2010 International Water Conference, IWC-10-18 at 5.

[43] GE provided EPRI with water quality requirements for influent to the ABMet® system.

[44] Steam Electric Power Generating Point Source Category: Final Detailed Study Report (2009), EPA 821-R-09-008, EPA-HQ-OW-2009-0819-0387 at 4-51.

[45] Carrera, J., Vicent, T., Lafuente, F., "Influence of Temperature on Denitrification of an Industrial High-Strength Nitrogen Wastewater in a Two-Sludge System," Water SA, 2003. Vol. 29 No. 1, pp. 11-16.

[46] Lewandoswki, Z., "Temperature Dependency of Biological Denitrification with Organic Materials Addition," *Water Research*, 1982, Vol. 16, pp. 19-22.

[47] Sonstegard et al. at 238.

[48] Shen, J., He, R., Han, W., Xiuyun, S., Li, J., Wang, L., *Biological Denitrification of High-Nitrate Wastewater in a Modified Anoxic/Oxic-Membrane Bioreactor*, Journal of Hazardous Materials, 2009, Vol. 171, pp. 595-600.

[49] EPA-HQ-OW-2009-0819-0819-0773, Table 5-2, p. 5-24.

[50] EPRI. 2007. *Treatment Technology Summary for Critical Pollutants of Concern in Power Plant Wastewaters*. 1012549.

[51] 2010 ICR Database.

[52] EPRI. 2008. *Flue Gas Desulfurization (FGD) Water Blowdown Characterization and Management: 2007 Update*. 1014073.

[53] EPRI. 2010. *Pilot-Scale and Full-Scale Evaluation of Treatment Technologies for the Removal of Mercury and Selenium in Flue Gas Desulfurization Water*. 1017955.

[54] EPA-HQ-OW-2009-0819-0736, EPA-HQ-OW-2009-0819-0790, and EPA-HQ-OW-2009-0819-0885.

[55] GE provided EPRI with water quality requirements for influent to the ABMet® system.

[56] Tewalt, S.J., L.J. Bragg, and R.B. Finelman. 2001. "Mercury in U.S. Coal – Abundance, Distribution, and Modes of Occurrence." USGS Fact Sheet FS-095-01. USGS, Reston, VA. http://pubs.usgs.gov/fs/fs095-01/.

[57] Neuzil, S.G., F.T. Dulong, and C.B. Cecil. 2005. "Spatial Trends in Ash Yield, Sulfur, Selenium, and Other Selected Trace Element Concentrations in Coal Beds of the Appalachian

Plateau Region, U.S.A." USGS Open-File Report 2005-1330. USGS, Reston, VA. http://pubs.usgs.gov/of/2005/1330/.

[58] Allen, J.O., D. Eggert and C.A. Tyree. 2011. "Effect of FGD Chemistry on Wastewater Composition," presented at Air Quality VIII Conference, Arlington VA, October 25.

[59] In 2010, EPA's sampling of seven plants – three of them completed by August 2010 – focused on scrubber wastewater, settling ponds, vapor compression evaporation systems, zero liquid discharge systems, and chemical and physical/chemical precipitation systems.

EPA expanded its wastewater sampling for the effluent guidelines rulemaking with two separate efforts. EPA required the seven facilities that were sampled in summer and fall 2010 to collect additional samples over a four-month period. For some facilities, this meant sampling into early 2011.

[60] Scheutze, J., D. Kunth, S. Weissbach, and H. Koeser. 2012. *Mercury Vapor Pressure of Flue Gas Desulfurization Scrubber Suspensions: Effects of pH Level, Gypsum, and Iron*. Envtl. Science & Tech.

Comment Response:

Temperature Sensitivity

EPA recognizes that the reaction rate for biological treatment can be affected by temperature. This is accounted for by the design, construction and operation for a well-designed wastewater treatment system and has been factored into EPA's BAT determination and the cost estimates for the ELGs. The biological treatment technology included in the BAT basis is designed to operate within a temperature range of 41 to 105 degrees F. When operating within that temperature range, the technology has been demonstrated to effectively treat FGD wastewater. The temperature of the influent FGD wastewater purge is usually near the upper end of that temperature range initially, and cools somewhat due to temperature loss to the ambient air as the wastewater moves through the equalization tank and the rest of the chemical precipitation stage. By the time the wastewater reaches the bioreactor, it is usually still warm but within the design temperature range. Generally speaking, if the wastewater temperature drops substantially lower, such as could occur if the entire treatment system were outdoors in parts of the country with very cold winters, more retention time may be needed in the system to treat the wastewater to a specified level or steps might need to be taken to ensure the amount of biomass within the bioreactor is large enough to counter any reduction in microbial activity. EPA's cost estimates take this into account. Based on comments received on the proposed rule, EPA added additional costs for plants to house the biological reactors in a building in cold weather climates.

EPA's cost estimates also take into account the upper end of the design temperature range. Because of the hydraulic residence time for the chemical precipitation stage and the temperature differential between the wastewater and the surrounding air, the wastewater temperature will usually drop to a level well within the design temperature range for the bioreactor. However, in parts of the country with hot summers, ambient cooling may not be sufficient to reduce the temperature low enough before the wastewater reaches the bioreactor. EPA's cost estimates take this into account by including costs for a heat exchanger for plants located in certain parts of the country. The heat exchanger will ensure that the temperature of the wastewater entering the bioreactor is lower than 105 degrees F. Thus, EPA's cost estimates include the equipment and buildings that would be needed to ensure the wastewater temperature is within the design temperature range and sufficiently stable for effective operation of the biological treatment system. EPA notes that the data used to calculate the effluent limitations for selenium and nitrate-nitrite reflect operation across different seasons of the year, with 398 observations for selenium and 70 observations for nitrate-nitrite. These data represent more than 5 years of data for one plant and more than 4 years of data for the other. For more information see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 34 in Comment Code 10.b, response to DCN EPA-HQ-OW-2009-0819-4684-A1, Excerpt Number 73, and the *Incremental Costs and Pollutant Removals for the Final Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category* (Cost & Loads Report) (DCN SE05831/SE05832).

The commenter states that the "two biological treatment systems without temperature control have not performed as well as Belews Creek." In doing so, the commenter implies that the lack of temperature control is the sole reason for a difference in pollutant removal efficacy. EPA does not agree. Although EPA agrees that temperature may play somewhat of a role for a portion of the year, the much more likely reason for the difference in performance is that the Roxboro and Mayo plants do not precede the bioreactor with a chemical precipitation pretreatment stage. EPA notes that commenter makes reference to the *Steam Electric Power Generating Point Source Category: Final Detailed Study Report*. However, the commenter fails to mention that the report stated "[t]he bioreactor effluent selenium concentrations at Belews Creek are substantially lower than those observed for Roxboro's bioreactor effluent, presumably due to the chemical precipitation stage providing more effective pretreatment than achieved by the settling pond." The pollutant removal processes in the chemical precipitation stage are far more robust than the gravity settling in the pond. In the chemical precipitation system, plants add lime (calcium hydroxide), ferric (or ferrous) chloride, and organosulfide to precipitate some metals. Lime is added to elevate the pH of the wastewater to a designated set point, helping precipitate metals into insoluble metal hydroxides that can be removed by settling and filtration. Ferric (or ferrous) chloride is used to coprecipitate additional metals and organic matter. The ferric chloride also acts as a coagulant, forming a dense floc that enhances settling of the precipitated in the downstream clarification step. Generally, sulfide precipitation improves the removal of some metals, such as mercury, by creating metal sulfide compounds that are less soluble than metal hydroxide compounds. Chemical precipitation can be designed to add all three chemicals to the same reaction tank or to add each chemical in separate tanks. By reducing the concentration of dissolved metals, adjusting the pH or alkalinity, and reducing the total suspended and dissolved solids concentrations of the FGD wastewater, the chemical precipitation system step acts to condition the wastewater for optimal treatment in the biological system, and additional chemical pretreatment can be done if necessary. This could include chemical addition to remove oxidants and lower ORP (e.g., sodium bisulfite, or use of ferrous chloride instead of ferric chloride). A separate denitrification step can also be included to decrease nitrite/nitrate concentrations prior to the biological stage.

TDS and Chloride Levels

EPA does not agree with the commenter's suggestion that the chloride levels in FGD wastewater are too high for the microorganisms in the bioreactor. EPA also does not agree with the commenter's statement that "if power plants install biological treatment systems, they would have to lower the chloride levels in the FGD scrubber to avoid harming the organisms in the biological treatment system" which "would increase the FGD purge stream flow and the water treatment flow rates." As support for their assertion, the commenter cites a paper stating that the biological treatment system "can treat wastewater with chloride levels as high as 25,000 ppm" and also presents information from EPA's ICR showing a chloride range of 136 to 40,000 ppm for plants with wet FGDs. However the commenter is mistaken on two very key points.

First, in response to the comments on the proposed rule, EPA investigated the upper chloride level for the biological treatment technology and found that testing conducted by the vendor determined that the maximum chloride level for treatment of FGD wastewater by the biological treatment system is at least 35,000 ppm and could certainly be higher. Outside of FGD applications, the vendor has demonstrated biological treatment at TDS levels containing 150,000 mg/L (DCN SE04208). For comparison, the data in the record for FGD wastewater shows that, in general, TDS concentrations in FGD wastewater are typically double the chloride concentration. Using that rule of thumb, the microorganisms in the bioreactor are expected to remain viable and effectively treat FGD wastewater at chloride levels much higher than 35,000 ppm.

Second, the commenter did not select the appropriate ICR data for comparison to any maximum limits for the microorganisms. The commenter cited the range of chloride concentrations for power plants with wet FGDs (i.e., those plants that *generate* FGD wastewater); however, the correct data to use are the chloride concentrations for plants that actually *discharge* FGD wastewater. Using the same set of ICR data cited by the commenter, the highest reported chloride concentration for plants that actually discharge the FGD wastewater is 25,000 ppm. That value is still within the acceptable range stated by the commenter, and 10,000 ppm lower than the concentration that the vendor has determined is also amenable to biological treatment. The ICR includes data for only two wet-scrubbed plants with chlorides higher than 25,000 ppm and neither of these plants discharge the FGD wastewater. Therefore, contrary to the commenter's assertion, the chlorides concentration at all plants that discharge FGD wastewater is lower than the maximum level for the microorganisms.

The commenter also notes that EPA considered flow minimization at plants with high FGD wastewater flow rates as a means to reduce the cost of the treatment system, and stated that "[u]sing flow minimization strategy could tremendously increase chlorides levels in FGD wastewater." However, EPA only accounted for flow minimization at three plants in its costing analysis, and the final rule does not require that plants install flow minimization. Additionally, for each of these three plants where EPA included flow minimization in the cost estimates, the flow reduction factored into EPA's analysis would only raise the chlorides to within 80% of the maximum chloride level specified in the ICR response for the FGD system. Therefore, any flow minimization implemented by the plants, which is not required, would not result in chlorides concentrations in the FGD wastewater that exceed the design concentrations for these FGD systems. In addition, the highest chloride concentration that would result from flow minimization at these three plants is 10,000 ppm, well below the 35,000 ppm limit discussed above. Therefore, EPA disagrees with the commenter that flow minimization would "tremendously increase chlorides levels in FGD wastewater." EPA also disagrees with the commenter's claim that plants would have to lower the chloride levels in the FGD scrubber, increasing the wastewater flow rate and the cost of the treatment system. As EPA shows above, the chloride concentrations in the FGD wastewater are within the range that the microorganisms can tolerate and therefore plants will not need to change their scrubber operation.

<u>Nitrate/Nitrite Concentrations</u>

EPA does not agree that there is very limited data to support the proposed nitrate-nitrite limits, nor that there is insufficient long-term data to determine the effectiveness of nitrate removal. The effluent limitations for nitrate-nitrite are based on 70 observations collected over several years of operation. These data are more than adequate for establishing the effluent limitations and they provide long-term demonstration of the effectiveness of nitrate removal. See the Statistical Support Document for Effluent Limitations and Section 3 of the TDD. Data for biological treatment of FGD wastewater at AEP's Mountaineer Plant (see data submitted by AEP in March 2014) and for a pilot-test at IPL's Petersburg plant (Higgins, T., et al. "Recent Applications of Meeting Compliance Challenges through Flue Gas Desulfurization (FGD) Wastewater) further demonstrate the effectiveness of nitrate removal. Additionally, GE provided performance data from two separate pilot studies that show effective removal of nitrate-nitrite concentrations (DCN SE04208 and SE04222).

The commenter states that "The biological treatment systems that EPA evaluated as BAT (Belews Creek and Allen) were designed for selenium removal, not nitrate/nitrite-N and selenium removal." EPA disagrees. As acknowledged by the commenter, "Thermodynamically, the nitrate/nitrite must be removed prior to initiation of selenium removal (selenate and selenite)." Therefore biological systems are *de facto* designed to remove nitrate/nitrite because they would not meet their designed selenium effluent concentration without also removing nitrate/nitrite.

The commenter notes that the biological treatment system at Belews Creek was designed to receive a maximum nitrate concentration of 100 ppm and says that higher nitrate loadings would require more microbes and a longer retention time to treat. EPA agrees that the expected nitrate-nitrite levels in FGD wastewater need to be taken into account in the treatment system design and operation. For those plants with nitrate-nitrite levels greater than 100 ppm, EPA's cost estimates include costs for a denitrification step prior to the biological treatment stage. See response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 44 in Comment Code 10.b and the *Incremental Costs and Pollutant Removals for the Final Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category* (Cost & Loads Report) (DCN SE05831/SE05832). The commenter suggests that actions such as a change in the fuel burned or the FGD recycle rate could affect the nitrate levels in FGD wastewater and affect the denitrification process, potentially decreasing the selenium removal. EPA closely evaluated the processes that could affect treatment system performance, as well as mechanisms for anticipating and/or monitoring for potentially adverse conditions, and response strategies for mitigating any adverse impacts. EPA determined that there are multiple parameters and mechanisms that would provide early indication to the plant operator(s) of degraded treatment system performance (or advance warning of changing wastewater characteristics prior to degrading treatment system performance) and that the wastewater characteristics and treatment system can be managed so that plants will be able to meet the final effluent limitations. In addition, EPA notes that nitrate/nitrite level can be measured quickly in the plants using a Hach kit or other method. This type of measurement would provide enough information to adjust the nutrient if the level of nitrate/nitrate is higher or lower than it had been. See DCN SE05846 (memorandum *Variability in Flue Gas Desulfurization Wastewater: Monitoring and Response*) for more information.

ORP Fluctuations

EPA recognizes that high ORP in the FGD wastewater, if not properly managed, could potentially be deleterious to the microorganisms in the bioreactor. However, EPA does not agree with the commenter's assertion that controlling ORP is extremely difficult, nor that plants are unable to ensure treatment levels when ORP fluctuates.

Plants can install relatively simple and inexpensive pH and ORP probes that can continuously monitor pH and ORP. Many plants likely already have the capability to monitor pH in the scrubber installed as they target their lime/limestone feed rate to maintain the absorber tank slurry pH around 5 S.U. Some plants have also started to monitor ORP in absorber tank, as shown by data submitted by Duke Energy and AEP. Plants also monitor pH of the wastewater influent to the chemical precipitation system to control chemical addition rates to ensure that the plant is achieving the target pH in the reaction tank. The pH is also monitored and can be adjusted upstream of the biological reactors (as part of the chemical precipitation system) to provide optimum conditions for microbial health and selenium reduction in the bioreactors. An ORP sensor included downstream of the bioreactors is employed to adjust the nutrient feed.

By monitoring ORP in the absorber or in the FGD purge, plants will have sufficiently advanced warning to respond to high ORP levels. As noted above, plants with anoxic/anaerobic biological treatment systems already monitor the ORP within the bioreactor and use that data to control the nutrient feed, as an indicator of the health of the microorganisms, and to monitor the overall performance of the bioreactor. EPA also included costs in its cost estimates for the final rule for plants to install an ORP probe in the FGD purge line prior to the equalization tank.

This additional ORP probe serves a couple of purposes. First, it acts as an early warning system (in addition to the ORP monitoring plants some already do for the FGD absorber) for the treatment system operators. Because of the hydraulic residence time in the chemical precipitation stage of the treatment system (including the equalization tank with 24-hour HRT), knowing the ORP of the influent purge gives operators at least 2 days advance notification before the wastewater reaches the bioreactor, and possibly double that amount of time. This gives operators ample opportunity to take steps to adjust the ORP of the influent wastewater, adjust nutrient addition rate or, if necessary, stimulate additional microbial activity in the bioreactor. Second, high ORP is an indicator that high concentrations of free oxidants may be present in the influent wastewater. Thus, measurements from this ORP probe could be used, along with direct analyses of free oxidants if operators choose, to determine whether the plant should add chemicals to condition the wastewater. EPA included costs in its cost estimates for the final rule for a chemical addition system that will add a chemical reducing agent (e.g. sodium bisulfite) into the chemical precipitation system when needed to respond to elevated ORP levels. Section 6.2 of the *Incremental Costs and Pollutant Removals for the Final Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category* (Cost & Loads Report) (DCN SE05831/SE05832) contains additional details regarding these costs. The reducing agent will react with oxidants present in the wastewater and lower the ORP into an acceptable level for biological treatment. Alternatively, plants could add ferrous chloride as instead of ferric chloride in the chemical precipitation system. Ferrous chloride will react with oxidants, while ferric chloride does not.

Additionally, it is possible to respond to elevated ORP levels by increasing the feed rate of the nutrient mix. The nutrient mix provides the carbon necessary for the biomass to grow. By increasing the nutrient feed, microbial activity increases and the biomass will grow large enough to have sufficient capacity to reduce the increased load of electron acceptors.

See Section 7.1.3 of the Technical Development Document for the *Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category* (TDD) (DCN SE05904) for additional discussion of how plants can implement a proactive oxidant monitoring and mitigation strategy.

Plants are finding that by controlling scrubber ORP they can also reduce the incidence of corrosive conditions within the absorber. Maintaining closer control of scrubber ORP to remain within desired operating ranges to minimize corrosion has the added benefit of controlling influent purge ORP within the range that facilitates biological treatment (without the need for further conditioning such as sodium bisulfite addition) and reduces fluctuations in the influent purge ORP. A Babcock and Wilcox study suggested the highly oxidizing (i.e. high ORP) conditions in the reaction tank can lead to formation of manganese (IV) oxides that form galvanic corrosion cells when they deposit on the walls of the tank (Bonnin-Nartker, et al., 2012). They also noted that high concentrations of peroxodisulfate, also linked to high ORP, are found in scrubber tanks that are aggressively corroded.

Based on the comment, and in particular because the commenter refers to conditions and data for a test burn of Illinois River Basin coal at Duke Energy's Allen Station, EPA reviewed untreated and treated pollutant concentration data (including data for the bioreactor influent following the chemical precipitation stage) along with data for power output (electricity generation), coal type and source, FGD scrubber characteristics, FGD wastewater characteristics, and chemical additives and addition rates. EPA reviewed such data for Duke Energy's Allen Station and Belews Creek Station. In addition, EPA reviewed similar data for AEP's Mountaineer Plant and for a pilot-test of the biological treatment technology at a plant burning Illinois River Basin coal.

The data for Allen and Belews Creek do not demonstrate that coal switches consistently lead to elevated concentrations of selenium and nitrate/nitrite, nor that changing the type or source of coal burned would lead to discharges at concentrations above the final effluent limitations. On the contrary, the data show that in almost all cases, the plant would meet the final selenium effluent limitations following fuel switches. Allen switched to a non-standard coal 7 times, and after each of these events then switched back to the plant's standard coal. That resulted in a total of 14 times that the plant changed from one type of coal to another. Of the 14 coal switch events at Allen, only one measured value during one of the fuel switches exceeded the final daily maximum selenium limitation and the average of all 13 observations for that month was below the final monthly average selenium limitation. Belews Creek switched to a non-standard coal 8 times, and after each of these events then switched back to the plant's standard coal. That resulted in a total of 16 times that the plant changed from one type of coal to another. During the 16 times that Belews Creek switched coals, the data demonstrate that the plant would meet the final limitations in all cases. The one observation at Allen that exceeded the final daily maximum selenium limit was associated with the use of Illinois Basin bituminous coal. EPA closely reviewed the types of standard and non-standard coal burned by the plants and found that both plants burned Illinois Basin coal (and other coals) multiple times without selenium concentrations exceeding the final effluent limitations. Furthermore, EPA reviewed the data for a pilot test of the biological treatment technology at IPL's Petersburg plant, which burns Illinois Basin coal, and found that the effluent concentrations for selenium and nitrate-nitrate were consistently below the final effluent limitations. The data for Mountaineer support the findings for Allen and Belews Creek, showing that although the plant obtained coal from multiple sources and changed the type of coal it was burning, there is no indication that changing coals would affect treatment system performance and prevent a plant from meeting the final effluent limitations. See DCN SE05846 (memorandum *Variability in Flue Gas Desulfurization Wastewater: Monitoring and Response*) for more information.

<u>Ammonia Generation</u>

EPA disagrees that a nitrifying process to remove ammonia is needed for the biological treatment system effluent. Ammonia is not necessarily generated from the biological treatment system, although it can be produced as a byproduct of the nutrient blend used to feed the microorganisms. That is, nitrate and nitrite should be reduced to nitrogen gas (N_2) and not ammonia. This is consistent with the data for AEP's Mountaineer plant, which show that at times there was an increase in ammonia across the bioreactor, but at other times the ammonia concentration in the influent was higher than the effluent (i.e., ammonia was not generated in the bioreactor at these times). See the Mountaineer data (AEP's March 2014 data submittal) and DCN SE04208. The presence of ammonia could indicate that the bioreactors have become too strongly reducing, and the ORP in the effluent would be very low. Plants could decrease the rate of nutrient feed or increase the backflush frequency or duration to compensate for this. Additionally, GE noted that the nutrient blend can be formulated by plants to minimize the addition of ammonia to the treated FGD wastewater effluent. Nutrient dosages can be tightly controlled through proper monitoring to ensure over-dosing events are minimized and excessive ammonia generation prevented.

However, EPA acknowledges that the data for the three plants for which EPA has ammonia data for the both the influent and effluent from the ABMet biological treatment system show an increase in the ammonia concentration across the biological treatment system. Reformulating the nutrient mix and closely controlling bioreactor ORP should enable a plant to minimize the amount of ammonia in the FGD effluent. Although these actions should be sufficient, if a plant did have a specific ammonia limit (e.g., a water-quality based effluent limit for ammonia), it might choose to add additional nitrification treatment to remove any excess ammonia (that is, opting for treating the wastewater rather than instituting process controls and product substitution to minimize ammonia formation). However, the commenter has not identified any specific power plants that have ammonia limits, nor have any other commenters. Additionally, from EPA's review of permits during the detailed study and rulemaking, EPA has not identified any plants with an ammonia limit for their FGD wastewater. Therefore, no plants are expected to incur costs, due to the ELG, related to the presence of ammonia in their FGD discharge.

Generation of Organics

EPA disagrees with the commenter that the biological system "requires further aerobic biological treatment to remove the organics" from the effluent. The amount of biomass contained within the bioreactor is controlled by backwashing the system, which flushes a portion of the biomass from the reactor. The backwash is returned to the equalization tank at the head of the FGD wastewater treatment system where it mixes with untreated FGD wastewater. The solids that were backwashed from the bioreactor are ultimately removed from the wastewater in the clarifier, along with other solids from the chemical precipitation stage. Plants can backwash the bioreactors at a sufficient frequency to ensure that the level of organics in the effluent is minimal. EPA included costs in its estimates for the final rule for the treatment and disposal of the backwash in the chemical precipitation component of the BAT basis. Section 6.2 of the *Incremental Costs and Pollutant Removals for the Final Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category* (Cost & Loads Report) (DCN SE05831/SE05832) contains more information.

Periodic or Reduced Operation of Biological Treatment System

Based on discussions with GE, there are many cases where anaerobic systems run on seasonal industrial operations and see shutdowns for as long as 6 months. A relatively small amount of feed water (with some nutrient added) once per week can be supplied to the biological reactor to keep the bacteria active. If back-up power is available, a constant recycle thru the system can also be done but is not a necessity. The biomass can remain in a less active (nearly inactive) state for long periods of time and resume normal metabolic function in a relative short time once wastewater is again available (DCN SE04208). Based on discussions with GE, the biological treatment system can quickly return to operation if proper maintenance of the microbiology occurs during shutdowns. This is consistent with data in the record showing how changes in electricity generation, including cycling operation and unit and plant-wide shutdowns, affect the effluent concentrations of selenium in FGD wastewater following treatment by chemical precipitation and anoxic/anaerobic biological treatment technologies. These data show that power plants can effectively operate biological treatment systems and that they can meet the final effluent limits even following extended shutdown periods.

Data for three coal-fired steam electric power plants were reviewed in depth: Duke Energy's Allen and Belews Creek Stations and American Electric Power's (AEP) Mountaineer Plant. The data reflect treatment system performance over a period of two years at one plant, and more than four years for each of the other plants.

Both baseload and cycling power generation operations are included in the data and this dataset provides the ability to evaluate effluent selenium concentrations under steady power output, increasing and decreasing power output, shutdown and restart of one or more generating units at a site, and complete plant-wide shutdown followed by restart of one or more generating units. In addition, the long periods of time covered by the data from these plants reflect operation during different seasons and therefore reflect the effects of both hot and cold weather on both power output and the wastewater treatment systems themselves. As such, this dataset provides a comprehensive look at effluent selenium concentrations under a wide variety of conditions encountered at power plants.

During an approximately 4-year period, Belews Creek Unit 1 was shutdown 16 times; the shutdown duration ranged from 1 to 76 days. Belews Creek Unit 2 shutdown 29 times; the shutdown duration for this unit ranged from 1 to 43 days. There were 4 times when both generating units at Belews Creek were shutdown, with the plant-wide shutdown durations ranging from 1 to 8 days. The data for Allen also represents more than 4 years of operation. One or more generating units at Allen were often shutdown during this period and there were frequent periods when all units at the plant are shutdown. In addition, there were 41 times when all five generating units at Allen were shutdown, with the plant-wide shutdown duration ranging from 1 to 44 days. The operating data for Mountaineer represents two years of operation. During that period, Mountaineer was shutdown 7 times with the shutdown duration ranging from 2 to 104 days.

See DCN SE05846 (memorandum *Variability in Flue Gas Desulfurization Wastewater: Monitoring and Response*). Also, see the response to DCN EPA-HQ-OW-2009-0819-4684-A1, Excerpt Number 74.

<u>Variability of Coal Plant Operations</u>

EPA does not agree that effluent limits based on biological treatment can interfere with plants switching from one type of coal to another. The variability of the wastewater and the impact to the treatment efficacy can be mitigated with proper communication within the plant and proper pretreatment of the wastewater prior to the biological treatment stage. As described in preamble section VIII, the BAT basis for FGD wastewater is chemical precipitation followed by biological treatment, not biological treatment alone. Chemical precipitation systems have demonstrated the ability to handle the FGD wastewater variability prior to biological treatment.

EPA reviewed effluent data, along with information about the type of coal burned and when the coal source or type changed, and found that the selenium concentration can sometimes become elevated; however, the data do not demonstrate that the limits of the final rule cannot be met or that the biological system cannot accommodate changes in fuel type or load. Additionally, there are reasonable actions that the plants could have taken to improve the performance of the treatment system.

EPA reviewed data for Duke Energy's Allen and Belews Creek Stations, and for American Electric Power's Mountaineer Plant. For Allen and Belews Creek, these data represent 15 periods when the plants switched to a non-standard coal (as defined by the operating company) and then back again to the standard coal, providing data for a total of 30 times when these two plants changed the type of coal they burned. Importantly, any effect that the fuel switches at these plants may have had on the effluent concentrations is reflected in the dataset EPA used to develop the final BAT effluent limitations for selenium and nitrate-nitrite in discharges of FGD wastewater. For Mountaineer, EPA did not have information for specific dates when the coal type or source changed; therefore, the data for this plant was evaluated more broadly to identify whether there were any periods when effluent concentrations for selenium changed substantially. The data for this plant represented the use of coals from many sources and multiple coal basins. EPA examined the data for these three plants and found that the data do not demonstrate that fuel switches in and of themselves, nor changing the type or source of coal burned, would lead to discharges at concentrations above the final effluent limitations.

On the contrary, the data show that in almost all cases, the plant would meet the selenium effluent limitations following fuel switches. As shown below, of the 14 coal switch events at Allen (with each switch event including the switch to a non-standard coal, and then another switch to return to the standard coal), only one measured value during one of the fuel switches exceeded the level for the final daily maximum selenium limitation and the average of all 13 observations for the affected month was below the final monthly average selenium limitation. During the 16 times that Belews Creek switched coals (again, each switch event including a switch to a non-standard coal followed by the return to standard coal), the data demonstrate that the plant would meet the final limitations in all cases. The one observation at Allen that exceeded the final daily maximum selenium limit was associated with the use of Illinois Basin bituminous coal. EPA closely reviewed the types of standard and non-standard coal burned by the plants and found that both plants burned Illinois Basin coal (and other coals) multiple times without selenium concentrations exceeding the final effluent limitations. Furthermore, EPA has reviewed the report for a pilot test of the biological treatment technology at a plant that burns Illinois Basin coal and found that the effluent concentrations for selenium and nitrate-nitrate were consistently below the final effluent limitations. The data for Mountaineer support the findings for Allen and Belews Creek, showing that although the plant obtained coal from multiple sources and changed the type of coal it was burning, there is no indication that changing coals would affect treatment system performance and prevent a plant from meeting the effluent limitations. In fact, with the exception of one observation that indicated a sampling error or treatment system upset had occurred, all effluent concentrations for the entire 2-year period at Mountaineer were substantially below both the final daily maximum and monthly average effluent selenium limitations for FGD wastewater.

EPA notes that neither the Allen nor Belews Creek Stations are currently subject to an enforceable selenium effluent limit. Accordingly, Duke has not needed to optimize the performance of the biological treatment systems at the Allen and Belews Creek Stations and they have not provided any evidence that they adjusted operations to do so. Given the information that is available to operators at both plants, such as unit loads, fuel type, fuel sulfur content, ORP, pH, and nitrate/nitrate content of the FGD blowdown, Duke's operators can adjust the operation of the biological treatment to account for fuel switches. Operators may find that some other parameters, such as the quality of gypsum produced and efficacy of SO_2 removal in the scrubber, also prove to be effective indicators of characteristics of the incoming wastewater. At the very least, enhanced communication between plant staff operating the boilers, the air pollution control equipment, and the wastewater treatment plant would provide sufficient notice and coordination of operational changes to ensure that the wastewater treatment plant can be adjusted to handle changing conditions in advance.

For more information, see response to DCN EPA-HQ-OW-2009-0819-4448-A1, Excerpt Number 24 in Comment Code 9.a.

For plants that are planning to include fuel flexing in their operations, in the years prior to the installation and operation of the FGD wastewater treatment system, the plant should consider sampling the untreated FGD wastewater to evaluate the wastewater characteristics that are present based on the differing fuel blends. Based on those characteristics, the plant will be better able to design a system that can properly treat its FGD wastewater given variability that might occur at the plant, and it will be better prepared to adjust chemical dosages in the chemical precipitation system to mitigate the variability in the wastewater that enters the biological treatment system. Additionally, EPA notes that the BAT basis design accounts for the 24-hour equalization tank which will help mitigate the "extreme changes" caused by fuel flexing. EPA also included costs in its estimates for the final rule for instrumentation, equipment, and staffing to ensure key wastewater parameters and conditions such as high influent ORP are mitigated.

Regarding the specific situation at the Monroe plant described by the commenter, EPA acknowledges that plants may choose to "fuel flex" for economic reasons. But it is unclear from the comment why the plant is unable to discharge FGD wastewater for a 36-hour period during times when the plant is burning 100% subbituminous coal. First, the commenter states that the plant continues to blowdown during this period and since the plant is reported to be doing so to remove fines, it must be also purging to the wastewater treatment system (if the purge is not sent to the treatment system, fines would remain within the FGD scrubber system and not be removed). If the plant is purging to the treatment system, there would be flow through the treatment system, even if at a reduced flow rate. Second, as noted by the commenter, the plant is aware of the impending fuel switch at least 24 hours before it occurs. Thus, if the plant wanted to ensure it had wastewater flow maintained through the treatment system, it could use that time to stockpile volumes of untreated wastewater by filling the equalization tank to its maximum level and, if desired, filling the FGD maintenance tank (a rarely used tank at plants that is used whenever an FGD scrubber will be drained for maintenance). Therefore, during that time, that plant should be capable of running a small flow through the system at it continues to receive at least some blowdown for fines control. The plant can also recycle the treatment system effluent back through the treatment system in a continuous recycle loop, if desired. These are examples of steps the plant could take to maintain continuous flow through the treatment system, should they wish to operate in that manner, but it is important to note that maintaining the flow is not necessary. The data in the record for the ELG show that the BAT basis can effectively operate with periodic, and even extended periods, where there is no flow through the treatment system (also see the discussion above in this comment response). Regarding the changes in FGD wastewater characteristics described, the increased nitrate could be controlled by including a separate denitrification system upstream of the ABMet biological process, and the ORP can be controlled by adding a reducing agent within the chemical precipitation system such that the ORP does not fluctuate as drastically in the biological treatment system.

Variable Mercury Concentrations

Both particulate mercury and dissolved mercury will be removed in a properly operated chemical precipitation system: particulate mercury via settling or adsorption to other floc, and dissolved mercury via addition of organosulfide and other chemicals. The commenter states that mercury concentrations in FGD wastewater are more variable than EPA's data for the proposed rule showed, and references selected data for Belews Creek. EPA notes that, in response to comments, EPA supplemented the dataset used to develop the final effluent limitations for mercury and other parameters. These data reflect substantial variability in the untreated wastewater, but more importantly, they demonstrate that the BAT and NSPS technology bases for the final rule effectively remove both dissolved and particulate forms of mercury (as well as other pollutants). EPA based the limits for mercury on treatment system effluent data for four plants, with a total of 670 observations representing approximately 4½ years of treatment system operation and reflecting the varied and changing operations at those plants (e.g., fuels, air pollution controls, electricity generation rates). See the Statistical Support Document for Effluent Limitations for more information about these data. Regarding the variability in mercury concentrations observed at Belews Creek, the dissolved mercury present in the wastewater would have been better controlled if the plant had been operating all components of the BAT. In particular, Belews Creek was not adding organosulfide in its chemical precipitation system to optimize removals of mercury and other metals. However, if the plant did use organosulfide and it had been monitoring the effluent from the wastewater treatment system, the plant would have identified the excursion and could have taken steps to address it by recycling the wastewater back to the equalization tank for reprocessing. At the same time, the plant could have begun increasing its dosage of organosulfide (and potentially polymer and ferric chloride) to target additional removal of the mercury. EPA notes that it included costs for a mercury analyzer in its cost estimates for the final rule. This analyzer would alert the operators to the mercury concentration in the treatment system influent or effluent and could be used to adjust the organosulfide dosage rate.

EPA also notes that many plants are monitoring the ORP in the scrubber because of the issues related to corrosion of the scrubber vessel, as well as the issues mentioned by the commenter. As such, plants should have ample warning to the potential for the increased dissolved mercury concentrations and can plan accordingly by increasing the chemical dosages in advance of the wastewater entering the system. Additionally, plants are capable of adding reducing agents directly to the FGD absorber to control the ORP levels in the scrubber.

Representativeness of Biological Treatment Performance

EPA does not agree that "[t]he biological treatment performance at Belews Creek and Allen does not represent the level of treatment that biological systems could achieve at other power plants." EPA recognizes that these plants were burning bituminous coal and that their concentrations of some parameters may differ from those present at other plants; however, these differences do not affect the treatability of the wastewater, nor the ability of other plants to meet the effluent limitations. For example, the commenter points to the chloride and TDS concentrations at Allen and Belews Creek, suggesting that the performance attained at Belews Creek may not be achieved by plants with higher chloride wastewaters. However, the data in the record do not show a correlation between chloride/TDS levels and effluent performance – put another way, there are no data showing that effluent performance is degraded at higher levels of chlorides or TDS. Furthermore, during the pilot study of the biological treatment technology at IPL Petersburg, for which all effluent values were below both the final daily and monthly limitations, the TDS of the wastewater ranged as high as 27,000 mg/L. The TDS at Petersburg therefore was substantially higher than the TDS at Allen and Belews Creek, without any observed effect of treatment system performance. More importantly, for every plant in the U.S. that discharges FGD wastewater, Steam Electric Survey data shows that the chloride concentration in their wastewater is within the range that has been already been demonstrated to be amenable for treating FGD wastewater treatment.

The chemical precipitation system is capable of handling variability in the FGD wastewater, see response to DCN EPA-HQ-OW-2009-0819-4448-A1, Excerpt Number 24 in Comment Code 9.a. By reducing the concentration of dissolved metals, adjusting the pH or alkalinity, and reducing the total suspended and dissolved solids concentrations of the FGD wastewater, the chemical precipitation system step acts to condition the wastewater for optimal treatment in the biological system, and additional chemical pretreatment can be done if necessary. This could include chemical addition to remove oxidants and lower ORP (e.g., sodium bisulfite, or use of ferrous chloride instead of ferric chloride). EPA does not agree that plants with higher nitrate levels in their wastewater may not be able to meet the effluent limitations. Varying nitrate levels can be addressed by changing the nutrient feed rate and by taking other steps to manage the biological processes. For those plants that have nitrates at higher than 100 mg/L in their influent, EPA included costs for the treatment system to include a separate denitrification step to reduce much of the nitrates prior to the biological stage. Therefore, the chemical precipitation pretreatment step is used to remove as much of the particulate and dissolved metals from the wastestream as possible, mitigate any "issues" in the wastewater that could impact the biological treatment system, (e.g., ORP, pH, temperature), and allow for a more consistent influent to the biological treatment system. There is substantial variability in untreated wastewater, but the data show that a well-designed and properly operated treatment system can effectively remove the pollutants present and meet the effluent limitations. For more information about the variability of pollutant concentrations in FGD wastewater (at an individual plant or between plants) and the achievability of the effluent limitations, see the Statistical Support Document.

While EPA has based the effluent limitations and standards for selenium and nitrate/nitrite (as N) for FGD wastewater based on the performance of the Allen and Belews Creek biological treatment systems, EPA does not contend that every plant in the industry can simply take the design parameters from those two plants, install the biological treatment system, and meet the effluent limitations. Each plant will need to work with engineering and design firms to assess the wastewater characteristics present at their plant to determine the most appropriate technologies and design the system accordingly meet the effluent limitations. Therefore, some plants may need to design the bioreactors to provide additional bed contact time (as provided by the hydraulic residence time and volume of biomass and carbon substrate), while other plants may find they need less. A system that is properly designed and operated will be able to effectively remove the varying load of nitrates and selenium in the wastewater. EPA notes that the commenter provides no additional data to prove that the technology would be incapable of achieving the limitations.

The commenter suggests that for plants with varying characteristics, "the performance achieved at Belews Creek and Allen may not apply." However, neither this commenter nor any other commenter making these claims has provided data in which to demonstrate their point, except for the SCANA data related to the Wateree pilot testing. However, as described in response to DCN EPA-HQ-OW-2009-0819-4593-A1, Excerpt Number 3, those pilot test results are flawed because the plant was not performing appropriate pretreatment prior to the biological system and adverse characteristics in the wastewater (which would have been detected and mitigated if using and properly operating the BAT technology) were not properly addressed prior to the pilot bioreactor unit. The commenter asserts that EPA's FGD wastewater data are flawed and not representative but has not provided data in which to demonstrate their point. EPA notes that the review of this industry began in 2006 with the start of the detailed study and has continued on through this rulemaking. The proposal was published in June 2013. Additionally, throughout that time, the trade associations were involved in essentially every site visit and sampling episode conducted by EPA. The industry and the trade associations continue to conduct pilot tests evaluating the biological treatment system and other technologies, yet the results of those pilot tests (except for Wateree) are not referenced in the industry comments to refute the performance of the technology. For example, the more recent pilot test at IPL Petersburg show that all effluent values for nitrate-nitrite and selenium throughout the test were lower than the effluent limitations in the ELGs.

EPA notes that, in addition to the Allen and Belews Creek plants, the full-scale treatment system at AEP's Mountaineer Plant has been able to comply with the effluent limitations.

EPA notes that, in response to public comments, it received more performance data for biological treatment systems and used these data, as appropriate, to develop the effluent limitations for the final rule. EPA conducted an engineering review of the data and determined that plants would be able to meet the effluent limitation (see TDD Section 13). Thus, EPA does not agree with the commenter's assertion that "even Belews Creek and Allen could not reliably meet the proposed limits."

The commenter states that "EPA must identify and characterize the factors (such as those mentioned above) that affect effluent quality." As EPA describes above and elsewhere in the record, the factors mentioned by the commenter affect the raw FGD wastewater and those effects can be addressed by proper design and operation of the BAT technology; thus, if the treatment system is properly operated, these factors will not affect effluent quality. EPA has evaluated a number of factors that could potentially affect effluent quality, including influent pollutant concentrations, wastewater characteristics (e.g., pH, ORP), and plant operational practices that may affect wastewater pollutants or other characteristics (e.g., fuel switching, cycling power operation). For each of these, EPA either determined that they do not affect the effluent quality or can be managed so they do not do so. Plants will need to design and operate the systems appropriately to be able to comply with the effluent limitations. EPA's record demonstrates that such design and operation is within plants' ability and that the BAT basis is capable of achieving the final limitations.

The commenter states that monitoring FGD systems is not a solution to effluent excursions. In particular, the commenter points to factors such as the type of coal burned and the scrubber ORP, claiming that they can change the performance of the treatment system. As noted above, EPA considered these specific factors, as well as others, and concluded that these can be managed to ensure plants meet their effluent limitations. Furthermore, EPA strongly disagrees with the commenter's suggestion that actively monitoring wastewater characteristics and treatment system performance will not enable plants to identify excursions and adjust for them. It will do so, but it is also important for plants to monitor conditions and take steps that can prevent the excursion from occurring in the first place. See DCN SE05846 (memorandum *Variability in Flue Gas Desulfurization Wastewater: Monitoring and Response*).

The commenter also presents information about the variability of selected pollutants in coal, noting a difference of 40% for mercury from two sources and a factor of four difference for selenium in coal from two sources. These percent differences in coal pale in comparison to the large variability embodied in the data used to establish the effluent limitations for the ELGs. See, e.g., the variability in pollutant concentrations for the FGD purge, as shown in the Statistical Support Document for Effluent Limitations.

Commenter Name: Cari Boyce
Commenter Affiliation: Duke Energy
Document Control Number: EPA-HQ-OW-2009-0819-4305-A3
Comment Excerpt Number: 43
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

EPA's evaluation of biological treatment relied on two stations, Duke Energy's Allen and Belews Creek Steam Stations, which burn similar coal and employs the same biological treatment system, GE ABMet. EPA has failed to demonstrate that other utilities would be able to achieve similar removal performance as the treatment systems at Allen and Belews Creek. These systems encounter a number of challenges and even EPA has acknowledged that they are "aware of industry concerns with the feasibility of biological treatment at some power plants. Specifically, industry has asserted that the efficacy of these systems is unpredictable, and is subject to temperature changes, high chloride concentrations, and high oxidation reduction potential in the absorber (which may kill the treatment bacteria)."[4]

First, the performance of biological treatment systems has not been demonstrated over a wide range of fuels. EPA's limited data set does not have enough samples to account for the variations in the bioreactor influent (i.e. baseline) concentrations due to changing fuel conditions or the subsequent impacts to treatment system performance for bioreactors. The data that EPA used for its analysis was collected when Allen and Belews Creek burned primarily low sulfur Central Appalachian coal. However, there is a wide range of coal types available and used outside of the Central Appalachian region.

Duke Energy has significant concerns with demonstrating continuous compliance with the proposed BAT limits for biological treatment systems with alternate fuels. Duke Energy's experience has shown that when coal is combusted with constituents or properties that are different from Central Appalachian coal (i.e. Northern Appalachian coal, Illinois River Basin, etc), increases in the ORP (oxidation reduction potential) of the scrubber slurry have been observed. High ORPs (greater than 500 mv), result in the formation of free available oxidants (FAO), which can adversely impact the microbe health in the bioreactor. This decline in microbial health can lead to reduced performance of the biological system. As an example, in late 2011, the Allen Steam Station conducted a test burn of a high sulfur blended coal containing Illinois River Basin coal. During the test burn, increased ORP values within the influent to the FGD wastewater treatment system and within the FGD scrubber were observed. With the increased oxidizing environment within the scrubber, a noticeable chorine-like smell was observed and an increase in FAO was detected within the influent to the FGD wastewater treatment system. To prevent damage to the microbes within the bioreactors, the test burn was stopped immediately and flow to the bioreactors was interrupted for several days, as reported to the North Carolina Department of Environment and Natural Resources (NCDENR) Mooresville Regional Office. If the test burn had been allowed to continue, and elevated ORP values continued, there was a concern that the increased oxidizing environment would cause substantial harm to the organisms in the bioreactors. Upon investigating this incident, it has become apparently clear that the wastewater matrix generated during this test burn was completely different than any previously observed FGD wastewater matrix at Allen or Belews Creek.

Second, biological systems rely on living organisms to treat the water. The microorganisms are susceptible to performance degradation due to operational and ambient variations. For example, it is difficult to maintain the microbe's health when units are offline. In past years, large coal plants have operated continuously as base loaded units. It would be challenging to maintain a biological system for coal stations that cycle or are peaking units, especially in colder regions. A real concern is the recent sporadic operational trend of coal units, due to low natural gas prices, coupled with the increased environmental costs.

In contrast to chemical precipitation, there is only one proven industry technology supplier for biological treatment of FGD wastewater, GE ABMet. Even so, GE has only installed five ABMet systems for the treatment of FGD wastewater. If a biological treatment option is determined as BAT, it is unlikely that GE would be able to provide the number of systems needed, within the time frame required and within the cost estimates developed by EPA. Other suppliers are introducing new systems to the market, however, they have not been demonstrated beyond a pilot scale for FGD wastewater. Overall, there are significantly more experienced suppliers for chemical precipitation systems designed to treat FGD wastewater effectively.

Effluent limitation guidelines are intended to be a national treatment standard and should be based on technologies which are appropriate and technically feasible on a national level. EPA has failed to demonstration the effectiveness of biological treatment on a national level. EPA only evaluated the treatment systems at Duke Energy's Belews Creek and Allen Steam Station, which primarily burned similar coal. Biological treatment is a targeted solution for particular constituents of concern, such as selenium and nitrate/nitrites. This technology, therefore, is best served to solve specific water-quality issues related to a particular site or receiving water body when it is determined that these constituents warranted removal. Furthermore, Duke Energy contends that an industry-wide requirement of biological treatment for FGD wastewater is not incrementally cost-effective and would provide little to no incremental environmental benefit over a chemical precipitation system.

Duke Energy does not support the EPA BAT options that include the use of biological treatment systems.

---

[4] 78 Fed. Reg. at 34470.

Comment Response:

EPA disagrees that biological treatment "is best served to solve water-quality issues related to a particular site or receiving water body." The Clean Water Act (section 301) requires *both* effluent limitations based on water quality, as well as technology-based effluent limitations, which reflect a specified level of control (e.g., Best Available Technology Economically Achievable, Best Available Demonstrated Control Technology). Indeed, the technology-based provisions of the Act represent Congress's response to the understood failure of pollution controls based solely on the quality of the receiving water. *Weyerhaeuser Co. v. Costle*, 590 F.2d 1011, 1042 (D.C. Cir. 1978). Thus, technology-based effluent limitations and standards are not based on the quality of the receiving water, but on the level of performance that can be achieved by available and demonstrated technologies. See responses to comments in comment code 6.c for more information on the difference between water quality-based effluent limitations and technology-based effluent limitations. As explained in the preamble, EPA has sufficient information in its record to establish Best Available Technology limitations for the steam electric power generating industry in the final rule. Where there is a need to set more stringent local limitations, EPA agrees that those limitations would need to be evaluated on a case-by-case basis considering the water-quality standards in those localities.

EPA does not agree that it has failed to demonstrate the effectiveness of the technology on a national level or that plants will not be able to meet the effluent limitations. EPA also does not agree that the performance of the BAT basis of chemical precipitation plus biological treatment is unpredictable or that changes in temperature or conditions of high ORP cannot be managed, nor does EPA agree that the chloride levels in FGD wastewater would affect the performance of the biological treatment system. Contrary to the commenter's assertion, the effective performance of the BAT basis has been demonstrated for a variety of coal types, including the Northern Appalachian and Illinois Basin coals cited by the commenter, and the data show that plants will be able to meet the effluent limitations when using these coals and when changing from one type of coal to another. EPA does not agree that microbial health will be difficult to maintain, nor that it will be challenging for cycling or peaking plants to operate biological treatment systems, even in cold climates. The data evaluated by EPA reflect years of cycling power operation at plants and also include peaking operations. In addition, these data show that cold weather did not affect treatment system (moreover, EPA includes costs in its estimates for the final rule for plants in cold climates to place the biological treatment stage inside a building to protect against extremely cold weather). See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107 regarding biological treatment performance and FGD wastewater variability. Also see DCN SE05846 (memorandum *Variability in Flue Gas Desulfurization Wastewater: Monitoring and Response*).

See response to DCN EPA-HQ-OW-2009-0819-4607-A1, Excerpt Number 13 and DCN EPA-HQ-OW-2009-0819-5552-A2, Excerpt Number 7 regarding the market availability of biological treatment systems. As noted in those responses, there are also other technology solutions plants can use to meet the effluent limitations, should they choose to implement process changes or non-biological treatment systems. Regardless, even if plants were to limit themselves to a single vendor for biological treatment, the technology is still available. EPA estimates that there will be 69 plants that incur costs to implement the final ELGs (that number takes into account the effects of the CPP rule; it is 87 plants if the CCP rule is not taken into account). At least 3 of those plants already operate the biological treatment technology from the vendor the commenter refers to, and therefore would not need to procure the treatment system. The final BAT limitations based on chemical precipitation plus biological treatment do not begin to apply for at least 3 years following promulgation, and the ELG requires that plants meet those final effluent limitations no later than December 31, 2023. NPDES permit authorities will determine the specific date that the BAT limits are available for a particular facility. However, assuming the acquisition of treatment systems is evenly distributed over a 5-year period (2018-2023), that will mean the vendor would be providing treatment systems to approximately 14 plants per year (approximately 18 treatment systems per year if CPP effects are not taken into account). That is not an unreasonable number of treatment systems for any vendor to supply, and in this particular instance the vendor is one of the largest companies in the world. The number of treatment systems needed to be supplied per year shrinks even more when recognizing that EPA has given plants more time to implement the ELGs: when factoring in the entire 8-year period between promulgation and the final implementation date, the vendor (or vendors) would need to supply an average of approximately 9 treatment systems per year (approximately 11 systems per year if CPP effects are not taken into account). Although the acquisition of treatment systems will not necessarily be evenly distributed across each of the years, these numbers illustrate that the number of treatment systems is not so large that a single vendor could not provide them, even if more were needed in some years than others (furthermore it is highly unlikely all plants will use the same vendor). Furthermore, as shown by the rapid change underway by plants to convert ash handling systems to implement the new CCR requirements, it is reasonable to anticipate that plants will similarly begin working with vendors to acquire wastewater treatment systems shortly after the ELGs are promulgated. It is also worth noting that the single vendor referred to by the commenter is the supplier for the biological stage of the treatment system; thus the comments refer only to a portion of the BAT basis. There are many vendors available to provide equipment and chemical additives the chemical precipitation treatment technology.

Commenter Name: Cari Boyce
Commenter Affiliation: Duke Energy
Document Control Number: EPA-HQ-OW-2009-0819-4305-A3
Comment Excerpt Number: 58

External Review Flag: Statistics
External Review Incorporated into Response: No

Comment Excerpt:

Selenium BAT Limits

As previously discussed, Duke Energy does not support chemical precipitation with biological treatment as a BAT option and believes that the selection of this technology should be applied to meet specific regional water quality limits. Furthermore, Duke Energy contends EPA has not obtained sufficient selenium data to capture the variability in fuels on the ability of the biological treatment system to remove selenium from FGD wastewater.

A summary of the selenium results from the EPA Sampling Event and the CWA 308 Sampling Event is provided in Table 1-11.

Table 1-11. Compliance Rate with Proposed Selenium Limits

Belews Creek FGD WWTS Effluent: Treatment = Chemical Precipitation + Biological		
Parameter	**Selenium (ug/L)**	
Sampling Type	EPA	
Number of Samples Collected	9	
Number of Samples below Detection Limit	3	
Number of Samples DL> Proposed Limit	0/3	
Proposed Limit (daily, monthly)	(<=16 ppb, <=10 ppb)	
Compliant with BAT daily max	5/9	55.6%
Compliant with BAT monthly max	5/9	55.6%

The nine samples from EPA's field testing from Belews Creek[12] Station demonstrate that the chemical precipitation with biological treatment system only achieved a 55.6% compliance rate with both the daily maximum (16 ug/L) and the monthly average (10 ug/L) limits for selenium.

Based on the EPA sampling data, Allen Steam Station demonstrates a much higher rate of compliance with the proposed selenium limit. However, as noted above, the data was obtained primarily when the station burned Central Appalachian Coal. With Belews Creek and Allen being very similar, we would expect similar performance. The difference in performance is due to several reasons, but primarily due to the fact Belews Creek started to burn a blend of Central Appalachian Coal with Northern Appalachian Coal. This is clear evidence that EPA has not fully evaluated the performance of biological treatment among a variety of fuels in developing the proposed selenium limits. Duke Energy, therefore, recommends EPA not establish BAT selenium limits for FGD wastewater in the ELGs and allow the state NPDES permitting authority to develop water quality-based effluent limits, as needed, for each station.

[12] EPA Sampling at Duke Energy Belews Creek Station 6/8/2010 -1/18/2011

Comment Response:

EPA does not agree that the data are not sufficient to capture the variability of fuels on the effects of the BAT performance. The final selenium and nitrate-nitrite limits are based on treatment system effluent data for two plants, with 398 observations for selenium and 70 observations for nitrate-nitrite. These data represent more than 5 years of data for one plant and more than 4 years of data for the other. These data reflect multiple changes in the type of coal used at these power plants, as well as changes in the source for a given type of coal. (Note that EPA has also reviewed data from other plants burning different coal; additionally, one of these plants changed its type and/or source of coal frequently during the 2-year period represented by the data). These data reviewed by EPA, and the data used to calculate the effluent limitations, demonstrate that plants will be able to meet the limits even when using different coal or changing the type of coal they burn. It is unclear why Duke Energy has only compared the nine samples from EPA's sampling program to the effluent limitations when Duke Energy has provided EPA with over 180 and 200 selenium samples representing the bioreactor effluent for Allen and Belews Creek, respectively. EPA also notes that, in response to public comments, it supplemented its dataset to use in developing the final limitations. Thus, the commenter's comparison of data to the proposed limits is not a relevant comparison for the final rule. See the Statistical Support Document for Effluent Limitations for a discussion of EPA's engineering review of the data and effluent limitations.

See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107 for additional information regarding variations from coal changes.

See response to DCN EPA-HQ-OW-2009-0819-4305-A3, Excerpt Number 43 for additional information regarding technology-based effluent limitations and water-quality based effluent limitations.

Commenter Name: Bruce W. Ramme
Commenter Affiliation: We Energies
Document Control Number: EPA-HQ-OW-2009-0819-4475-A1
Comment Excerpt Number: 36
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Disadvantages of Biological Treatment

Biological treatment, while effective at removing selenium, has a number of drawbacks. Biological treatment is only effective if the organisms are alive. What happens when units are shut down for extended periods of time (e.g., scheduled or forced outages, or units are not dispatched due to economics) and no FGD wastewater is being sent to the biological wastewater treatment system? Organisms are also sensitive to variable conditions in the waste stream (e.g., chloride levels, temperature, nitrate/nitrite levels, and oxidation reduction potential). This instability and unpredictability may pose problems in maintaining the biological treatment systems.

Also, Jill Sonstegard, et al. claim that the GE ABMet biological treatment systems were "designed to handle chloride levels up to 20,000 ppm, suspended solids up to 100 ppm, nitrate-N loading less than 100 ppm."[5] EPA calculated an overall average pollutant concentration for nitrate/nitrite as N to be 67.3 ppm for FGD wastewater effluent treated by one-stage chemical precipitation systems.[6] Yet, two of the sites EPA sampled with chemical precipitation systems, Hatfield's Ferry and Pleasant Prairie, have nitrate/nitrite effluent levels greater than the 100 ppm design specification for the GE ABMet biological treatment system (see Tables 1 and 2 below). We are concerned that the operation of the GE ABMet biological system (as designed for Belews Creek and Allen) may not meet the nitrate/nitrite limits if applied to Pleasant Prairie. A de-nitrification step may be needed in between the chemical precipitation phase and the biological reactor. EPA did not evaluate the costs or consider the trade-offs for adding a de-nitrification step. In some circumstances, ammonia can be produced as a byproduct of the biological treatment system. Any facilities facing discharge limits for ammonia or whole effluent toxicity limits ("WET" testing) could potentially require further treatment and incur additional costs.

Table 1: Hatfield's Ferry Nitrate-Nitrite as N data from EPA 4-day Sampling and Monthly CWA 308 Monitoring[7,8]

Sample Collection Date	FGD WWTP Influent Nitrate Nitrite as N (mg/L)	FGD WWTP Effluent Nitrate Nitrite as N (mg/L)
12/6/2010	129	130
12/7/2010	208	140
12/8/2010	157	140

12/9/2010	129	130
10/5/2010	120	130
11/10/2010	120	86
1/12/2011	150	150
2/9/2011	100	83

Table 2: Pleasant Prairie Nitrate-Nitrite as N data from EPA 4-day Sampling and Monthly CWA 308 Monitoring[9,10]

Sample Collection Date	FGD WWTP Influent Nitrate Nitrite as N (mg/L)	FGD WWTP Effluent Nitrate Nitrite as N (mg/L)
6/21/2010	150	160
6/22/2010	160	160
6/23/2010	160	160
6/24/2010	160	160
9/30/2010	190	210
11/3/2010	160	170
12/8/2010	160	150

1/26/2011	230	220

[5] Sonstegard, J., J. Harwood, and T. Pickett. *Setting the Standard for Selenium Removal*, 2010 International Water Conference, IWC-10-18 at 5.

[6] EPA, *Technical Development Document for the Proposed Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category*, EPA-821-R-13-002 (April 2013), EPA-HQ-OW-2009-0819-2257 (2013 TDD) at 10-10, Table 10-4.

[7] Sampling Episode Report, Allegheny Energy's Hatfield's Ferry Power Station, EPA-HQ-OW-2009-0819-0813, p. 4-6, Table 4-1, 4-11, Table 4-2.

[8] CWA 308 Monitoring Data, Allegheny Energy's Hatfield's Ferry Power Station, EPA-HQ-OW-2009-0819-0884, Table G5-1, Table G5-2.

[9] Sampling Episode Report, We Energies Pleasant Prairie Power Plant, EPA-HQ-OW-2009-0819-0755, p.4-4, Table 4-1, 4-8, Table 4-2.

[10] CWA 308 Monitoring Data, We Energies Pleasant Prairie Power Plant, EPA-HQ-OW-2009-0819-0884, Table B5-1, Table B5-2.

Comment Response:

Regarding the treatment of FGD wastewater with high nitrate/nitrite concentrations, see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 44 in Comment Code 10.b.

Regarding the other comments regarding biological treatment performance (e.g., ammonia, nitrate/nitrite, chlorides, temperature, ORP, shutdown periods), see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107.

Commenter Name: Tom DeLawrence
Commenter Affiliation: PowerSouth Energy Cooperative
Document Control Number: EPA-HQ-OW-2009-0819-4460-A1
Comment Excerpt Number: 41
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

(a) Organisms are sensitive to nitrate/nitrite levels

Proponents of the GE ABMet biological treatment system claim that it is "designed to handle . . . nitrate-N loading less than 100 ppm."[8] Like GE's assertion for chloride concentrations, its assertions regarding acceptable nitrate/nitrite levels may be true as well. However, EPA and the industry cannot be sure because the FGD influent from both the Allen and Belews Creek plants have nitrate/nitrite levels much lower than 100 ppm. In fact, the systems at these two facilities were not even designed to treat and remove nitrates because of the low levels found in their respective waste streams.

EPA's ICR data reveals that the nitrate/nitrate levels found in FGD wastewaters can be as high as 400 mg/L. There is nothing in the record to support a determination that biological treatment systems can effectively treat these extreme nitrate/nitrate concentrations to a degree that will consistently comply with EPA's proposed selenium and nitrate limitations. Accordingly, EPA's proposed nitrate/nitrite limits are not sufficiently supported and cannot be justified without additional data collection and/or analysis of more, and varying, FGD waste streams at facilities throughout the country.

(b) Organisms are sensitive to FGD wastewater Oxidation Reduction Potential

Biological treatment systems often experience problems when there is high oxidation reduction potential ("ORP") in FGD wastewater. In extreme cases, high ORP can even kill the microorganisms. High ORP means that the FGD wastewater has high concentrations of oxidants that could consume the biological system's reduction capability, which could reduce its capability to remove nitrate/nitrite and selenite/selenate. EPA failed to consider this potential impact.

(a) Biological back wash from the treatment process

The biological filters utilized in biological treatment systems become saturated quite often. When they do, the filters must be back-flushed. How often such back-flushing is needed depends upon operational needs and the quantity and volume of back wash that plant personnel will be able to manage. Plant personnel will likely have to closely monitor their biological filters at first in order to determine how often back-flushing is required. This will require operational changes and additional resource allocation. Separately, how is this back-flushing wash water to be disposed of by the industry? Certainly there will be additional costs associated with disposing of this wash water appropriately. These facts make this technology even more cost-prohibitive and were inadequately considered by the agency in proposing biological treatment as a regulatory option for this waste stream.

(b) Footprint concerns

Many facilities may not possess sufficient real estate to physically install a biological system and any associated infrastructure. EPA paid no more than lip-service to the idea that it may not be feasible to construct the necessary structures and appurtenances at certain facilities given their individual locations, designs, and layouts. By way of example, there are significant space limitations to installing the necessary equipment and tanks at the Lowman Plant. An elaborate cooling system, several first- and second-stage bioreactors, multiple effluent transfer tanks, and multiple backwash holding tanks would likely need to be installed at the facility in order to effectively utilize this technology. This creates a significant footprint concern for the plant, let alone the expenditure of significant additional costs it may cause. EPA's consideration of this issue in its BAT analysis is severely lacking and further weighs against selection of this technology as BAT. EPA's proposed selection of it in the Draft Rule is unreasonable, unsupported, and should be revisited.

---

8 Sonstegard, J., J. Harwood, and T. Pickett. Setting the Standard for Selenium Removal, 2010 International Water Conference, IWC-10-18 at 5.

Comment Response:

EPA does not agree that the nitrate-nitrite limits are not sufficiently supported, nor that plants will be unable to effectively treat wastewater containing high nitrate concentrations. See the Statistical Support Document for Effluent Limitations, DCN SE05846 (memorandum *Variability in Flue Gas Desulfurization Wastewater: Monitoring and Response*), and the response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 44 in Comment Code 10.b.

Regarding the other comments regarding biological treatment performance such as treating wastewater containing high ORP, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107.

EPA does not agree that aspects of the treatment technology, including its operation and waste disposal, were not adequately considered. The biological treatment system generates backwash that is equivalent to less than five percent of the total FGD flow every month and with minimal percent solids (DCN SE00753). Based on discussions with GE, the protocol dictates that the generated volume is spread out over that month to ease handling and minimize instantaneous volumes, i.e., a plant operating multiple reactor trains will alternate reactor trains to backwash on a weekly basis. The design of the BAT basis accounts for recycling the backwash water to the equalization tank that feeds the chemical precipitation system. EPA included costs in its estimates for the final rule for the treatment and disposal of the backwash in the chemical precipitation component of the BAT basis, as described in section 6.2 of the *Incremental Costs and Pollutant Removals for the Final Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category* (Cost & Loads Report) (DCN SE05831/SE05832). As shown in that document, EPA also included costs in its estimates for the final rule for adequate staffing for operation and maintenance of the treatment system, as well as staffing associated with disposal of treatment residuals.

EPA does not agree that plants lack adequate space for installing the BAT technology, based on survey data (including aerial view/diagrams of plants and plant boundaries showing adequate land is available) and the size of the treatment system. For example, in the case of Lowman see the survey data for question C1-2 showing that of a total plant area of 480 acres, there are approximately 150 acres of unused land. The commenter greatly exaggerates the scale of the treatment system by referring to the need for an "elaborate cooling system," which is no more than a simple cross-flow or counter-flow non-contact cooler and is a small component in the system (requiring less than approximately 10ft x 10ft floor space) and multiple backwash tanks. The backwash volume is not large and can either be sent directly to the equalization tank or a relatively small tank that retains the backwash volume for a short period of time, only as long as needed to feed the captured volume into the equalization tank. Regardless, the plant's survey data show that there is adequate land available at the facility. In developing EPA's cost methodology, EPA reviewed the responses to Question D6-3 of the Steam Electric Survey for each plant. Based on this review, EPA determined 80 percent of plants installing tank-based treatment technology, such as chemical precipitation, reported zero costs or did not report any costs for land and the remaining plants reported very low land costs (approximately 1 percent of purchase equipment costs). Accordingly, EPA determined that few if any plants would incur any significant cost for land acquisition or development and concluded that for those plants where land available may be constrained, the contingency costs included in the cost estimate would take such additional costs into account. The information submitted by PowerSouth for the Lowman Plant does not substantiate their claim that the plant has significant space limitations such to preclude installation of the BAT basis.

Commenter Name: Thomas Cmar
Commenter Affiliation: Earthjustice, et al.
Document Control Number: EPA-HQ-OW-2009-0819-4684-A1
Comment Excerpt Number: 70
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

1. Chemical precipitation plus biological treatment is technologically available

Chemical precipitation plus biological treatment is a very well established technology to treat FGD wastewater.[265] There are already at least six full-scale ABMet biological treatment systems in the United States, in addition to nine ongoing pilot tests.[266] The largest of these is the system at Progress Energy's Roxboro plant, which treats up to 1,400 gallons per minute.[267]

Despite this record of experience, industry has raised concerns that biological treatment systems are too vulnerable to fluctuations in influent characteristics. In the proposed rule, EPA notes "industry concerns with the feasibility of biological treatment at some power plants [, s]pecifically . . . that the efficacy of these systems is unpredictable, and is subject to temperature changes, high chloride concentrations, and high oxidation reduction potential in the absorber (that may kill the treatment bacteria)."[268]

We agree with EPA that the available data do not support these assertions. As the attached report of Dr. David Jenkins discusses, although the biological system functions most effectively with certain influent characteristics, variations in influent characteristics can be accommodated by adequate equalization, monitoring and instrumentation controls. The plants currently operating these systems have already developed approaches to deal with variability in the wastewater characteristics. For example, the Roxboro plant has a 250 million gallon impoundment that can store up to 30 days of blowdown capacity and serves to "equalize the blowdown to mitigate any fluctuations in the chemistry of the stream."[269] In addition, when the system was being installed at Allen, Duke Energy learned from some of the early experience at Belews that additional ORP and pH probes were needed for proper operation.[270]

While the wastewater purged from the scrubber may be variable, there are many treatment steps and opportunities for equalization, monitoring and adjustment before that wastewater enters the bioreactor.[271] Wastewater leaving the scrubber typically passes through a gypsum separation system (like a hydrocyclone), then various equalization and precipitation tanks. At each of these stages, the water cools, is mixed with earlier and later purges from the FGD system, and can be monitored and adjusted.[272]

Steam EGUs are sophisticated, well-controlled and well-monitored systems—it is unrealistic to assert that the wastewater entering the bioreactor would be subject to unpredictable and unmanageable variations. Plant managers are accustomed to monitoring processes and operations to ensure compliance with stringent air pollution control measures, and that expertise can be employed to ensure that water permit limits are met as well. Moreover, the air pollution controls systems generating these wastewaters also have operational limitations. Although the ABMet system tolerates up to only 20,000 ppm chloride,[273] FGD scrubbers themselves are also not generally constructed to withstand anything higher than 20,000 ppm chlorides.[274] An increase in chloride levels above what the ABMet system can handle would therefore be the result of poor plant operation, not a regularly occurring plant process that would need to be modified to accommodate the ABMet system.

EPA has established biological treatment systems as BAT in other industries, illustrating that the systems are not inherently unpredictable or unstable and that their use has proved appropriate as an industry-wide standard.[275]

---

[265] This process has also been used to reduce selenium and other metals in many other industries, including: drainage water from irrigated agriculture, mining wastewater, metals processing wastewaters. and oil refinery wastewaters. Jenkins FGD Report, Appendix C, at 4.

[266] *See* ERG Memo, Status of Biological Treatment Systems to Remove Selenium (April 19, 2013), EPA-HQ-OW-2009-0819-2127.

[267] Blankenship, Steve, "Bugs" Used to Treat FGD Wastewater, Power Engineering, Dec. 20, 2010, EPA-HQ-OW-2009-0819-1233.

[268] 78 Fed. Reg. at 34,470.

[269] Sonstegard et al., Full Scale Operation of GE ABMet Biological Technology for the Removal of Selenium from FGD Wastewaters, EPA-HQ-OW-2009-0819-2079, at 4.

[270] Jenkins Report, Appendix C, at 9.

[271] *Id.* at 7.

[272] *Id.*

[273] Sonstegard, Full Scale Operation, EPA-HQ-OW-2009-0819-2079, at 3.

[274] TDD at 6-2.

[275] *See, e.g.*, 42 Fed. Reg. 1398-426 (1977) (setting standard based on activated sludge treatment for pulp and paper industry); 39 Fed. Reg. 7894 (Feb. 28, 1974) (setting standard for meatpacking industry based on aerobic and anaerobic lagoons); 65 Fed. Reg. 81,242, 81,269-70 (Dec. 22, 2000) (setting organic pollutant standard for centralized waste treatment industry based on sequential batch reactor); 69 Fed. Reg. 54476 (Sept. 8, 2004) (setting total nitrogen standard for meat producing facilities based on biological treatment, nitrification, partial denitrification, and disinfection); 52 Fed. Reg. 42,522 (Nov. 5, 1987) (setting standard for sources in the Organic Chemicals, Plastics, and Synthetic Fibers (OCPSF) industrial category based on biological treatment usually involving activated sludge or aerated lagoons); 63 Fed. Reg. 50,388 (Sept. 21, 1998) (setting organic pollutant standard for pharmaceutical manufacturing industry based on advanced biological treatment).

Comment Response:

EPA agrees with the commenter that the BAT basis of chemical precipitation plus biological treatment is a proven technology for control of pollutants in discharges of FGD wastewater and for other industry wastewaters, and that it is technologically available (see preamble section VIII).

Commenter Name: Ron Shipman
Commenter Affiliation: Georgia Power Company
Document Control Number: EPA-HQ-OW-2009-0819-4447-A1
Comment Excerpt Number: 21
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Biological Treatment Is Not Feasible And Available For All FGD Wastewaters

Biological treatment, in general, is not feasible and available for all FGD wastewaters. A Southern Company subsidiary, Southern Company Services, has thoroughly studied biological treatment technology, and found: (1) this technology is not demonstrated as effective for a range of FGD influents; (2) it has many significant operational issues and will lead to power plant outages (or diversions of wastewater) if broadly applied; and (3) there is not enough experience with biological treatment of FGD wastewater to warrant its selection as a model technology for this rulemaking.

First, biological treatment is not effective for a range of FGD influents. The plants on which EPA's biological treatment systems model technology were based were designed to handle chloride levels up to 20,000 ppm, suspended solids up to 100 ppm, and nitrate-N loading less than 100 ppm. No such system has been demonstrated where flow minimization practices cycle up the concentrations to higher levels for these parameters. For example, based on EPA's ICR data, chlorides range up to 40,000 ppm. In addition, the organisms within the model system are not as resilient as EPA claims. The organisms are sensitive to chloride levels and swings in chloride levels. High chloride levels can affect treatment levels, as can total dissolved solids and temperature fluctuations. The organisms are also sensitive to nitrate/nitrite and oxidation reduction potential levels.

In addition, biological treatment systems require water temperature to be well controlled to ensure good selenium and nitrate-N removal. If a plant shuts down due to a scheduled or unscheduled outage, the microbes may be lost from the bioreactor due to their relatively narrow thermal requirements and tolerance, resulting in a temporary loss of treatment performance. Declines in temperature, such as a 20 degree temperature drop, can potentially decrease treatment performance by greater than 90 percent.

Second, biological treatment systems have many significant operational issues and will lead to outages (or diversions of wastewater) if broadly applied. Biological systems require a stable, consistent FGD wastewater influent stream, which is challenging even during normal plant operations, but is of greater difficulty given the variability of coal unit dispatch exhibited in recent times. As coal units come on line, it is very unlikely that biological treatment systems will be able to startup and immediately meet the proposed limits. With the extensive variables discussed above, basing this proposed technology on two plants that are not representative of an entire industry will not work.

Lastly, there is not enough experience with biological treatment of FGD wastewater to warrant its selection as a model technology for this rulemaking. As discussed above, EPA's assessment of biological treatment is based on only two plants, Allen and Belews Creek. The biological treatment demonstration at these plants only represents the capabilities of biological treatment for their FGD wastewater. Accordingly, the biological treatment experience at these two plants is simply not enough to warrant its selection on an industry-wide basis.

Comment Response:

Regarding the treatment of FGD wastewater with high nitrate/nitrite concentrations, see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 44 in Comment Code 10.b.

See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107 for a detailed discussion on FGD wastewater variability and biological treatment performance, including issues raised by the commenter such as chlorides, temperature, ORP, nitrates, and operation during or after shutdown periods. EPA has considered each of these issues, as well as other factors related to operation of the BAT basis, and determined the technology is available and that plants will be able to meet their effluent limitations. EPA does not agree that there is a lack of experience with biological treatment that precludes its selection as the basis for BAT (note that the BAT basis also includes chemical precipitation and other elements). Also, EPA notes that, in addition to the two plants referenced by the commenter (the data from which were used to develop the effluent limitations), EPA has also assessed other relevant data, including with respect to the operation of biological treatment systems at the Mountaineer Plant and IPL Petersburg.

Commenter Name: Donald R. Carlson
Commenter Affiliation: Kansas Department of Health and Environment (KDHE)
Document Control Number: EPA-HQ-OW-2009-0819-3922-A1
Comment Excerpt Number: 6
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

We question the feasibility of providing anaerobic/anoxic biological treatment for the parameter selenium. In Kansas, most facilities are either located within a metropolitan area where the facility utilizes the municipal sanitary sewer for handling and disposal of domestic wastewater from the plant. The facilities located outside of metropolitan areas most generally employ wastewater lagoon systems or septic tank and lateral field systems if they are relatively small. None of the facilities would be able to provide the anaerobic/anoxic biological treatment for selenium unless they build a set of biological reactors specifically for this purpose and even then could not support the raw wastewater strength to effectively run such a system without introducing some form of high strength "synthetic wastewater" i.e., molasses, blood, milk, etc. In addition to the biological reactors, they would most likely also then have to develop a wastewater sludge dewatering process with the dewatered sludge being directed to a landfill for disposal.

Comment Response:

The comment references the "handling and disposal of domestic wastewater from the plant" but the final selenium limitation is only applicable to FGD wastewater discharged at power plants meeting the applicability of 40 CFR 423. For those power plants meeting the applicability, the final rule establishes BAT limitations for FGD wastewater discharges based on a chemical precipitation system followed by anoxic/anaerobic biological treatment system (for generating units that are greater than 50 MW and that are not oil-fired). The final rule does not, however, require facilities to install that technology, but only that the appropriate facility effluent limitations and standards be achieved. A plant will have to evaluate for their FGD wastewater whether or not additional treatment is required to meet the limitations and standards. EPA notes that the biological system evaluated for the final rule does require nutrient addition, and EPA has included costs for the nutrients in it cost estimate for the final rule. Furthermore, EPA's cost estimates for the final rule include all equipment required to install and operate the BAT basis (e.g., including treatment sludge dewatering and biological reactors).

Commenter Name: Paul Chu
Commenter Affiliation: Electric Power Research Institute (EPRI)
Document Control Number: EPA-HQ-OW-2009-0819-4499-A1
Comment Excerpt Number: 58
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

5.7 The EPA-established BAT may not effectively capture selenium species other than selenite and selenate. Facilities whose FGD wastewater contains these other species may have difficulty meeting the proposed limits.

EPRI has conducted numerous studies to characterize selenium speciation in FGD waters and to clarify the factors that impact speciation [EPRI, 2009; EPRI, 2010; EPRI, 2011]. FGD water samples were analyzed for selenium species by ion chromatography-inductively-coupled plasma-dynamic reaction cell-mass spectrometry (IC-ICP-DRC-MS). In addition to the common selenium species—selenite and selenate—this analytical approach is able to identify several selenium compounds, such as selenocyanate and selenosulfate. In some FGD waters, there are other unidentified selenium peaks [EPRI, 2009]. Thus, the various selenium species, including measured but unidentified compounds, do not sum to match total dissolved selenium in some samples. When this occurs, there is a consistent low bias, and the scientific community has concluded that some "unaccounted" compounds—possibly colloidal selenium—appear to become bound in the ion chromatograph and do not elute for analyses. All told, these unidentified and unaccounted selenium compounds are observed only periodically at select facilities.

EPRI is conducting a subsurface, anaerobic wetland study at a southeastern U.S. bituminous coal-fired power plant equipped with a wet FGD. Several times over the course of the study at this facility, EPRI has measured significant levels of selenium compounds other than selenite and selenate (Table 5-2). This observation raises concern that measured but unidentified forms of selenium, as well as unaccounted selenium, may be less effectively captured in the anaerobic bioreactor installed at the site.

Table 5-2
Selenium Compounds Observed at Anaerobic Wetland Study Site

Sample	Selenite Se(IV) (µg/L)	Selenate Se(VI) (µg/L)	Other Measured, Unidentified Selenium (µg/L)	Sum of Measured Selenium Species (µg/L)	Total Dissolved Selenium (µg/L)	Unaccounted Selenium (µg/L)
Influent 12/3/12	1,730	154	39	1,923	1,990	67
Effluent 12/3/12	9	ND (MDL)	10	19	94	75

ND = non-detect
( ) = Minimum Detection Level for the non-detect data

EPA used data from Duke Energy's Belews Creek and Allen facilities to set numeric limits for selenium. Both of these sites employ a General Electric (GE) Advanced Biological Metals (ABMet) anaerobic bioreactor. EPRI's review of the available selenium speciation data indicates that selenium is present primarily as selenite and selenate at these two sites; other measured selenium compounds are non-detects, and unaccounted selenium is essentially zero. While EPRI evaluated an alternative biological approach (an anaerobic, subsurface wetland) at its southeastern site, the general biology is believed to be similar to that at Belews Creek and Allen. Thus, EPRI is concerned that other selenium compounds may be challenging to remove using the GE ABMet or other biologically based approaches. Facing this removal challenge, some facilities may fail to consistently achieve the proposed numeric monthly limit of 10 ppb. EPRI is collecting additional data and conducting ongoing research to evaluate the selenium chemistry in these waters and explore new or improved treatment and management options.

Comment Response:

EPA acknowledges that the biological treatment system is specifically targeted for selenate and selenite removal through biological reduction of those compounds to the elemental selenium. However, using self-monitoring data provided by Duke Energy for the Allen and Belews Creek plant, EPA evaluated the removals of methylseleninic acid (MeSe(IV)), selenocyanate (SeCN), and selenomethionine (SeMe) observed in the chemical precipitation and biological treatment systems. Based on EPA's evaluation, documented in the memorandum "Average Percent Removals of Selenium Species for Chemical Precipitation followed by the Biological Treatment System at Allen and Belews Creek," EPA found that all three of these species had a greater than 90 percent removal across the combination of the chemical precipitation and biological treatment system. Based on this analysis, EPA has determined that these species of selenium can be treated by the BAT chemical precipitation and biological treatment system. The commenter wrongly uses data for a constructed wetland to assert that such selenium compounds may not be adequately treated. EPA evaluated constructed wetlands treatment systems (CWTS) over the course of this rulemaking and the preceding detailed study and found that the performance of such systems is highly unreliable and much less effective than the BAT basis of chemical precipitation plus biological treatment. Thus, the performance of CWTS to remove pollutants is irrelevant to the question of whether pollutants can be removed by the BAT basis.

In addition, EPRI has not addressed concerns about potential analytical method interferences in its determination of unaccounted selenium. EPRI calculated the concentration of unaccounted selenium by subtracting the sum of the concentrations of all detectable selenium species measured by IC-ICP-DRC-MS from the total selenium concentration. However, the method used to separate and detect the selenium species requires that the sample be filtered prior to analysis, where the analysis to measure the total concentration of selenium does not require the sample to be filtered. EPRI has not addressed concerns that the unaccounted selenium might simply be left adsorbed to the filter used during sample preparations required for IC-ICP-DRC-MS analysis and not detected. Instead, EPRI asserts that this "missing" selenium must be in some form that is not detectable by the IC-ICP-DRC-MS method. EPA disagrees that the rulemaking record for the final rule is insufficient to set BAT limitations based on chemical precipitation plus biological treatment for FGD wastewater discharges at this time.

Commenter Name: Cari Boyce
Commenter Affiliation: Duke Energy
Document Control Number: EPA-HQ-OW-2009-0819-4305-A3
Comment Excerpt Number: 60
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

In the near future, FGD chemistry will undergo additional changes across the industry due to compliance with pending air regulations, such as the Mercury and Air Toxics Standards (MATS). The determination of the very low BAT limits, which were based on testing prior to the industry's implementation of MATS controls, presumes that the facilities will perform the same after the installation of advanced air controls as they performed prior to the new controls and does not allow any margin for future FGD process chemistry changes. FGD effluents can change based on different fuels, additives, and operating conditions. As supported in the data above, these differences can make identical processes perform differently.

In conclusion, Duke proposes that more sample data is needed to establish a national standard. The selection of extremely low BAT limits, which are at the very low end of currently available process technology, does not account for any variability or any margin for future FGD process chemistry changes. The variation in Duke Station's data as well as industry data indicates that not all FGD processes result in the same constituent concentrations and that the proposed limits need to be increased to account for this variability.

Comment Response:

EPA does not agree that more data are needed to establish the BAT effluent limitations for FGD wastewater, nor that the effluent limitations need to be increased to provide for future FGD process changes. EPA based the final limits for arsenic and mercury on treatment system effluent data from four plants, with 183 observations for arsenic and 670 observations for mercury. These data represent approximately 4½ years of operation for these plants. The selenium and nitrate-nitrite limits are based on treatment system effluent data from two plants, with 398 observations for selenium and 70 observations for nitrate-nitrite. These data represent more than 5 years of data for one plant and more than 4 years of data for the other.

EPA disagrees with the commenter that the BAT basis "does not allow any margin for future FGD process chemistry changes." EPA notes that the BAT basis comprises a chemical precipitation system followed by biological treatment. There is extensive demonstration by the BAT technology, including both the chemical precipitation and biological treatment stages, to handle the variability of FGD wastewater. See responses to DCN EPA-HQ-OW-2009-0819-4448-A1, Excerpt Number 24 in Comment Code 9.a and DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107 regarding chemical precipitation and biological treatment performance and FGD wastewater variability. Also see the data summarized in the Statistical Support Document for Effluent Limitations. As such, if the FGD wastewater does change due to future changes in response to compliance with air regulations, the operation of the chemical precipitation system can be adjusted (e.g., changes/addition of treatment chemicals, changes to chemical dosages) to address the changes in the wastewater and prepare the wastewater for the biological treatment system. The commenter provides no data showing this would not be the case or that the changes envisioned would change the wastewater characteristics in a manner such that plants would not be able to meet the effluent limitations. EPA notes that many plants have already installed air pollution controls to prepare for MATS implementation and have been testing these systems; however, EPA received no data showing that operation of such systems would change the FGD wastewater in a way that prevents compliance with the ELGs.

Commenter Name: Jacob G. Smeltz
Commenter Affiliation: Electric Power Generation Association (EPGA)
Document Control Number: EPA-HQ-OW-2009-0819-4450-A1
Comment Excerpt Number: 13
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

For example, in three of the four preferred options (alternatives), EPA proposes chemical precipitation plus biological treatment to meet the proposed effluent limitations for FGD wastewater. EPA is required to show under Clean Water Act § 304(b) that any treatment it is proposing is feasible and available. EPGA avers, however, that EPA has failed to show the feasibility of this treatment for the industry because the evaluation was based on flawed data and analysis.

Indeed, EPA did not look at various facilities with different influent wastewater characteristics; EPA did not assess the complexity of operating biological systems; EPA did not evaluate the actual costs of biological treatment; EPA did not conduct a proper evaluation of the true cost per pound of removal for the parameters of concern; nor did EPA understand the consequences that can occur with this type of treatment, such as ammonia production in the vessel, effects of temperature change and the complications caused by nitrate removal. EPA has set limits based on a single biological treatment vendor's proprietary system at two facilities, inappropriately assuming that (1) the reductions that can be met at those plants can be met elsewhere, (2) the treatment will be available and appropriate to use elsewhere and (3) the treatment will be equally effective at all facilities nationwide.

Comment Response:

EPA does not agree with the commenter's statements.

EPA's cost methodology considered a number of factors that would impact the costs for installing and operating a biological treatment system. For more details on the cost factors EPA considered, see the TDD and Section 6 of the *Incremental Costs and Pollutant Removals for the Final Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category* (Cost & Loads Report) (DCN SE05831/SE05832).

Regarding biological treatment performance and FGD wastewater variability, including ammonia generation and temperature changes, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107.

Regarding the market availability of biological treatment systems, see response to DCN EPA-HQ-OW-2009-0819-4607-A1, Excerpt Number 13.

Regarding the treatment of FGD wastewater with high nitrate/nitrite concentrations, see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 44 in Comment Code 10.b.

Regarding the pollutant loadings evaluation, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 95 in Comment Code 6.f.

Also see the TDD, the Statistical Support Document for Effluent Limitations, and DCN SE05846 (memorandum *Variability in Flue Gas Desulfurization Wastewater: Monitoring and Response*).

Commenter Name: Michael G. Cashin
Commenter Affiliation: Minnesota Power (MP)
Document Control Number: EPA-HQ-OW-2009-0819-4484-A1
Comment Excerpt Number: 6
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

EPA consideration of site specific climate variations. Seasonal conditions for temperature and precipitation affect the performance and viability of water and waste treatment system design. For example, Minnesota's cold winter climate would certainly have an effect on the work-ability of biological treatment systems and the length and nature of construction seasons for treatment system installation. MP comments that ELG effective dates and requirements specifics to the outcome of biological treatment activities need to be flexible and goal based in recognition of the uniqueness of each wet- scrubbed system and the climate it is operated within. FGD outcomes should also allow for the use of alternative BAT if it is shown over time to substantially meet the final ELG limitation requirements for FGD wastewaters.

Comment Response:

Regarding temperature considerations, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107 and DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 34 in Comment Code 10.b. EPA has evaluated data for the operation of the BAT technology during cold weather and found that it performed without any degradation in performance. In addition, EPA's cost estimates include costs for the treatment system to be housed indoors in certain parts of the country with very cold winters.

The final rule does not require facilities to install the system identified as the technology basis for BAT, but only that the appropriate effluent limitations and standards be achieved. A plant will have to evaluate for their FGD wastewater whether or not additional treatment is required to meet the limitations and standards. The facility must demonstrate compliance with the effluent limitations at all times.

Please see section XVI of the preamble (Regulatory Implementation) for more information on timing of the ELG requirements.

Commenter Name: Dean Ellis
Commenter Affiliation: Dynegy Inc.
Document Control Number: EPA-HQ-OW-2009-0819-4491-A1
Comment Excerpt Number: 18
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Installing biological treatment systems like those suggested by EPA (anoxic/anaerobic systems, fixed-film bioreactors, etc.) are labor intensive and require very skilled operators. They are also very susceptible to upsets.

Comment Response:

EPA acknowledges that operators must gain the technical experience of operating any new system, including a biological treatment system. EPA considered the cost of installation and operations in its approach to estimating industry-level costs for implementing the rule, as described in the TDD and Section 6.2 of *the Incremental Costs and Pollutant Removals for the Final Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category* (Cost & Loads Report) (DCN SE05831/SE05832).

EPA disagrees with the commenter that the biological system is "very susceptible to upsets." See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107.

Commenter Name: Raven Power Holdings, LLC
Commenter Affiliation: Raven Power Holdings, LLC
Document Control Number: EPA-HQ-OW-2009-0819-4467-A1
Comment Excerpt Number: 22
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

EPA relied on data from only two biological reactors for their evaluation of biological treatment--Allen and Belews Creek Steam Stations. Since both of these stations utilize the same biotreatment technology, GE's ABMet system, EPA obviously is not considering biological treatment generically, but a vendor- specific fixed film technology, much different than the biological suspended growth sequencing batch reactors (SBR) exclusively in use for FGD water treatment in Maryland to comply with site specific water quality criteria.

The ABMet systems, similar to the SBRs with which Raven Power has experience, encounter a number of challenges. EPA has acknowledged that they are "aware of industry concerns with the feasibility of biological treatment at some power plants. Specifically, industry has asserted that the efficacy of these systems is unpredictable, and is subject to temperature changes, high chloride concentrations, and high oxidation reduction potential in the absorber (which may kill the treatment bacteria)."[1]

Biological systems have not been evaluated over a wide range of fuels and FGD absorber operational ranges. The Allen and Belews Creek systems have operated primarily on Central Appalachian bituminous coal using forced oxidation spray tower absorbers. These systems have not been evaluated on fuels from other regions, i.e. Northern Appalachian and Illinois Basin, or fuel types, i.e. sub-bituminous (Powder River Basin) or lignite. The biological systems evaluated have a very limited geographical range of operation, North Carolina. In fact of the five systems in operation, four are in North Carolina and the fifth is in West Virginia. The viability of these systems in cooler winter climates is undocumented.

If the ABMet technology is selected as BAT, it is unlikely that the single vendor, GE, would have adequate resources to provide and commission the number of systems needed within the time frame required by the proposed rule or the cost estimates developed by EPA. Other comparable technologies are being introduced, but none of them have been demonstrated in FGD wastewater service beyond pilot scale.

The SBRs utilized at Raven Power's Brandon Shores plant, which were specifically designed for nitrate/nitrite removal and do significantly reduce the amount of these constituents in the FGD waste stream, have not demonstrated the ability to produce effluent that meets the proposed numerical nitrate/nitrite limit, yet are able to meet the net-sum zero nitrogen discharge permit requirements driven by the Chesapeake Bay Nutrient Reduction program.

[1] 78 Fed. Reg. at 34470

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107 regarding biological treatment system performance and FGD wastewater variability. The data EPA used to calculate the effluent limitations include effluent data collected when plants were burning the Northern Appalachian and Illinois River Basin coals identified by the commenter. Although the plants were not burning subbituminous or lignite coals, EPA has evaluated the characteristics of FGD wastewater associated with these coals and found that they are similar to wastewater from plants burning bituminous coal – for example, the pollutant concentrations associated with subbituminous coals are similar to pollutant concentrations from bituminous coals. In addition, EP has not identified any other wastewater characteristics relevant to operation/performance of the BAT basis that differ between these coal types, nor has the commenter provided any data showing why plants using these other coals would be unable to meet the effluent limitations.

See response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 34 in Comment Code 10.b regarding EPA's considerations for climate variations in the installation and implementation of the biological treatment system.

See response to DCN EPA-HQ-OW-2009-0819-4607-A1, Excerpt Number 13 and DCN EPA-HQ-OW-2009-0819-4305-A3, Excerpt Number 43 regarding the market availability of biological treatment systems.

See response to DCN EPA-HQ-OW-2009-0819-5140-A2, Excerpt Number 60 in Comment Code 10 regarding upset and bypass accommodations.

Regarding the SBRs utilized at the Brandon Shores plant, EPA notes that the final nitrate/nitrite effluent limitation was revised in response to public comments. Additionally, the final rule does not require facilities to install the system identified as the technology basis for BAT, but only that the appropriate effluent limitations and standards be achieved. A plant will have to evaluate for their FGD wastewater whether or not additional treatment is required to meet the limitations and standards. The SBR technology identified by the commenter is not designed for selenium removal and EPA's data for this technology found that it is not effective at doing so. EPA did not select the SBR technology as the BAT basis.

Commenter Name: Thomas Cmar
Commenter Affiliation: Earthjustice, et al.
Document Control Number: EPA-HQ-OW-2009-0819-4684-A1
Comment Excerpt Number: 72
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Oxidation-Reduction Potential: One parameter about which EPA seeks additional information is the impact of ORP of the wastewater entering the biological system. Oxidation-reduction potential is the tendency of a chemical species to acquire electrons and be "reduced." This is an important factor for the functioning of the biological reactor, because that reactor works by reducing oxidized forms of selenium (e.g., selenate, selenite), and also oxidized forms of nitrogen such as nitrate and nitrite to their elemental forms. These oxidized compounds then form "nanospheres of granulated elemental selenium which accumulate in and around the bacterial cells" within the activated carbon matrix.[279] The reduced nitrogen forms a gas, which along with other organic gases is removed from the system by "burping" on a regular basis.[280]

The wastewater entering the bioreactor has a positive ORP of around +200 or +300 mV.[281] If the ORP of the wastewater entering the reactor is too high, then not all of the metals, nitrates, and nitrites would be removed. Thus, careful control of the influent ORP is essential. The ABMet system achieves this by "feeding a proprietary molasses-based nutrient lend into the reactors as a carbon source for the bacteria."[282] Dr. Jenkins similarly notes that "Process control is necessary to maintain the correct ORP conditions for Se removal. This requires the installation of ORP sensor and control instrumentation on each of the individual anaerobic treatment units. The ORP sensor signal regulates the molasses dosing rate which in turn decreases (more molasses added) or increases (less molasses added) the ORP."[283]

---

[279] TDD at 7-12; Sonstegard et al., Full Scale Operation, EPA-HQ-OW-2009-0819-2079, at 4.

[280] TDD at 7-12.

[281] Sonstegard, Full Scale Operation, EPA-HQ-OW-2009-0819-2079, at 4.

[282] *Id.* at 5. *See also* Jenkins FGD Report, Appendix C.

[283] Jenkins FGD Report, Appendix C, at 6-7. Sonstegard et al., also state that "accurate, factory certified ORP probes are critical." Full Scale Operation, EPA-HQ-OW-2009-0819-2079, at 7.

Comment Response:

EPA agrees with the commenter that plants will need to monitor ORP levels entering the biological treatment system to maintain the activity of the micro-biology in the reactors. See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107 for additional information. The BAT basis for the ELGs includes instrumentation such as ORP sensors.

Commenter Name: Thomas Cmar
Commenter Affiliation: Earthjustice, et al.
Document Control Number: EPA-HQ-OW-2009-0819-4684-A1
Comment Excerpt Number: 73
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Temperature: EPA's record and other available evidence shows that the ABMet system can operate effectively in all climates. The ABMet system is guaranteed to perform between approximately 40ºF and 105ºF.[284] EPA has already accounted for climatic difference by including the cost of a heat exchanger in the cost estimate for plants in the southern United States.[285] However, heat exchangers may not be necessary where the plant can use an existing FGD wastewater settling pond to cool the blowdown. The Roxboro plant in North Carolina, which has been operating a biological treatment system for FGD water since 2008, uses a 250 million gallon settling pond to cool the FGD blowdown, which exits the gypsum dewatering step at a temperature of 105°F.[286]

Data show that the ABMet biological system was resilient in a range of temperatures.[287] At two plants that allowed wastewater to equalize to ambient outdoor temperature before entering the ABMet system, summer influent temperatures as high as 95 °F and winter temperatures as low as 42 °F. Despite this variation in temperature, "effluent results . . . remained constant throughout the year."[288]

Biological activity slows at lower temperatures, but the biological community remains intact.[289] When the ABMet system was starting up at the Roxboro plant in February 2008, the water in the FGD settling pond was only 50 ºF, 10 ºF lower than the design value.[290] The operator compensated for this by running the wastewater through a heated recirculation loop to bring the temperature up to 80 ºF. Ultimately, however, the system acclimated to lower temperatures and raw feed water could be introduced without supplemental heating.[291] According to the inventor of ABMet, Tim Pickett, "selenium removal is achieved in a matter of hours."[292] Thus, the residence time in the bioreactor is likely short enough that accommodations will not need to be made for low temperatures in all but the most extreme climates.[293]

The record supports a conclusion that ambient temperature concerns do not render ABMet technologically infeasible.

[284] Jenkins FGD Report, Appendix C, at 3; see also Sonstegard, ABMet Biological Selenium Removal from FGD Wastewater, EPA-HQ-OW-2009-0819-1232, at 3-4.

[285] TDD at 9-23.

[286] Sonstegard et al., Full Scale Operation of GE ABMet Biological Technology for the Removal of Selenium from FGD Wastewaters, EPA-HQ-OW-2009-0819-2079.

[287] Sonstegard et al., Setting the Standard for Selenium Removal, Docket No., EPA-HQ-OW-2009-0819-1233, at 2-6.

[288] *Id.* at 5.

[289] *See* Jenkins Report.

[290] Sonstegard et al., Full Scale Operation, EPA-HQ-OW-2009-0819-2079, at 7.291 *Id.*

[291] *Id.*

[292] Blankenship, Steve, "Bugs" Used to Treat FGD Wastewater, Power Engineering, Dec. 20, 2010, EPA-HQ-OW-2009-0819-1233. *See also* Sonstegard et al., ABMet: Setting the Standard for Selenium Removal, EPA-HQ-OW-2009-0819-1233, at 1 (ABMet designed to remove selenium in a two-to-sixteen hour empty bed contact time).

[293] *See Weyerhaeuser Co. v. Costle*, 590 F.2d 1011, 1055 & n.73 (D.C. Cir. 1978) (finding that EPA had properly considered the impact of colder ambient temperature in finding a biological treatment system to be BAT, where EPA found that waste treatment would occur before the influent had cooled significantly, due to the 6-8 hour residence time of the system); *see also Am. Meat Inst. v. E.P.A.*, 526 F.2d 442, 455 (7th Cir. 1975) (finding firm record support for EPA's conclusion on the effect of cold weather on the efficiency of the anaerobic lagoon).

Comment Response:

EPA agrees with the commenter that the "ABMet biological system [is] resilient in a range of temperatures." EPA included costs in its cost estimates for the final rule to account for steps plants may need to take to manage the temperature of the FGD wastewater entering the bioreactor (e.g., heat exchangers in hot climates and buildings in cold climates). See response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 34 in Comment Code 10.b. In addition, the BAT basis includes a tank-based chemical precipitation stage preceding the bioreactor, rather than a settling pond. This will provide more effective control over the temperature of the influent wastewater, as well as better control over the characteristics of the water (pollutant concentrations and other characteristics such as pH and ORP) entering the bioreactor.

Commenter Name: Thomas Cmar
Commenter Affiliation: Earthjustice, et al.
Document Control Number: EPA-HQ-OW-2009-0819-4684-A1
Comment Excerpt Number: 71
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

a. Well-managed biological systems are resilient to a wide range of influent conditions.

The ABMet system has been designed to handle the highly concentrated FGD wastewater. The bacteria used to seed the bioreactor "have been isolated from previously-contaminated sites and chosen specifically for use in FGD systems because of their hardiness in the extreme water chemistry as well as for their proven efficiency for selenium respiration and reduction."[276] According to Duke Energy's Bill Kennedy, the activated carbon inside the ABMet reactor provides a physical structure to which the bacteria can attach; this structure "allows them to respond to upsets. If something changes in the system, they're actually protected down inside the carbon structure, and the bacteria will not be washed out even in extreme conditions."[277] According to the operators of the Allen system, steady-state can be re-achieved within 1 to 2 residence times of a significant variation.[278]

---

[276] Sonstegard et al., "ABMet: Setting the Standard for Selenium Removal," EPA-HQ-OW-2009-0819-1233, at 2.

[277] Blankenship, Steve, "Bugs" Used to Treat FGD Wastewater, Power Engineering, Dec. 20, 2010, EPA-HQ-OW-2009-0819-1233, at 5.

[278] Final Allen Site Visit Notes, EPA-HQ-OW-2009-0819-0598, at 12.

Comment Response:

EPA agrees with the commenter that the biological treatment system can withstand a "wide range of influent conditions." Additionally, EPA notes that the BAT basis is comprised of chemical precipitation followed by biological treatment. Chemical precipitation systems are designed, and system operating conditions are adjusted on an ongoing basis, to account for such variations. See response to DCN EPA-HQ-OW-2009-0819-4448-A1, Excerpt Number 24 in Comment Code 9.a regarding chemical precipitation performance and FGD wastewater variability.

Commenter Name: Thomas Cmar
Commenter Affiliation: Earthjustice, et al.
Document Control Number: EPA-HQ-OW-2009-0819-4684-A1
Comment Excerpt Number: 74
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

b. Biological reactors can operate effectively with intermittent wastewater streams.

The record shows that biological reactors are compatible with the sometimes intermittent nature of the FGD wastewater flows. The FGD wastewater flow may be intermittent if the plant operates on a cycling basis, or due to planned and unplanned outages. EPA's record shows that even in the event of an unplanned outage, the biological treatment system can be maintained without any serious issues.[294] At one plant where what was thought to be a temporary outage evolved into a 48-day shutdown, the plant responded by periodically (every four days), running process water through the bioreactor, along with a dose of nutrients, to prevent the matrix from becoming dormant.[295] The period also allowed time for flushing and backwash of the system. After the system was restarted, it was immediately capable of achieving extremely low levels of selenium in effluent, close to 2 ug/L.[296] This event demonstrated the resiliency of the bioreactor in the event of a longer-term shutdown, when experienced staff are available to maintain the system. Likewise, during a pilot test at Duke Energy's Marshall plant, it was confirmed that station upsets and shutdown "had no significant impacts on performance."[297]

The plant that experienced the extended unplanned outage is designated as a cycling facility, meaning that it has frequent short-term shutdowns in response to changes in demand. But as its operators have found, the cycling nature of the plant has not caused any problems in operation or efficacy of the bioreactor.[298] Duke Energy's Allen plant is a cycling, rather than baseload plant, and the plant's operators have developed procedures to maintain the biological system during these periodic shutdowns.[299] If the plant has advance notice of a shutdown, it can reserve FGD purge water in the equalization system and operate the system at reduced flow rate just prior to and during the shutdown. If the plant does not have notice of a short shutdown, it will run service water and nutrients through the reactor. During a three week shutdown, the plant simply left idle water in the system, and the bioreactor returned to typical performance within 24 hours of restart.[300]

For similar reasons, the intermittent nature of landfill leachate streams would not be problematic for operation of the biological treatment system, assuming proper monitoring and storage capacity. *See infra* Section VI.

---

[294] Sonstegard et al., Setting the Standard, EPA-HQ-OW-2009-0819-1233, at 6.

[295] *Id.*

[296] *Id.* at 6-7.

[297] Blankenship, EPA-HQ-OW-2009-0819-1233, at 4.

[298] Sonstegard et al., Setting the Standard, EPA-HQ-OW-2009-0819-1233, at 7.

[299] *See* Final Site Notes for Allen, EPA-HQ-OW-2009-0819-0598, at 12.

[300] *Id.*

Comment Response:

EPA agrees with the commenter that the biological treatment system can be turned down during periods of low or no flow, and then quickly returned to operation and be able to meet the effluent limitations. Also see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107 regarding seasonal or periodic operation of the biological treatment system.

Commenter Name: Thomas Cmar
Commenter Affiliation: Earthjustice, et al.
Document Control Number: EPA-HQ-OW-2009-0819-4702-A7
Comment Excerpt Number: 1
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

The U.S. Environmental Protection Agency has evaluated treatment technology options to reduce the discharges of pollutants from wet flue gas desulfurization (WFGD) wastewater streams. In its proposed rule issued June 7, 2013, EPA proposed the following 3 treatment alternatives for WFGD wastewater treatment: (i) Chemical precipitation (Option 1); (ii) Chemical precipitation followed by biological treatment (Options 2, 3b, 4, 4a), and; (iii) Chemical precipitation followed by evaporation (Option 5). (78 Fed. Reg. 34,432, 34,490, at Table X-1)

In each of these alternatives, the chemical precipitation step includes hydroxide precipitation, polysulfide precipitation, and iron co-precipitation as well as equalization, pH adjustment, and clarification. This review will focus on the biological treatment recommended in alternative (ii) above, which adds an anaerobic bioreactor to the chemical treatment step to reduce the concentration of selenium (Se) in the wastewater discharge.

This review will examine whether the numeric effluent limitations proposed by EPA for Se and mercury (Hg) can be met by the combined chemical and biological treatment systems evaluated by EPA as the basis for its best available technology determination.[1] These limitations are summarized in Table 1.

Table 1. EPA's Proposed Effluent Total Se and Total Hg Limitations for the Chemical Precipitation and Biological Treatment Technology Option for FGD Wastewater (Proposed Rule, Table X—1).

Constituent	Daily Limitation	Monthly Limitation
Total Selenium	16 ppb	10 ppb
Total Mercury	242 ppt	119 ppt

After reviewing the operating data from three full-scale chemical precipitation and biological treatment systems, I conclude that a carefully-monitored and well-operated anaerobic bioreactor system can reliably achieve the effluent Se limits proposed by EPA. I further conclude that anaerobic biological treatment processes provide additional Hg removal over that achievable by chemical precipitation with hydroxide and polysulfide.

---

[1] I found that the presence of nondetects in both the influent to and effluent from the biological treatment system prevented a similar analysis as to arsenic."

Comment Response:

EPA agrees that plants properly operating the BAT basis will be able to meet the effluent limitations for the ELGs. EPA's data also shows that the system provides additional removal of arsenic and mercury. See the Statistical Support Document for Effluent Limitations.

Commenter Name: Thomas Cmar
Commenter Affiliation: Earthjustice, et al.
Document Control Number: EPA-HQ-OW-2009-0819-4702-A7
Comment Excerpt Number: 8
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

The issue has been raised that the use of the polysulfide-based precipitants in the two- step chemical precipitation treatment proposed by EPA could cause downstream toxicity. Two types of toxicity can be envisioned: (i) toxicity to the microorganisms in the biological treatment system, and (ii) toxicity in the effluent of the biological system to biota in the receiving water. The biological operating data with respect to both total Se and Hg removal show no evidence of any deleterious effects that could be attributed to the use of a polysulfide-based precipitation agent in the chemical precipitation stage of the process. Indeed, both the total Se and Hg removal performances of the biological treatment units seemed to be better when both hydroxide- and polysulfide-based precipitants were being used upstream (NE USA Plant) than when just hydroxide precipitation was employed (Allen and Belews Creek Plants).

Toxicity data for NALMET®1689, a precipitant/flocculant product used in the polysulfide precipitation of WFGD wastewater, was obtained from its Materials Safety Data Sheet (NALMET®1689, MSDS, 2001) as follows: Rainbow Trout, 96-h LC50 = 74 mg product/L; Sheepshead Minnow, 96-h LC50 = 1000 mg product/L; Daphnia magna, LC50 = 73 mg product/L, EC50 = 18 mg product/L. Keiser et al., (2010) indicate a typical use of NALMET®1689 at 50 mg product/L for WFGD wastewater precipitation. Typically, of the total amount of polymer added in precipitation/flocculation processes, some 95-99% is retained in the precipitated solid (Worksafe Australia, 1996). This means that only 1-5% of the precipitant/flocculant product would pass through to the biological system following the precipitation process. Thus, at a dose of 50 mg/L, some 0.5-2.5 mg/L would be present in the biological process influent. This concentration is well below the toxic concentrations indicated above. Thus there should be no concern that polysulfide precipitation/flocculating products such as NALMET®1689 will exert toxicity in the effluents of WFGD wastewater chemical precipitation/biological treatment units.

Comment Response:

EPA agrees with the commenter that the use of organosulfides in the chemical precipitation system will not have any "deleterious effects" on the biological system and will not "exert toxicity in the effluents of WFGD wastewater."

Commenter Name: Chris M. Hobson
Commenter Affiliation: Southern Company
Document Control Number: EPA-HQ-OW-2009-0819-4379-A1
Comment Excerpt Number: 72
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Engineering Assessment of FGD Wastewater Treatment System

1. Biological Treatment is Not Feasible and Available for All FGD Wastewaters

Southern Company engineers have thoroughly evaluated full-scale biological treatment, and they find: (1) it is not demonstrated as effective for a range of FGD influents; (2) it has many significant operational issues and will lead to outages (or diversions of wastewater) if broadly applied; and (3) there is not enough experience with biological treatment of FGD wastewater to warrant its selection as BAT for this rulemaking. The following sections explain Southern's concerns.

EPA lists chemical precipitation plus biological treatment as the model technology option for FGD wastewater in BAT Options 3b (scrubber capacity >2,000 MW), 3, and 4a. EPA's proposed limits for FGD wastewater are as follows.

Pollutant	**Daily Max**	**Monthly Avg.**
Arsenic	8 µg/L	6 µg/L
Selenium	16 µg/L	10 µg/L
Mercury	242 ng/L	119 ng/L
Nitrate/Nitrite-N	0.17 mg/L	0.13 mg/L

As already noted, EPA based the BAT limits for selenium and nitrate/nitrite-N on data collected at Belews Creek and Allen. However, biological treatment itself has application limits, such as variation in chloride levels, temperature, nitrate/nitrite, and Oxidation Reduction Potential (ORP), that make it very difficult to apply on an industry-wide basis, especially in an NPDES permit compliance scenario. Belews Creek and Allen are not representative of the entire coalfired industry; application of biological treatment systems at other plants likely will not produce consistent compliance with the proposed limits.

In the sections below, we address some of the limitations of biological treatment, particularly the GE ABMet system.

a. Organisms are Sensitive to Chloride Levels

Jill Sonstegard, et al. claim that the GE ABMet biological treatment systems were "designed to handle chloride levels up to 20,000 ppm, suspended solids up to 100 ppm, nitrate-N loading less than 100 ppm."[14] Both Belews Creek and Allen biological treatment systems were built before 2010; therefore, both plants' biological treatment systems were designed for FGD wastewater with less than 20,000 ppm chlorides. For the past few years, both plants have treated FGD wastewater with chloride levels less than 10,000 ppm. Though GE claims that its ABMet system can treat wastewater with chlorides levels as high as 25,000 ppm,[15] no such system has been demonstrated. The organisms within the ABMet system are not as "resilient" as EPA claims. 78 Fed. Reg. at 34,463 col. 2. Variations in chloride levels – as well as high chloride levels – can affect treatment levels, as can total dissolved solids and temperature fluctuations. The organisms are also sensitive to nitrate/nitrite and ORP levels.

Based on EPA's 2010 ICR data, the chloride range in power plants with wet FGDs is 136 to 40,000 ppm, and the average is 7,740 ppm (2013 TDD at 6-5). In addition, EPA in the rule calls for flow minimization, asserting that "[t]he flow minimization at these plants would be achieved by either reducing the FGD purge rate or recycling a portion of their FGD wastewater." 78 Fed. Reg. at 34,459 col. 3. Using flow minimization strategy could tremendously increase chlorides levels in FGD wastewater.

About 11% of power plants already cycle up their scrubbers to greater than or equal to 20,000 ppm. Southern's plants were built to have the capability to cycle up chlorides well above 20,000 ppm chloride. If power plants install biological treatment systems, they would have to lower the chloride levels in the FGD scrubber whereby increasing FGD purge stream flow and water treatment flow rates. This would result in larger-sized wastewater treatment systems, thereby increasing capital and O&M costs.

b. Organisms are Sensitive to Temperature

For biological treatment systems, water temperature has to be well controlled to ensure good selenium and nitrate-N removal. By 2010, there were four GE ABMet systems in operation. Two of those systems, Belews Creek and Allen, have chemical precipitation pretreatment and heat exchangers to control the water temperature. The other two biological systems use ponds as pretreatment and do not have temperature control equipment. The two biological treatment systems without temperature control have not performed as well as Belews Creek.[16]

Variation of water temperature can impact the bacteria's behavior. Usually temperature impacts the biological reaction rate as follows:

$K2/K1 = \theta^{(T2-T1)}$

Where, K = reaction rate constant

T = temperature,

θ = temperature coefficient, usually between 1.06-1.15.

$K2 = K1(1.1)^{-10c} = K1 \times 40\%$

$K2 = K1\,(1.1)^{-20c} = K1 \times 14\%$

Research shows that the denitrification reaction rate could decrease by 50% with a 10°C temperature drop, and by 80% with a 20°C temperature drop[17,18]. Also, one vendor observed a reaction rate decrease of 50% with every 10°C temperature drop for a biological treatment system treating FGD wastewater (verbal communications). Therefore, biological systems must be designed to keep water temperatures stable in order to keep the reaction rate stable, especially in high latitudes and altitudes. This limitation of biological treatment will significantly increase the cost to maintain and operate the system, and will likely cause compliance issues with the limits EPA has proposed in this rule.

c. Organisms are Sensitive to Nitrate/Nitrite Levels

The biological treatment systems that EPA evaluated as BAT (Belews Creek and Allen) were designed for selenium removal, not nitrate/nitrite-N and selenium removal. GE states that their ABMet® system is "designed to handle … suspended solids up to 100 ppm, nitrate-N loading less than 100 ppm."[19] Both Belews Creek and Allen have nitrate/nitrite-N levels lower than 100 ppm. Literature shows that higher nitrate-N loading needs more microbes and longer retention time to remove the nitrate-N levels. This series of steps may not be possible with the current residence time and nutrient feed at Belews Creek and Allen, particularly if higher nitrogen levels were present in the influent.

Thermodynamically, the nitrate/nitrite must be preferentially removed prior to initiation of selenium removal (selenate and selenite)[20]. Without very well controlled denitrification, selenium removal will be impacted. Under certain conditions, such as fuel change or change in FGD recycle rate, the nitrate in the FGD wastewater can significantly increase over several days, and the denitrification process can be severely impacted. With higher nitrate levels in the influent, the microbes in the biological treatment system will consume the nitrate, and as a consequence, the selenium removal will decrease. In response to such a change, theoretically more nutrients would be required by the biological system to enhance the microbe growth. However, the adjustment needs time therefore more bioreactors may be needed to achieve the target nitrate and selenium levels. Under such conditions, nutrients usually would be overfed and residual chemical oxygen demand (COD), excessive biomass and soluble microbial products could be generated during the process.[21] This usually requires further aerobic biological treatment to remove the organics, which could significantly increase the capital and O&M costs.

There is very limited data to support the proposed nitrate/nitrite-N limits because the bioreactor influent levels at both Belews Creek and Allen, 15 mg/L and 32 mg/L, respectively, are very low as compared to the nitrate/nitrite-N levels up to 300 mg/L[22] in other FGD wastewaters sampled by EPA. In addition, there is insufficient long-term data available to determine the effectiveness of nitrate removal. Nitrate/nitrite-N data was not collected by Belews Creek and Allen after the treatment systems were optimized.

d. Organisms are Sensitive to FGD Wastewater Oxidation Reduction Potential

High oxidation reduction potential (ORP) in FGD wastewater can cause problems for the biological system. Biological treatment systems for denitrification and selenium removal are anoxic-anaerobic processes. First, biological systems have to consume the oxygen or other oxidants, such as free available oxidants and then nitrate/nitrite, and finally selenite/selenate. A very high ORP means that the FGD wastewater has high concentrations of these oxidants which will consume the biological system's treatment capability, subsequently reducing its capability to remove nitrate/nitrite and selenite/selenate.

As Duke noted in its comments on the draft permit for the Merrimack Station, "[m]any factors affect ORP, including the use of selective catalytic reduction (SCR) equipment, the generating load, the amount of sulfur in the coal, the pH, the quality of makeup water for the scrubber." Duke Energy's Letter to EPA Region 1 and New Hampshire Department of Enviornmental Services – Comments on NPDES Permit No. NH0001465, Merrimack Station (February 27, 2012), p. 2. Because of these many factors, Duke finds that ORP "routinely fluctuates and cannot be well controlled" and therefore the metals in the wastewater existing the scrubber also vary. *Id*.

Duke described just such as incident for its Allen Station during a 30-day test burn of a high sulfur blend Illinois River Basin coal:

During the test burn, increased ORP values within the influent to the FGD wastewater treatment system and within the FGD scrubber were observed. With the increased oxidizing environment within the scrubber, a noticeable chlorine smell was observed and an increase in free available oxidant (FAO) was detected within the influent to the FGD wastewater treatment system. To prevent damage to the microbes within the bioreactors, the test burn was stopped immediately and flow to the bioreactorswas interrupted for several days….

Id. Duke explains that, within the higher oxidizing environment, concentrations of selenium and mercury in the effluent from the chemical precipitation system increased. Also, concentrations of selenium were elevated in the bioreactor effluent. *Id*. at 3.

Duke further explains that it stopped the test burn because it feared the increased oxidizing environment would "cause substantial harm to the organisms in the bioreactors." *Id*. Duke concluded that:

… the wastewater matrix generated during this test burn was completely different than any previously observed FGD wastewater matrix at Allen or Belews Creek. Due to the shift, Duke Energy is questioning the validity of all the data previously collected at these two stations to evaluate the effectiveness of FGD wastewater treatment systems.

Id.

Sudden ORP changes have been observed in several Southern plants. FGD scrubber ORP has dropped from over 600 mV to below 300 mV in a week, and then returned to over 600 mV after a few months of operation. The dissolved selenium levels as well as the species of selenium changed with this variation of ORP. As ORP increased, the dissolved selenium level increased with selenate the dominate species in the wastewater. When ORP levels decreased, the dissolved selenium levels decreased with selenite the dominate species in the wastewater. This variation in ORP and dissolved selenium levels can significantly impact the biological treatment system performance. The contributing factors associated with the FGD scrubber ORP variations were not determined, and more ORP variations are probable.

Many factors can cause high ORP conditions in the FGD scrubber, such as changes in coal source, as noted by Duke Energy. Other factors that increase ORP in the FGD scrubber include electrostatic precipitator performance and FGD scrubber chemistry[23]. Unfortunately, some of these factors cannot be controlled or prevented. Therefore, Southern submits that further study of the effects of fuel changes and other factors on ORP and resulting effluent quality is needed.

e. Future Coal Plant Operations

A stable, consistent FGD wastewater influent stream is key for biological systems to maintain a consistent treatment performance. This can be very difficult to do considering the normal fluctuations within plant operations, but particularly when plants look for ways to be viable and yet comply with more stringent regulations. Companies may convert coal-fired generation to natural gas, but keep coal capabilities as a backup. Without continuous steady FGD wastewater feed to the treatment system, it could be very difficult to keep consistent performance of biological treatment systems. Also, as one or more of the coal units come on line to meet demand, it is questionable that the biological treatment system could startup and immediately meet the proposed limits.

f. The Biological Treatment Process Produces Ammonia

In some circumstances, ammonia can be produced as a byproduct of the biological treatment system. Within the anaerobic biological process, nitrate is converted to nitrogen gas, and in the process, ammonia can be produced. Ammonia levels in the treated effluent can vary by plant and can be impacted by temperature, ORP, and microbial activity. Any facilities facing discharge limits for ammonia or whole effluent toxicity limits (*i.e.*, WET testing) could potentially require further treatment and incur additional costs. EPA has not considered the type or the cost of post-treatment requirements to remove ammonia. Adding such cost would further increase the overall industry costs.

There are many technologies available to remove ammonia from wastewater. Depending on the flow and concentration for the biological treatment system, technologies such as breakpoint chlorination, air stripping, ion exchange technologies or additional biological methods could potentially be used.

- Breakpoint chlorination is a process where chlorine is continually added to water up to the point of saturation, and all present ammonia is oxidized so that only free chlorine remains.
- Ammonia stripping involves the removal of ammonia from wastewater by gasifying it with air or steam under controlled conditions. This process is relatively simple; however, there are many disadvantages, such as scale formation, temperature impacts, and release of the ammonia to the atmosphere.
- Ion exchange is a reversible chemical reaction where ammonium ion from the wastewater is exchanged for an ion attached to an immobile solid particle. An ion exchange system with a high affinity for ammonium ion has the potential to effectively remove ammonia from wastewater.
- Biological denitrification of wastewater is another method that can convert ammonia into ammonia gas with the use of bacteria.

All of these technologies have advantages and disadvantages, and the treatment costs can be very expensive depending on the flow rate. For example, if a large biological treatment system on a coal-fired plant had to treat for ammonia discharge at 800 gpm, the capital cost would be $15 million dollars with annual O&M costs of $600,000.

g. The Performance of Biological Treatment Systems at Belews Creek and Allen Should Not Be Applied to the Entire Industry

As discussed above, biological treatment systems can be affected by high chloride levels, high and low temperatures, high nitrate levels, and high ORP. The biological treatment performance at Belews Creek and Allen do not represent the level of treatment that biological systems could achieve at other power plants. The follow table provides a comparison of Belews Creek and Allen chemical precipitation effluent (bioreactor influent) data compared to data from other EPA-sampled plants and an industry range for each parameter.

Table 17: Comparison of Belews Creek and Allen CP Effluent (Bioreactor Influent) to Other EPA-Sampled Plants and Industry Ranges

Parameter	Belews Creek	Allen	Other Plants	Industry Range
TDS, mg/L	15,000	9,800	15,000 - 29,000	4,000 - 50,000[24]
Chloride, mg/L	8,300	4,500	2,300 - 14,000	136 - 40,000[25]
Selenium, Total, µg/L	490	200	140 - 2,600	140 - 10,000[26]
Nitrate/nitrite-N, mg/L	16	28	21 - 180	10 - 1,000[27]

The TDS in Belews Creek and Allen FGD wastewater is on the low end of the range for the industry. High TDS levels could be a potential issue for the biological treatment system due to osmotic pressure which can potentially dehydrate the microbes. To our knowledge, no research has been done to determine how adaptive the microbes will be in a high TDS environment.

Both biological treatments systems at Belews Creek and Allen were designed for FGD wastewater with less than 20,000 mg/L chlorides. Also, both plants chloride level to the treatment system is consistently below 10,000 mg/L. Chloride levels in many other plants could be significantly higher than this value and higher than GE's guaranteed value of < 25,000 mg/L. Therefore the performance achieved at Belews Creek and Allen might not apply to high chloride wastewaters.

Belews Creek and Allen biological treatment influent contains on average 345 µg/L total selenium and 22 mg/L nitrate/nitrite-N, respectively.[28] These levels are well below the levels at the other EPA-sampled plants as well as for the industry. The GE feed water quality requirements for influent to the ABMet® system is < 8,000 µg/L dissolved selenium (oxidized forms only, no reduced species).[29] The low levels of nitrate/nitrite at Belews Creek and Allen means that their biological treatment systems should more easily meet the proposed nitrate/nitrite-N and selenium limits; however, the exceedance frequency analysis discussed in Section IX, D, shows differently.

In general, the demonstration at Belews Creek and Allen only present the capabilities of biological treatment for their FGD wastewater. The removal of nitrate/nitrite-N and selenium to the proposed limits has not been demonstrated at other plants where the levels of TDS, chloride, nitrate/nitrite and dissolved selenium levels are significantly higher.

---

[14] Sonstegard, J., J. Harwood, and T. Pickett. 2010. "ABMet: Setting the Standard for Selenium Removal," presented at the 2010 International Water Conference, IWC-10-18, at 238.

[15] GE provided EPRI water quality requirements for influent to the ABMet® system.

[16] Steam Electric Power Generating Point Source Category: Final Detailed Study Report (2009), EPA 821-R-09-008, EPA-HQ-OW-2009-0819-0387 at 4-51.

[17] Carrera, J., T. Vicent, and F. Lafuente. 2003. "Influence of Temperature on Denitrification of an Industrial High-Strength Nitrogen Wastewater in a Two-Sludge System." *Water SA,* Vol. 29 No. 1, p. 11-16.

[18] Lewandoswki, Z. 1982. "Temperature Dependency of Biological Denitrification with Organic Materials Addition." *Water Research*, Vol. 16, p. 19-22.

[19] Sonstegard et al. 2010 at 238.

[20] *Id.*

[21] Shen, J., R. He, W. Han, X. Sun, J. Li, and L. Wang. 2009. "Biological Denitrification of High-Nitrate Wastewater in a Modified Anoxic/Oxic-Membrane Bioreactor (A/O-MBR)." *Journal of Hazardous Materials* 172 (2009) 595-600.

[22] EPA-HQ-OW-2009-0819-0819-0773, Table 5-2, p. 5-24.

[23] Allen, J.O., D. Eggert, and C.A. Tyree. 2011. "Effect of FGD Chemistry on Wastewater Composition," presented at Air Quality VIII Conference, Arlington VA. October 25.

[24] EPRI. 2007. *Treatment Technology Summary for Critical Pollutants of Concern in Power Plant Wastewaters*. 1012549. EPRI, Palo Alto, CA.

[25] Steam Electric Survey (2010 ICR) Database, EPA-HQ-OW-2009-0819-2070.

[26] EPRI. 2008. *Flue Gas Desulfurization (FGD) Water Blowdown Characterization and Management: 2007 Update*. 1014073. EPRI, Palo Alto, CA.

[27] EPRI. 2010. *Pilot-Scale and Full-Scale Evaluation of Treatment Technologies for the Removal of Mercury and Selenium in Flue Gas Desulfurization Water*. 1017955. EPRI, Palo Alto, CA.

[28] EPA-HQ-OW-2009-0819-0736, EPA-HQ-OW-2009-0819-0790, and EPA-HQ-OW-2009-0819-0885.

[29] GE provided EPRI water quality requirements for influent to the ABMet® system.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107. Also see DCN SE05846 (memorandum *Variability in Flue Gas Desulfurization Wastewater: Monitoring and Response).*

Commenter Name: Tom DeLawrence
Commenter Affiliation: Public Service Company of New Hampshire(PSNH)

Document Control Number: EPA-HQ-OW-2009-0819-4633-A1
Comment Excerpt Number: 29
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Biological treatment of FGD waste water has various significant limitations, many of which are due to the fact that the technology relies upon biological processes which require precise conditions in order to function properly. As discussed above, EPA based its proposed BAT limits for selenium and nitrate/nitrite-N on data collected at Belews Creek and Allen plants, but those plants are not representative of the entire coal-fired electric utility industry and the limits derived from EPA's constrained analysis of those plants will be difficult to achieve at most other plants in the industry. Because EPA used only these two plants, which have ideal operating conditions for utilizing biological treatment of FGD waste water, EPA ignored the limitations of this technology that would prove problematic at most other plants if required to implement this technology. Likewise, EPA disregarded the carbon dioxide emissions associated with operating this technology due to parasitic loads needed to operate associated equipment and because of emissions attributable to biological processes. PSNH offers the following non- exclusive discussions of the most common sensitivities or expected problems associated with this technology.

(a) Chloride levels

Contrary to EPA's claim that the organisms used in the GE ABMet system upon which EPA based its evaluation of this treatment option are "resilient," 78 Fed. Reg. at 34,463, it is a fact that performance of biological treatment can be greatly affected by high or variable levels of chlorides present in the waste stream. According to GE, its ABMet system is designed for FGD waste water containing less than 20,000 ppm of chloride.[10] As explained above, EPA's evaluation of this system—and indeed, of biological treatment as a whole—had no variability whatsoever. EPA's uninformed conclusions about the effectiveness of this system therefore carry little to no weight.

Based on EPA's ICR data, chloride concentrations range from 136 to 40,000 ppm, with an average of 7,740 ppm (2013 TDD at 6-5), at power plants in the industry. In addition, chloride levels are dependent upon flow levels of the waste stream, with a lower flow rate tending to increase concentrations of chlorides. Using flow minimization strategy could tremendously increase chloride levels in FGD waste water. EPA in the Proposed Rule calls for flow minimization, asserting that "[t]he flow minimization at these plants would be achieved by either reducing the FGD purge rate or recycling a portion of their FGD wastewater." 78 Fed. Reg. at 34,459. However, EPA does not address the impact lower flow rates may have on chloride levels, and ultimately, the efficacy of biological treatment.

Moreover, approximately 11% of power plants already cycle up their scrubbers to 20,000 ppm or more. Approximately 5% of plants currently cycle up their scrubbers above 20,000 ppm. If these power plants were to implement biological treatment systems, they would have to lower the chloride levels in their FGD waste stream, and thus increase water flows and increase the size of their waste water treatment systems, thereby further increasing capital and operation and maintenance ("O&M") costs.

(b) Temperature

Water temperature has to be well controlled to ensure good selenium and nitrate/nitrite removal in biological treatment systems. Sustained extreme temperatures, as well as periodic variations of water temperature could impact the behavior of the bacteria. Four GE ABMet systems were in operation in the industry as of 2010. Belews Creek and Allen are two of those systems and both have chemical precipitation pretreatment and heat exchangers to control the water temperature. The other two biological systems use only pretreatment ponds and do not have temperature control equipment. The two biological treatment systems without temperature control have not performed as well as those utilized by Belews Creek and Allen.[11]

PSNH and other utilities located in cold weather climates will experience additional complications with biological treatment because the microorganisms in the biological treatment process have a mortality risk below 40ºF. New Hampshire experiences sustained temperatures at or below 40ºF most of the winter season, meaning PSNH would have to construct large buildings at each of its facilities to enclose the equipment needed. This equipment includes, among other things: tanks, pumps, piping, electrical and control system, foundations, sumps, curbs, trenching for exterior interconnection piping for numerous systems, an electrical power supply line, and an HVAC system to control the temperature, which would increase the parasitic load at the facility. Costs also vastly underestimated include engineering for design, construction management, training, PSNH labor, and overhead costs, among others. Additional O&M costs would range from $500,000 to $600,000 annually at Merrimack Station alone, as well. EPA is required to consider cost, and to come to a reasonable conclusion with respect to proper BAT for a point source.

(c) Nitrate/Nitrite Levels

Proponents of the GE ABMet biological treatment system claim that it is "designed to handle . . . suspended solids up to 100 ppm, nitrate/nitrite loading less than 100 ppm."[12] Despite this claim, Belews Creek and Allen both have nitrate/nitrite levels lower than 100 ppm, meaning those facilities can more easily meet the nitrate/nitrite and selenium limit. In fact, the systems were not designed to effectively remove nitrates, only selenium. Nitrate levels in FGD waste waters at other facilities in the industry range from 20 to more than 400 mg/L. Under high nitrate/nitrite scenarios, the operation of the biological treatment systems may not meet EPA's proposed selenium and nitrate limits. EPA has insufficient data upon which it can justifiably impose the nitrate/nitrite limits in the Proposed Rule. Furthermore, there is insufficient long- term data available to determine the effectiveness of nitrate removal.

(d) Oxidation Reduction Potential

EPA also failed to adequately consider the impact high oxidation reduction potential ("ORP") in FGD waste waters could have on the effectiveness of biological treatment. High ORP means that the FGD waste water has high concentrations of oxidants that could consume the biological system's reduction capability, which could reduce its capability to remove nitrate/nitrite and selenite/selenate. Even worse, in extreme cases within high ORP scrubbers, hypobromite (BrO-) could be produced, which could kill the bacteria. The ORP at both Belews Creek and Allen are typically very low, meaning they also do not experience this potential problem that could affect operations at other facilities in the industry.

(e) Production of Ammonia

EPA also failed to consider the potential additional costs associated with ammonia produced during the biological treatment process. Specifically, ammonia may be generated as a byproduct of the biological treatment system at some facilities during the anaerobic biological process. The formation of this byproduct can be impacted by temperature, ORP, and microbial activity and could vary greatly within the industry. This may present additional issues, including requiring additional treatment, at facilities subject to ammonia discharge limitations or whole effluent toxicity limits.

(f) Biological Backwash

Another issue with biological treatment is the saturation of the biological filter and the need to backflush the system's microbes and collected waste. Activated carbon layers in various reactors are used where biological mass is grown. There are typically two stages of biological carbon filters which do require backwash on a periodic basis. The frequency with which this backwash process must occur is based on operational needs and the quantity and volume of backwash that plant personnel will be able to manage. This biological filter might need to be constantly monitored to ensure that it does not become saturated. This will require operational changes and resource allocation and renders this technology even more cost-prohibitive and ineffective. EPA is under a duty to consider this and similar operational issues and, had it done so in the Proposed Rule, it would been have hard pressed to conclude that biological treatment is BAT for the industry.

This biological backwash has the potential to negatively impact physical/chemical systems at facilities, as well. The only feasible option for many plants—including Merrimack Station—given operational and site constraints, is to recirculate the treated waste back through the physical/chemical system. This must be done at slow feed rates in order to prevent overloading the system so that it is able to capture the trace amounts of selenium. However, plants such as Merrimack Station which have for years operated physical/chemical system for FGD waste water treatment will likely lack added margin to accept this new flow through its normal operations, and it would be very difficult for such a system to also be charged with treating the sludge from the biological treatment process. Therefore, adding the waste back from a biological system would bring the guaranteed removal rate of the physical/chemical system into question.

Merrimack Station's physical/chemical system is carefully designed and operated to provide the maximum reduction level of all constituents of concern. Many FGD waste water treatment systems like Merrimack's are finely tuned to accept a high ORP which, for example, affects mercury speciation and capture. It is critical to the operation of the physical/chemical system to maintain the correct ORP level, which at Merrimack Station is elevated. A biological reactor necessarily changes the anaerobic levels which, in turn, lower the ORP significantly. If this stream containing lower ORP is then reintroduced to the physical/chemical system, it could also significantly impact the effectiveness of the system. In fact, the addition of lower ORP is not consistent with the original design guidelines and could likely jeopardize the guarantees of the physical/chemical system itself. Moreover, the high ORP will significantly reduce the effectiveness of EPA's proposed biological reactor.[13]

The recirculated effluent from the biological system would necessarily contain biological solids and waste. Current physical/chemical systems are not designed to process biological waste or the expected volume of that waste. If facilities were required to recirculate the treated waste back through the physical/chemical system, the effluent would exceed the design solids loading. EPA has not considered this aspect or consequence of utilizing biological treatment and, as a result, biological reactors cannot be considered BAT for power plants currently using physical/chemical systems.

Where a facility like Merrimack Station is unable to dispose of the backwash via ponds, and because a recirculation methodology is not feasible, it would be forced to seek out other disposal options. EPA does not consider the cost of waste disposal into its cost-estimate analysis associated with biological treatment.

(g) Footprint Concerns

Another issue with biological treatment relates to the engineering processes associated with applying this control technique. This issue has been well-studied and applied by PSNH to its Merrimack Station during EPA's development of Merrimack Station's NPDES permit, and PSNH's concerns for Merrimack are indicative of the problems many facilities would face if required to implement biological treatment within their current FGD systems.

First, it is not a given that a facility has the necessary space to physically install a biological system and building. EPA has not considered whether such a treatment system is even feasible prior to its unreasonable and unsupported proposal to select biological treatment as BAT for an industry with a wide range of plant locations, designs, and layouts. EPA has not reviewed any site-specific conditions, or associated costs, of even a typical coal-fired power plant, let alone one whose infrastructure is already constrained and congested. This also translates into added costs to remove existing facilities to make room for such a building and to interconnect it to the station's physical/chemical waste water treatment system.

By way of example, there are significant space limitations to installing the necessary equipment and tanks at Merrimack Station. In addition to the four reactor vessels needed to conduct the actual biological treatment process, an additional two tanks for backwash and two tanks for waste water would also be necessary. This creates a significant footprint concern for Merrimack Station, and also implicates significant cost concerns, as well. Consideration of all relevant factors related to this BAT factor would weigh against selection of biological treatment as BAT. EPA's proposed selection of it is unreasonable, unsupported and should be revisited.

(h) Operational Constraints Due to Existing Equipment

Effluent from FGD scrubbers can vary depending on a number of factors, both related to the particular scrubber system installed at a particular facility as well as the type of coal burned at the plant. For example, Merrimack Station's FGD effluent is different from the effluent associated with many scrubber systems, and is certainly different from the two Duke Energy plants from which EPA based its entire conclusion to "prefer" biological treatment as BAT. Specifically, Merrimack Station's nitrate levels are elevated. Additionally, Merrimack Station's ammonia levels are surprisingly low—typically measuring less than 1 mg/l. Data indicates that these levels are atypical. Based on this information, it appears the system is converting ammonia into nitrates, which is similar to what happens in a biological treatment system.

This is problematic because power plants do not operate in a steady state condition and have many changing factors that must be taken into account during operation. For example, nitrate concentrations that are elevated to the level that Merrimack Station experiences cannot be effectively treated by the biosystem.[14] Moreover, if the microorganisms in the biological treatment system become acclimated to living among elevated nitrate levels (around 60 to 100 mg/l or higher), they could very well be more sensitive to upsets in conditions. This is a real possibility if the high nitrate levels are not consistently maintained – a likely outcome given the fact that the scrubber at Merrimack Station is associated with two different sized units each burning different and variable coal blends, which can each change output levels frequently during the week, causing numerous transient conditions and resultant chemistry and process changes. Importantly, higher nitrate levels also require more backwashing, adding to the overload of the physical/chemical system.

Therefore, the reality of constantly changing operational factors, as evidenced by the FGD WWTS at Merrimack Station, should have been considered by EPA. Such a consideration would have weighed significantly against EPA's proposal to select biological treatment as BAT. EPA's conclusion that a biological treatment process is BAT is based on flawed data and is therefore unreasonable. Contrary to EPA's determination, BAT for the FGD waste stream is physical/chemical treatment, a process already used successfully at a significant number of plants across the United States. The use of biological treatment is not supported by a proper consideration of the BAT factors; therefore, EPA's inclusion of this technology as a possible BAT option was unreasonable, arbitrary and capricious. EPA did not (and cannot) support the data it used to calculate the effluent limits, and it cannot demonstrate that the effluent limits it established are technologically and economically achievable.[15]

---

10 Sonstegard, J., J. Harwood, and T. Pickett. Setting the Standard for Selenium Removal, 2010 International Water Conference, IWC-10-18 at 5. Although GE has subsequently claimed that the system can treat wastewater with chloride levels as high as 25,000 ppm, see http://www.gewater.com/products/abmet-selenium- removal.html (ABMet FAQ document entitled, Cost Estimating Summary for Biological Treatment of Flue Gas Desulfurization Wastewater). no such system has been demonstrated, as the Allen and Belews Creek systems

were developed prior to 2010 and therefore must have been designed for wastewater containing less than 20,000 ppm chlorides.

11 Sonstegard, J., J. Harwood, T. Pickett, and D. Johnson, Full Scale Operation of GE ABMet Biological Technology for the Removal of Selenium from FGD Wastewaters, 2008 International Water Conference, IWC-08-
31. Steam Electric Power Generation Point Source Category: Final Detailed Study Report (2009), EPA 821-R-09- 008.

12 Sonstegard, J., J. Harwood, and T. Pickett.
Setting the Standard for Selenium Removal, 2010 International Water Conference, IWC-10-18 at 5.

13 Biological treatment requires a healthy population of microbes to be effective. High ORP kills microbes and, thus, will significantly decrease the effectiveness of biological treatment, demanded by EPA.

14 See Placer Data Library, Detection Limits and Reporting Limits, http://www.placerdata.com/library/reportinglimits.php.

15 Additional or related limitations of biological treatment systems include: "(1) [p]otential need for pretreatment to remove suspended solids; (2) [b]ackwash water required to periodically slough off excess microbial growth, prevent short-circuiting of flow, and for de-gassing; (3) [l]arge footprint required given the low hydraulic loading rate (e.g., 2.4 gpm/ft2 or 81-162 Lpm/m2) requirements and high minimum hydraulic residence requirements (46 hours); (4) [p]resence of an excessive amount of nitrates will require proportional amount of carbon or energy source. This excess carbon source will also generate some additional biomass; (5) [e]xternal carbon source is required if soluble influent organic content or COD is insufficient; (6) [w]asted biomass residuals contain elemental selenium that may be hazardous depending upon the TCLP results; (7) [m]edia replacement may be required over the life of the system; (8) [b]iological residuals will need to be thickened and dewatered for landfill disposal." See CH2MHILL's Final Report: Review of Available Technologies for Removal of Selenium in Water (June 2010) at VIII, 4-65–66, available at http://www.epa.gov/region1/npdes/merrimackstation/pdfs/ar/AR-132.pdf (1-8 numbers added).

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107 regarding biological treatment system performance and footprint constraints.

EPA disagrees with the commenter that it "disregarded the carbon dioxide emissions associated with operating this technology due to parasitic loads needed to operate associated equipment and because of emissions attributable to biological processes." EPA estimated changes in carbon dioxide emissions in its evaluation of non-water quality environmental impacts associated the ELGs (i.e., additional generation required to meet demand due to energy requirements of the BAT technology). EPA determined that there are no emissions of carbon dioxide associated with the actual biological processes (i.e., the biological microbes do not generate carbon dioxide in the process).

EPA notes that the Merrimack plant operates an evaporation system that, if properly operated, can meet the effluent limitations. In fact, such systems can be operated in a manner that completely eliminates all discharge to surface waters. Therefore, the plant already has technology in place to meet the requirements of the final rule and will not need to install the biological treatment system. Therefore, the comments related to changes that PSNH believes would be necessary to install the BAT basis at Merrimack, including whether sufficient space is available, are not relevant. The final rule does not require facilities to install the system identified as the technology basis for BAT, but only that the appropriate effluent limitations and standards be achieved.

Based on discussions with GE, the backwash can be recycled back to the equalization tank upstream of the chemical precipitation system for further solids removal. Costs associated with the treatment of backwash from the biological treatment system are incorporated into the chemical precipitation system costs for the final rule. Additionally, the volume of backwash and solids is small compared to flow of the FGD wastewater and well within the capacity factor of the design of the system. See response to DCN EPA-HQ-OW-2009-0819-4460-A1, Excerpt Number 41 regarding backwash generation from biological treatment. EPA evaluated the characteristics of each existing treatment system at plants to identify what changes, if any, would be needed for plants to install and operate the chemical precipitation plus biological treatment system identified as the BAT basis. Where additional equipment or capacity was found to be needed, EPA included such costs in its cost estimates for the final rule.

Regarding the treatment of FGD wastewater with high nitrate/nitrite concentrations, see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 44 in Comment Code 10.b. Additionally, EPA notes that citation 14 in the comment letter does not provide any data support that commenter's assertions.

See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107. Also see DCN SE05846 (memorandum *Variability in Flue Gas Desulfurization Wastewater: Monitoring and Response*).

Lastly, EPA disagrees that it "did not (and cannot) support the data it used to calculate the effluent limits, and it cannot demonstrate that the effluent limits it established are technologically and economically achievable" for reasons discussed in the preamble.

Commenter Name: Tom DeLawrence
Commenter Affiliation: Alabama Power Company
Document Control Number: EPA-HQ-OW-2009-0819-4489-A1
Comment Excerpt Number: 15
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

2. EPA Did Not Adequately Consider the Technological Limitations of Biological Treatment Systems

Biological treatment systems have several significant operational limitations. Tellingly, some plants that have installed such a system are now turning to other treatment technologies that accomplish better removal rates for a wider range of metals and pollutants. Specifically, there is evidence that Roxborough Station and Mayo Station, both Progress Energy plants, are replacing their biological treatment systems with alternative treatment technologies due to the need for additional dissolved solids removal.[11] This too indicates that biological treatment has either not been in place long enough to determine whether it is effective at treating FGD wastewater, or that this treatment process is not the best option for this waste stream.

EPA failed to consider a number of significant limitations associated with this treatment technology. A thorough evaluation of all of a biological treatment system's operational processes, maintenance activities, and engineering processes prove that biological treatment is not BAT. EPA's failure to consider each of the following faults of this technology render its current analysis unreasonable and insufficient to support any determination that this technology is BAT for the industry.

a. Sensitivities of Microorganisms Utilized in Biological Treatment Technologies

There are a number of intricate operational parameters that can impact the operational effectiveness of biological treatment. EPA failed to consider or adequately address a number of sensitivities associated with the organisms comprising the biological reactors used by this technology. Had the agency done so, it would have realized that this technological option is not appropriate for full-scale FGD wastewater treatment for the industry. EPA's claims that microorganisms used in bioreactors for FGD wastewater treatment are "resilient and have shown that they operate effectively under varying conditions that occur in FGD systems and FGD wastewater treatment systems" are haphazard and patently ignore the substantial evidence to the contrary. *See* 78 Fed. Reg. at 34,463. FGD wastewater characteristics to which biological organisms are inherently sensitive include, but are not limited to, chloride levels, temperature, nitrate/nitrite levels, and oxidation-reduction potential ("ORP"). The issues associated with each are explained in brief, below.

First, it is well established that performance of biological treatment can be greatly affected by high or variable levels of chloride present in the waste stream. According to GE, its ABMet system is designed for FGD wastewater containing less than 20,000 ppm of chloride.[12] EPA's own ICR data reveal that the range of chlorides found in the FGD waste stream at industry facilities range from 136 to 40,000 ppm. *See* EPA, Technical Development Document for Proposed Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category, Doc. No. EPA-821-R-13-002 (Apr. 2013), at 6-5 (hereinafter referred to as "2013 TDD"). EPA's evaluation of this system—and indeed, of biological treatment as a whole—did not account for chloride variability whatsoever. Moreover, EPA has called for flow minimization from the industry, asking facilities to either "reduc[e] the FGD purge rate or recycle[e] a portion of their FGD wastewater". 78 Fed. Reg. at 34,459. It is questionable whether this regulatory initiative is within the agency's legal authority. Regardless, chloride levels have an inverse relationship with flow levels of this waste stream, meaning lower flow rates will result in increased concentrations of chlorides. Thus, any flow minimization strategy could tremendously increase chlorides levels in FGD wastewater. There is nothing in the record to support an assertion that EPA adequately considered these potential issues.

Second, the microorganisms used in biological treatment systems are sensitive to temperature. Water temperature has to be well controlled to ensure good selenium and nitrate/nitrite removal. In 2010, there were four GE ABMet systems in operation. Two of those systems, Belews Creek and Allen, had chemical precipitation pretreatment and heat exchangers to control the water temperature. The other two biological systems use ponds as pretreatment and do not have temperature control equipment. The two biological treatment systems without temperature control have not performed as well as Belews Creek and Allen.[13] With temperatures in its service footprint exceeding 90ºF in the summer months and below freezing in winter, Alabama Power may be forced to enclose any treatment system of this kind to eliminate this sensitivity. This would significantly increase capital and annual O&M costs. Alternatively, Alabama Power may experience variable levels of effectiveness with this technology and be forced to more closely scrutinize it in order to troubleshoot any adverse impacts of changing temperatures. EPA did not sufficiently consider this temperature issue.

Third, organisms are sensitive to nitrate/nitrite levels. Proponents of the GE ABMet biological treatment system claim that it is "designed to handle . . . nitrate/nitrite loading less than 100 ppm."[14] Notably, EPA's ICR data shows that the nitrate/nitrite levels in the FGD wastewater within the industry can be as high as 400 mg/L. How effective is this treatment if nitrate/nitrite levels are that high? It is likely not known. Belews Creek and Allen both have nitrate/nitrite levels lower than 100 ppm and have therefore never had an issue with this technological limitation. In actual fact, there is nothing in the record to support a determination that biological treatment systems can effectively treat these extreme nitrate/nitrate concentrations to a degree that will consistently comply with EPA's proposed selenium and nitrate limitations. Therefore, under high nitrate/nitrite scenarios, there is reason to doubt that the operation of the biological treatment systems can meet EPA's proposed selenium and nitrate limits.

Fourth, biological organisms are sensitive to high ORP. Biological treatment systems first have to consume the oxygen or other oxidant, such as S2O8, before consuming nitrate/nitrite, and finally selenite/selenate. A very high ORP means that the FGD wastewater has high concentrations of oxidants that could consume the biological system's reduction capability, which could reduce its capability to remove nitrate/nitrite and selenite/selenate. Even worse, in extreme cases within high ORP scrubbers, hypobromite (BrO-) could be produced and kill the bacteria. The ORP at both Belews Creek and Allen are typically very low, meaning they provide no insight into this potential problem that could affect operations at other facilities in the industry.

Another issue with biological treatment not addressed in the Proposed Rule is the saturation of the treatment system's biological filter and the periodic need to back flush the system's microbes to remove the buildup of pollutants. Activated carbon layers in various reactors are used where biological mass is grown. There are typically two stages of biological carbon filters that require backwash on a periodic basis. The frequency with which this backwash process must occur is based on operational needs and the quantity and volume of backwash that the facility can manage. Presumably, then, the main component of the biological treatment process—the biological filter—might need to be constantly monitored to ensure that it does not become saturated. This will require operational changes and resource allocation. EPA has not adequately accounted for how this is to be accomplished across the broad spectrum of variability in operational characteristics among the facilities that would be subject to a final rule, making this technological option even more cost-prohibitive and ineffective.

b. Unwanted Byproducts of Biological Treatment

Another technological problem associated with biological treatment of FGD wastewater is that the biological treatment process itself produces ammonia and hydrogen sulfide as natural byproducts, thereby increasing levels of those constituents in the wastewater stream. This can, in turn, impact toxicity levels. Although EPA summarily claims in the Proposed Rule that such increased ammonia levels can be treated with an additional treatment step, such a "step" is nowhere near as technologically simple or as economically reasonable as EPA suggests. Moreover, sulfate is reduced to sulfide during biological treatment processes as bacteria reduce selenate and selenite to metal selenium and reduce nitrate and nitrite to nitrogen gas and ammonia. Sulfide production can be beneficial inasmuch as the sulfide could further precipitate heavy metals such as mercury, nickel, copper, zinc, etc. However, this sulfide also combines to make the undesirable hydrogen sulfide byproduct. The increased levels of ammonia and hydrogen sulfide produced during the biological treatment process mean additional operational processes will be necessary at additional costs and manpower. Again, EPA failed to account for these material issues.

c. Design and Engineering Issues Associated with Biological Treatment

Another issue with biological treatment at Alabama Power's plants relates to the engineering processes associated with applying this control technology. It is unclear whether Alabama Power's plants have the necessary space to physically install this treatment system and any associated buildings. To install a robust system, Alabama Power would likely need to install an elaborate cooling system, several first- and second-stage bioreactors, multiple effluent transfer tanks, and multiple backwash holding tanks at the facility. EPA failed to consider whether the installation of this infrastructure is even feasible at all or most plants subject to a final rule prior to its consideration of biological treatment as BAT. EPA also failed to consider or review any site-specific conditions with respect to whether and how the necessary infrastructure can fit spatially within the footprint of the existing facility. This translates into added costs to remove existing facilities to make room for such additional infrastructure and to interconnect it to the plant's physical/chemical wastewater treatment system. EPA must thoroughly consider this concern prior to basing any effluent guidelines based on this technology.

---

11 Both of these plants use the ABMet biological metals removal system created by GE.

12 Sonstegard, J., J. Harwood, and T. Pickett. *Setting the Standard for Selenium Removal*, 2010 International Water Conference, IWC-10-18 at 5. Although GE has subsequently claimed that the system can treat wastewater with chloride levels as high as 25,000 ppm, *see* http://www.gewater.com/products/abmet-selenium-removal.html (ABMet FAQ document entitled, *Cost Estimating Summary for Biological Treatment of Flue Gas Desulfurization Wastewater*), no such system has been demonstrated, as the Allen and Belews Creek systems were developed prior to 2010 and therefore must have been designed for wastewater containing less than 20,000 ppm chlorides.

13 Sonstegard, J., J. Harwood, T. Pickett, and D. Johnson, *Full Scale Operation of GE ABMet Biological Technology for the Removal of Selenium from FGD Wastewaters*, 2008 International Water Conference, IWC-08-31; Steam Electric Power Generation Point Source Category: Final Detailed Study Report (2009), EPA 821-R-09-008.

14 Sonstegard, J., J. Harwood, and T. Pickett. *Setting the Standard for Selenium Removal*, 2010 International Water Conference, IWC-10-18 at 5.

Comment Response:

EPA disagrees with the commenter that just because "some plants that have installed [a biological treatment] system are now turning to other treatment technologies that accomplish better removal rates for a wider range of metals and pollutants" does not indicate "that biological treatment has either not been in place long enough to determine whether it is effective at treating FGD wastewater, or that this treatment process is not the best option for this waste stream." As noted by the commenter, the Mayo plant is "replacing [its] biological treatment systems with alternative treatment technologies due to the need for additional dissolved solids removal." EPA is aware that Mayo is installing an evaporation system. The Mayo plant switched to treatment using evaporation technology because the plant needs to comply with water quality-based effluent limitations (WQBELs) for other pollutants, not because the biological technology is unable to meet effluent limitations for the pollutants limited by the ELGs. Additionally, EPA is aware that the evaporation system is capable of achieving greater removals of pollutants compared to the biological treatment system. This in no way indicates that the treatment system is not effective because it was not designed to remove dissolved solids, as indicated by the commenter. EPA notes that the final standards for new sources (NSPS/PSNS) applicable to discharge of FGD wastewater are based on chemical precipitation plus evaporation, and the BAT limitations applicable to FGD wastewater in the voluntary incentives program is also based on such technology. In that way, EPA encourages plants to adopt the technology employed by Mayo. The preamble for the ELGs notes that FGD wastewater includes pollutants not removed by the chemical and biological treatment technologies and that it may be necessary for permitting authorities to establish WQBELs that are more stringent than the ELG, at least for certain pollutants such as bromide. EPA noted that the evaporation technology being used at Mayo (and other plants) will effectively remove bromides and many other pollutants from FGD wastewater.

See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107 regarding biological treatment system performance and FGD wastewater variability and temperature fluctuations. Additionally, the commenter mentions the generation of hydrogen sulfide in the biological treatment system. EPA disagrees with the commenter that hydrogen sulfide byproducts will require additional treatment steps for FGD wastewater. According to GE's technical paper "Full Scale Implementation of GE ABMet® Biological Technology for the Removal of Selenium in FGD Wastewater" (IWC-07-50), the biological treatment system can operate at ORP levels that favor sulfide formation. Sulfide produced in the system readily forms metal complexes with other metals and precipitate out of the FGD wastewater. During backwashing events, the system releases any trapped gasses generated in the process, including hydrogen sulfide (DCN SE02955). Additionally, EPA notes that large concentrations of sulfides are only a problem if the ORP goes too low for a long time. The ABMet system as evaluated by EPA includes the ability to monitor ORP and respond by changing the nutrient feed rate if the ORP becomes too low. Plants currently operating the biological treatment system have processes in place to monitor for hydrogen sulfide. EPA's cost for this technology is based on the very same technology and instrumentation, including trained operators to fully monitor conditions associated with the biological treatment system.

Regarding the treatment of FGD wastewater with high nitrate/nitrite concentrations, see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 44 in Comment Code 10.b.

Regarding backwash generation from biological treatment, see response to DCN EPA-HQ-OW-2009-0819-4460-A1, Excerpt Number 41.

EPA does not agree that plants would lack adequate space to install the BAT technology, nor does the commenter provide any support for the unsubstantiated statement that it is "unclear whether Alabama Power's plants have the necessary space to physically install this treatment system and any associated buildings." See the response to DCN EPA-HQ-OW-2009-0819-4460-A1, Excerpt Number 41.

Commenter Name: Tom DeLawrence
Commenter Affiliation: PowerSouth Energy Cooperative
Document Control Number: EPA-HQ-OW-2009-0819-4460-A1
Comment Excerpt Number: 39
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Biological Treatment Technologies have a Number of Limitations that Could Prove Problematic for the Industry.

Biological treatment technology primarily relies upon biological processes to treat FGD wastewaters that require precise conditions and can be negatively impacted by any alteration in those conditions. As discussed above, EPA's proposed BAT limits for selenium and nitrate/nitrite are based on data collected at Belews Creek and Allen plants. Yet, those plants are not representative of the entire coal-fired electric utility industry and the limits derived from

EPA's limited analysis of those plants will be difficult to achieve at most other plants. What follows is a brief discussion of a number of conditions or factors that have the potential to disrupt the aforementioned biological processes and render this treatment technology less effective or wholly ineffectual.

(a) Organisms are sensitive to flow and plant load swings

Current natural gas prices have dramatically impacted the industry. Some coal-fired units have been converted, or intend to convert, to natural gas. Other entities have idled or altered the use of their coal-fired generation fleet. Any fluctuation and/or alteration of plant operations can have a dramatic adverse impact on any biological treatment system because, to effectively operate, such systems require a stable, consistent FGD wastewater influent stream. This can prove difficult enough under normal plant operating conditions due to standard fluctuations in load or demand. The aforementioned added instabilities currently experienced at coal-fired plants may make the generation of a consistent FGD waste stream infeasible. EPA has not adequately considered how normal plant operations, as well as external market impacts, can impact the overall effectiveness of this technology. Nor has the agency sufficiently considered the fact that a biological system likely cannot effectively treat FGD influent immediately upon startup of a plant.

(b) Organisms are sensitive to chloride levels

The concentration of chlorides in an FGD waste stream can have dramatic impacts on the effectiveness of biological treatment. GE claims its ABMet system is designed to handle FGD wastewater containing less than 20,000 ppm of chloride.[6] This may be true, but EPA failed to evaluate existing systems with substantially different chloride concentrations. As such, the agency has not evaluated what impact differing concentrations—or concentrations in excess of 20,000 or 25,000 ppm—could have on this proposed treatment technology. Indeed, the results of EPA's own ICR reveal that the range of chlorides found in the FGD waste stream at industry facilities range from 136 to 40,000 ppm. See 2013 TDD at 6-5.

Chloride levels are also dependent upon flow levels of the waste stream. Lower flow rates typically result in increased concentrations of chlorides. EPA in the Draft Rule calls for flow minimization, asserting that "[t]he flow minimization at these plants would be achieved by either reducing the FGD purge rate or recycling a portion of their FGD wastewater." 78 Fed. Reg. at 34,459. While this initiative is questionably within EPA's regulatory purview, any such flow minimization strategy could tremendously increase chlorides levels in FGD wastewater. EPA ignores this potential impact to the efficacy of biological treatment.

(c) Organisms are sensitive to temperature

Biological treatment systems require well-controlled, water temperature, as well, to ensure good selenium and nitrate/nitrite removal. Of the four systems utilizing GE's ABMet system in 2010, two had installed temperature controls (Allen and Belews Creek) and two had not. Those without such controls have not performed as well as Allen and Belews Creek.[7]

PowerSouth's Lowman Plant could experience additional complications with biological treatment at various points throughout the year if water temperature is not adequately controlled. In Alabama, temperatures regularly exceed 90ºF in the summer months and have the potential to drop below freezing at times during winter months. These extreme temperature ranges could threaten the viability of biological treatment or, at the very least, affect the biological processes of the technology differently throughout the year causing a need to closely scrutinize and tweak the technology to maintain its effectiveness.

---

6 Sonstegard, J., J. Harwood, and T. Pickett. Setting the Standard for Selenium Removal, 2010 International Water Conference, IWC-10-18 at 5. Although GE has subsequently claimed that the system can treat wastewater with chloride levels as high as 25,000 ppm, available at http://www.gewater.com/products/abmet- selenium-removal.html (ABMet FAQ document entitled, Cost Estimating Summary for Biological Treatment of Flue Gas Desulfurization Wastewater). no such system has been demonstrated, as the Allen and Belews Creek systems were developed prior to 2010 and therefore must have been designed for wastewater containing less than 20,000 ppm chlorides.

7 Sonstegard, J., J. Harwood, T. Pickett, and D. Johnson, Full Scale Operation of GE ABMet Biological Technology for the Removal of Selenium from FGD Wastewaters, 2008 International Water Conference, IWC-08-31. Steam Electric Power Generation Point Source Category: Final Detailed Study Report (2009), EPA 821-R-09- 008.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107.

Commenter Name: Tom DeLawrence
Commenter Affiliation: Alabama Power Company
Document Control Number: EPA-HQ-OW-2009-0819-4489-A1
Comment Excerpt Number: 14
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

1. **There is insufficient data to support EPA's conclusion that biological treatment is an available or effective technology, and what data does exist supports the opposite conclusion**

There is not sufficient data to support a conclusion that biological treatment is an available or effective technology in the steam electric power generating industry. This technology is new and has not been fully vetted. Its effectiveness is unclear and contradictory, and evidence of its success is speculative at best—especially given the fact that each biological treatment system must be able to adapt to the conditions in its own plant in order to successfully remove any constituents. Changes in fuel type, FGD operations, temperatures, plant size, boiler type, testing capabilities, and other variables will all impact the operation of biological treatment. Because these variables vary greatly from plant to plant, this treatment option is anything but widely applicable.

As EPA concedes in the Proposed Rule, only a handful of plants across the country—all of which are owned by two companies[8]—even use the most "common" type of biological treatment system to treat FGD wastewater. 78 Fed. Reg. at 34,452 ("EPA identified five plants that operate the fixed-film anoxic/anaerobic biological treatment systems to treat FGD wastewater"). Moreover, EPA only considered a subset of this already limited data, electing to evaluate the biological treatment data from only two plants: Belews Creek and Allen. Both plants are owned by the same company and have virtually identical systems. Therefore, EPA essentially based its conclusions as to the availability and performance of biological treatment systems on a single model. This is not enough data to inform a rulemaking with potential applicability to the majority of coal-fired power plants nationwide.

Total reliance on the lone Duke Energy scenario to dictate effluent limits for an entire industry is also improper because both the Belews Creek and Allen plants produce FGD influent streams which are much easier to treat than the typical FGD influent at a coal-fired power plant. This is evident by simply reviewing the levels of total suspended solids ("TSS") and total dissolved solids ("TDS") in the FGD influents at the other plants from which EPA has collected samples. All of these other plants experience higher—or <u>much</u> higher—TSS and TDS levels in their FGD waste streams prior to entering their wastewater treatment systems. All of these other facilities also experience higher nitrate/nitrite levels than either Belews Creek or Allen. In fact, the pretreatment FGD wastewater at two facilities, Hatfield's Ferry and Pleasant Prairie, contain nitrate/nitrite influent levels beyond the design capacity of the GE ABMet biological treatment system used by Duke Energy.[9] It is therefore likely that those plants, for example, would be unable to meet the limits achieved at Belews Creek and Allen even if the former installed and operated the exact same system used at the latter.[10]

In addition to the small number of biological systems currently being operated, and the smaller number of systems actually considered by EPA, the biological treatment processes at these plants have only been installed for a few years. This is an insufficient length of time for EPA or the industry to fully understand the successes and limitations associated with even the one system EPA evaluated, let alone the technology as a whole. Without a sufficient length of time to evaluate the system's success, it is difficult to know whether the technology can be sustained over the long-term, given "unknowns" associated with, among other concerns: (1) the suitability of the construction materials used in these systems over time; and (2) the nature and extent of maintenance and/or component replacement required during routine operation and during outages.

Other obvious differences between plants that affect their ability to utilize biological treatment systems that EPA must consider include changes to the purge stream based upon coal types, boiler design and operation, scrubber operation, footprint of the plant, the sensitivity of the microorganisms (bugs) as they adapt to varying conditions (as discussed in greater detail below), and climate. Moreover, because of the limited time and scope of the implementation of this treatment system, other unknown operational issues associated with biological treatment render the success and effectiveness of this technology to treat FGD wastewater unknown at this time. Biological treatment therefore cannot be BAT.

---

[8] Biological treatment is currently operational at Roxborough Station (Progress Energy), Mayo Station (Progress Energy), Allen Station (Duke Energy), Belews Creek Station (Duke Energy), and Flint Station (Duke Energy-West Virginia).

[9] The systems at Belews Creek and Allen were not even designed to effectively remove nitrates, as pre-existing FGD influent numbers were not problematic at those locations.

[10] Notably, EPA has also failed to evaluate any biological treatment systems that optimize both selenium and nitrate/nitrite removal, particularly systems that receive higher than average selenium and nitrate/nitrite levels.

Comment Response:

EPA disagrees with the commenter that there is not sufficient time to evaluate the materials of construction for the biological treatment system. The biological treatment systems have demonstrated over the past decade "the suitability of the construction materials" used for typical FGD wastewaters. Operation and maintenance costs incorporate costs needed for adjustments to the system during routine operation and outages. Section 6.2 of the *Incremental Costs and Pollutant Removals for the Final Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category* (Cost & Loads Report) (DCN SE05831/SE05832) includes more information on the direct and indirect costs factors included in EPA's cost estimates for the biological treatment system.

Regarding biological treatment system performance and FGD wastewater variability, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107.

Commenter Name: Elizabeth E. Aldridge, Hunton & Williams
Commenter Affiliation: UWAG
Document Control Number: EPA-HQ-OW-2009-0819-4655
Comment Excerpt Number: 99
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

7. **Imposing Nitrate Limits for Biological Treatment Systems Optimized for Selenium and Mercury Removal Is Not Demonstrated to Work at Sites with High Nitrate or Selenium Concentrations**

EPA has proposed FGD wastewater limits for both nitrate and selenium based on biological removal of these compounds. These removals are based on anaerobic biological activity reducing nitrogen or selenium to their ground state or some other reduced form in which they are easily removed. The nitrate/nitrogen reaction is well known as denitrification and has been used in wastewater treatment for many years. In these systems, nitrate is anaerobically reduced by groups of microbes capable of the denitrification process through a series of stages, with nitrogen gas being the end result. The microbes grow by using nitrates as a source for their oxygen in the otherwise anaerobic environment.

Something similar is occurring with selenium, although the particular microbes are more highly specialized to be capable of reducing selenates instead of, or at least in preference to, nitrates. This is because thermodynamically nitrates usually are much more easily reduced by organisms to furnish oxygen than are selenates. The reduction of selenium requires specialized species or mixes of species of microbes to be present and active in the biological treatment process, and to remain active, and not be replaced by other competing species. UWAG's consultant, URS, does not claim specific knowledge of the microbes necessary to perform this; it is part of the proprietary information known only to the vendor of these systems. Nevertheless, it is likely that, under certain influent wastewater conditions, nitrates and oxidized selenium compounds compete against each other for the microbes. The systems likely must be optimized for removal of a specific target compound such as selenium. The optimizations required for selenium removal are likely not the same conditions that are optimal for nitrate removal.

This might not be an issue if all FGD wastewater were the same. However, the SER data indicate that the FGD influent to biological treatment is highly variable, especially as to nitrate concentration and TDS. EPA only used data from the Belews Creek and Allen facilities to determine the nitrate limit. Belews Creek and Allen have the cleanest chemical precipitation effluent (biological influent) wastestreams for overall pollutants. Other chemical precipitation effluent wastestreams have higher TDS and higher nitrate values. The following table shows the average TDS and nitrate concentrations for the five plants used by EPA to set FGD limits plus Pleasant Prairie.[37] Note that the chemical precipitation-only treatment systems are nearly all higher in TDS, and some are very much higher in nitrate concentration.

Plant Site	Treatment Present	Average TDS in CP Effluent mg/L	Average Nitrate/Nitrite Nitrogen in CP Effluent mg/L
Belews Creek	CP and bio	16,687	17
Allen	CP and bio	8956	23
Hatfield	CP only	15,815	124
Keystone	CP only	20,500	16.4
Miami Fort	CP only	29,563	84
Pleasant Prairie	CP only	21,188	174

Hatfield, Miami Fort, and Pleasant Prairie all have much higher levels of nitrate than the two facilities where biological treatment was performed. Pleasant Prairie is about 10 times the concentrations found at Allen or Belews Creek. Miami Fort also has a TDS level about twice as high as the highest average TDS for Allen's biological treatment system.

The EPA engineering review does not discuss whether the Agency contacted the major vendor of these biological systems to determine how and under what conditions their system might be capable of meeting both the selenium and nitrate limits, particularly given the high variability of FGD wastewaters. We are not aware of any independent documentation as to EPA contact with the vendors or any other independent experts in this highly specialized form of biological treatment.

EPA should show experts in this specialized field of biological treatment of FGD wastewater the range of variable constituents found in the various chemical precipitation effluents from the SER sampling events that currently do not have biological treatment, and ask them to assess whether the nitrate and selenium limits can simultaneously and consistently be met in these varied wastewaters. Experts in this field should further be asked about what modifications, if any, would be required by various plants due to elevated levels of TDS and/or nitrate/nitrite.

---

[37] Pleasant Prairie is included because its dissolved constituents (NO3 and TDS) should be representative of the chemical precipitation effluent.

Comment Response:

On multiple occasions, EPA has had discussions with GE about the feasibility of biological treatment for FGD wastewaters. GE has conducted a number of pilot and full-scale studies that have demonstrated the effectiveness of the biological treatment system in meeting nitrate-nitrite and selenium limits (DCN SE04208, SE04222). EPA acknowledges that nitrate and selenium removal are targeted at different stages of biological treatment, i.e., denitrification occurs in anoxic/anaerobic conditions and selenium reduction occurs in anaerobic/fermentative conditions within the biological treatment system, as illustrated in GE's technical paper "Full Scale Implementation of GE ABMet® Biological Technology for the Removal of Selenium from FGD Wastewaters" (IWC-07-50) (DCN SE02955). The commenter implies that there are competing reactions at play and differing levels of nitrates or selenium would somehow prevent a plant from meeting the effluent limitations. That is not the case based on information in the record, and a plant that has adequately designed the capacity of the treatment system, manages parameters such as nutrient feed rate and ORP, and pretreats wastewater with extremely high nitrate levels will be able to meet the effluent limitations.

See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107 regarding variability of FGD wastewater. Also see DCN SE05846 (memorandum *Variability in Flue Gas Desulfurization Wastewater: Monitoring and Response*) for a discussion of the processes in the bioreactor and how plants can (and should) ensure the proper operation of the treatment system, including steps that should be taken to condition the influent wastewater prior to the bioreactor.

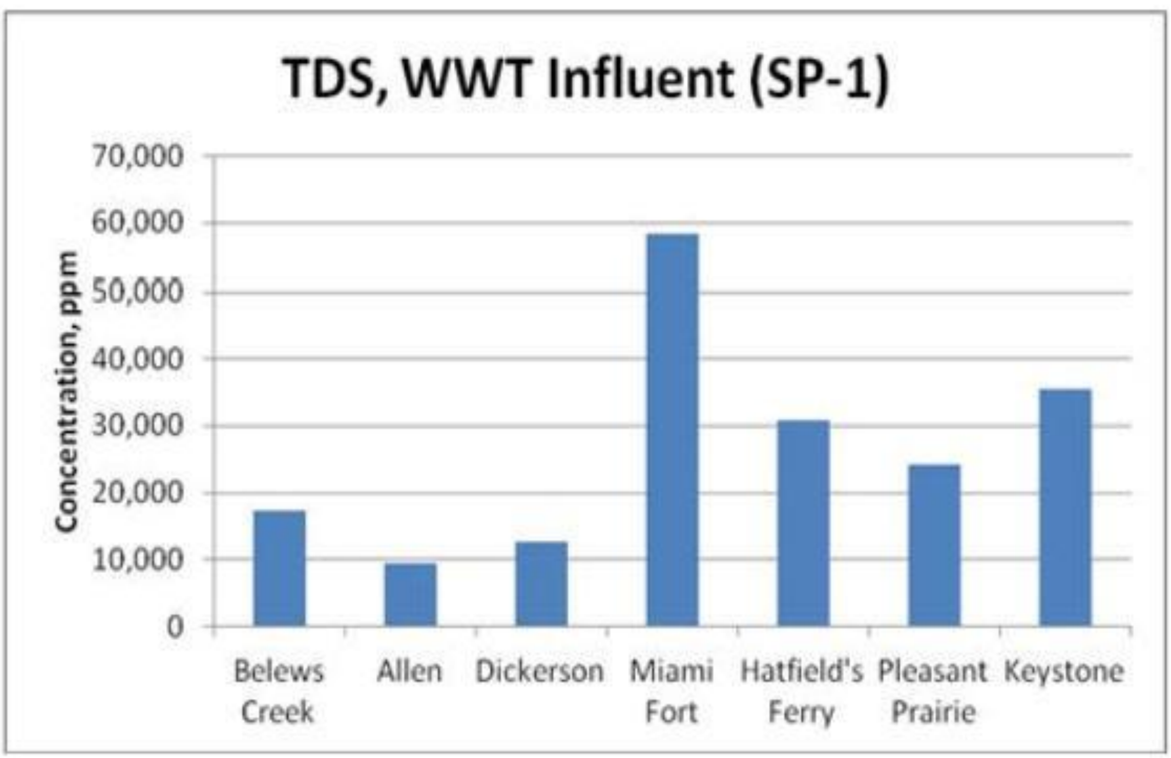
The ability of the biological technology to effectively operate under varying conditions of chlorides, TDS and other characteristics is well-demonstrated by the record for the rule.

Commenter Name: Elizabeth E. Aldridge, Hunton & Williams
Commenter Affiliation: UWAG
Document Control Number: EPA-HQ-OW-2009-0819-4655
Comment Excerpt Number: 84
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

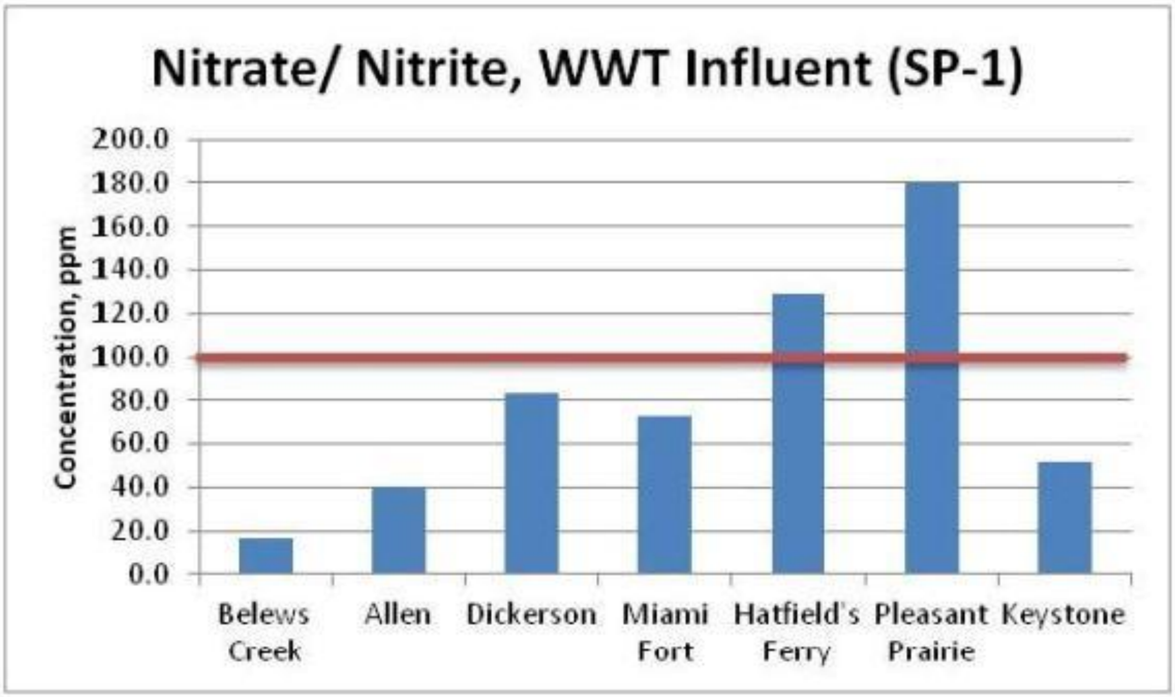
C. Allen and Belews Creek Influents Are Materially Different From Those of Other FGD Systems

Belews Creek and Allen have similar FGD influents, and their influents are different from the FGD wastewater at the other sampled plants. UWAG compared the amount of TDS for each sampled plant (see graph below). The Belews Creek and Allen TDS levels are lower than the FGD influents of Miami Fort, Hatfield's Ferry, Pleasant Prairie, and Keystone.



Constituents in TDS include sulfate, chloride, nitrogen compounds, and dissolved metals. These constituents can have an impact on FGD treatment. EPA has not proven that the performance of the chemical precipitation plus biological treatment at Belews Creek and Allen would be the same at these other plants.

Belews Creek and Allen also have lower nitrate/nitrite levels than Miami Fort, Hatfield's Ferry, and Pleasant Prairie (see graph below). Hatfield's Ferry and Pleasant Prairie have nitrate/nitrite influent levels that are greater than the 100 mg/L (ppm) design specification for the biological treatment system installed at Belews Creek and Allen.



EPA's own sampling data show that nitrate/nitrite concentrations vary greatly between plants. The chemical precipitation effluent values range from <10 ppm (EPA-HQ-OW-2009-0819-0808, Table 4-2, p. 4-11) to 300 ppm (EPA-HQ-OW-2009-0819-0773, Table 5-2, p. 5-24). The treatment systems at Belews Creek and Allen target selenium removal but not nitrogen removal, and both plants have low selenium and nitrate/nitrite levels in their influent. EPA has not evaluated *any* biological systems that optimize both selenium and nitrate/nitrite removal. EPA has also failed to analyze pollutant removals of either selenium or nitrogen species for systems receiving higher selenium and nitrate levels.

Biological treatment of nitrogen may be more complicated than treatment of selenium because it involves a series of denitrification/nitrification steps. These steps can be strongly influenced by many factors, including ambient temperatures, coal characteristics, design and operation of the scrubber, and pretreatment steps. Therefore, the operation of the GE ABMet biological treatment system (as designed for Belews Creek and Allen) may not meet the selenium or nitrate/nitrite limits if applied to Hatfield's Ferry, Pleasant Prairie, or any plant with both high selenium and nitrate/nitrite levels.

Clearly, then, Allen and Belews Creek cannot represent the entire industry, for the following reasons.

1. Nothing in EPA's record demonstrates that plants burning PRB can comply with the limits for FGD wastewater that EPA is proposing.

2. According to EPA, there are 1-5 plants burning primarily petroleum coke and 1-5 plants burning lignite that have wet scrubber discharges. 2013 TDD at 6-5. Nothing in EPA's record demonstrates that lignite or petroleum coke plants can comply with the proposed limits for FGD wastewater.

3. The two plants used to characterize biological treatment efficacy for the entire industry (Belews Creek and Allen) do not represent the variability within the industry. They burn similar coals and operate similar systems.

4. As shown in the graphs above, Belews Creek and Allen also have very similar influents, with low TDS and nitrate/nitrite levels relative to other industry facilities. Other facilities cannot simply engineer to reach these low influent levels prior to the FGD wastewater treatment system.

Industry effluent limitations should not be based on the performance of only two plants. Instead, EPA should collect more data, particularly for arsenic and mercury, from other facilities that operate chemical precipitation systems. According to EPA, there are 42 plants currently operating chemical precipitation systems for FGD wastewater treatment. The variability of more than two treatment systems should be evaluated. Plants that burn subbituminous coal, lignite, and blends of coals should be included in the evaluation.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107 regarding biological treatment system performance and FGD wastewater variability. The comment about influent TDS levels ignores that there is no need to "engineer" the TDS to reach the levels observed at Belews Creek and Allen. The TDS levels for plants discharging FGD wastewater are well within the acceptable range for the microorganisms, and the performance for the IPL Petersburg pilot test certainly demonstrates that the biological treatment system can operate at TDS levels much higher than the Duke plants. EPA disagrees with the commenter that facilities cannot "engineer" the wastewater to lower the levels of nitrate/nitrite; in fact, for levels higher than 100 mg/L, EPA has included costs in its cost estimates for the final rule for plants to include a denitrification step to lower the nitrate/nitrite prior to the bioreactor. It is not necessary to denitrify wastewater with lower influent concentrations of nitrate/nitrite because those levels are will within the design parameters for the biological treatment system and are addressed by the nutrient feed rate.

Regarding treatment of FGD wastewater from plants burning PRB coals, in response to public comments, the final limitations for arsenic and mercury in FGD wastewater are based in part on data from the Pleasant Prairie Power Plant. See response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 53. Additionally, EPA notes that biological treatment system provides a mechanism to reduce selenium and nitrate/nitrate and that the selenium and nitrate/nitrite present in the FGD wastewater from plants burning PRB coals is not different from those burning bituminous coals. As such, with proper pretreatment in the chemical precipitation system and appropriate design and operation of the biological treatment system, the effluent limitations can be achieved.

Regarding petroleum coke and lignite plants, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 124 in Comment Code 4.b. Furthermore, EPA has evaluated the characteristics of wastewater associated with different types of coals and petroleum coke and found they are similar to wastewater from plants burning bituminous coal – for example, the pollutant concentrations associated with subbituminous coals are similar to pollutant concentrations from bituminous coals. In addition, EP has not identified any other wastewater characteristics relevant to operation/performance of the BAT technology that differ between these coal types, nor has the commenter provided any data showing why plants using these other fuels would be unable to meet the effluent limitations.

Commenter Name: Tom DeLawrence
Commenter Affiliation: PowerSouth Energy Cooperative
Document Control Number: EPA-HQ-OW-2009-0819-4460-A1
Comment Excerpt Number: 37
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Biological Treatment is Not an Available, Proven Technology and the Sensitivities Associated with it Would Present Numerous Issues for the Industry, Including the Lowman Plant.

EPA has not collected and/or analyzed sufficient data to support a conclusion that biological treatment is an effective and affordable technology. Accordingly, it is not a legally available technology and cannot constitute BAT for this waste stream. As explained above, EPA tethered its analysis of this technology to essentially one type of system utilized at two facilities in the country. Yet, the GE ABMet system used at these facilities was constructed in the recent past and has not been in operation long enough to determine the overall effectiveness of this technology over the long-term. More importantly, even if they had been in operation a sufficient length of time, the FGD waste stream and other site specific factors are not representative of effluent generated throughout the industry, and therefore cannot provide a rational foundation for declaring this technology as BAT.

EPA's limited analysis of biological treatment is particularly irrelevant to PowerSouth's Lowman Plant. The Tombigbee River, to which the Lowman Plant discharges treated effluent, has significantly lower levels of selenium than the waters accepting effluent from Duke Energy's

Allen and Belews Creek plant. Additionally, the Lowman Plant's FGD influent levels of 20,000 ppm TSS and 5,000 to 6,500 ppm TDS exceed those experienced at the Allen and Belews Creek plants. Other conditions that PowerSouth has not yet evaluated at the Lowman Plant, or compared to the Duke Energy facilities, but are known to impact the effectiveness of this technology are changes to the purge stream based upon coal types, boiler design and operation, scrubber operation, footprint of the plant, and the sensitivity of the microorganisms as they adapt to varying conditions and climate. All of these real and potential differences provide a glimpse of the reality that many facilities in the industry, including the Lowman Plant, would not likely be able to achieve the constituent effluent levels of Allen and Belews Creek even if they employed the same biological treatment system.

In the end, this technology is simply too undeveloped. Its effectiveness is unclear and contradictory, and evidence of its success is speculative at best, especially given the fact that each biological treatment system must be able to adapt to the conditions in its own plant in order to successfully remove any constituents. The biological treatment system from which EPA attempts to model its proposed requirements for the entire industry is not an appropriate measure of what is actually achievable for the majority of power plants, and EPA would have realized this error had it considered a broader array of facilities, data, and operating conditions. Changes in fuel type, FGD operations, temperatures, plant size, boiler type, testing capabilities, and other variables may all impact the operation of biological treatment and would significantly hinder the purported effectiveness of this technology if implemented at facilities throughout the country.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107.

Commenter Name: Theresa Pugh
Commenter Affiliation: American Public Power Association (APPA)
Document Control Number: EPA-HQ-OW-2009-0819-5140-A2
Comment Excerpt Number: 59
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Biological Technology

APPA agrees with UWAG's comments regarding the vulnerability and suitability of biological systems used for effluent treatment. APPA has significant concerns with biological systems, including the impact that a failure of a biological system might have on the local or regional utility system. It is possible that APPA's smaller utilities with often one baseload plant would be more vulnerable operationally to possible failures or upsets/bypass issues with biological systems. **Our concerns about biological systems might even be more acute than those larger utilities with a fleet of coal- and natural gas-fired plants to dispatch during extreme heat or**

cold weather. *APPA asks EPA and OMB to consider these issues in the context of all power plants—but especially in the context of smaller plants*.

Biological systems can fail for a variety of reasons. Variations in chloride levels, total dissolved solids, and temperature fluctuations can affect treatment levels exhibited by biological systems and could lead to "upsets" or failure. All of these factors are related to the operation of the plant and can fluctuate upward as the plant is ramped up towards peak load, or to compensate for extreme weather situations.

For biological treatment systems, water temperature has to be well controlled to ensure good selenium and nitrate-N removal. This might require technology, such as heat exchangers, to control the water temperature. In cases where there is no additional physical space at the utility plant for temperature control equipment, the biological system will be more vulnerable to the same extreme weather conditions that cause increased need for generation.

Biological systems must be designed to keep water temperatures and the reaction rate stable, especially in high latitudes and altitudes. This limitation of biological treatment will significantly increase the cost to maintain and operate the system and could potentially cause compliance issues if not well-controlled. For plants in urban areas (or that are space constrained), there may not be room to house the various reactor vessels and conditioning units required to operate these systems. In many cases the extra burden on existing plant systems would be increased. Biological treatment itself has application limits that make it very difficult to apply on an industry-wide basis.

If EPA chooses a biological option for treatment, then the agency should recognize the inherent limitations in biological technology and should establish a mechanism for ensuring that a utility is not exposed to the same requirements that would be applied to a conventional and demonstrated mechanical technology.

Comment Response:

EPA disagrees with the commenter that smaller plants will have a more difficult time operating a biological treatment section. See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107 regarding biological treatment system performance and FGD wastewater variability, as well as seasonal or periodic operation of the biological treatment system. EPA notes that it reviewed 2 years of data for the Mountaineer plant (a single unit plant), as well as more than double that amount of time for the Duke power plants, and found no indication that the biological treatment system (nor any other aspect of the treatment system) ever had any impact on electricity generation at the plant or affected the electric grid.

See response to DCN EPA-HQ-OW-2009-0819-5140-A2, Excerpt Number 60 in Comment Code 10 regarding upset and bypass accommodations.

Commenter Name: Tom DeLawrence
Commenter Affiliation: Public Service Company of New Hampshire(PSNH)
Document Control Number: EPA-HQ-OW-2009-0819-4633-A1
Comment Excerpt Number: 28
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

As explained above, EPA essentially proposes to require implementation of biological treatment at other facilities based solely on the performance of one biological treatment system utilized at two facilities: Duke's Allen and Belews Creek Stations. However, these plants vary greatly from many other stations, including PSNH's Merrimack Station, in that they are discharging into waters identified as having higher concentrations of selenium. Additionally, the two Duke Energy plants have an FGD purge stream on the order of 400 to 600 gallons/minute, while, for example, PSNH's Merrimack Station FGD purge stream is 50 gallons/minute. Importantly, Merrimack Station's physical/chemical treatment facility has minimal capacity to process additional effluent from the bioreactors. Other obvious differences that EPA must consider are changes to the purge stream based upon coal types, boiler design and operation, scrubber operation, footprint of the plant, the sensitivity of the microorganisms as they adapt to varying conditions, and climate. Biological systems must also be periodically backwashed to remove the buildup of pollutants and EPA has not indicated how this waste stream is to be managed by facilities across the country. Moreover, because of the limited time and scope of the implementation of this treatment system, other unknown operational issues associated with biological treatment render the success and effectiveness of this technology to treat FGD waste water unknown at this time. Biological treatment therefore cannot be BAT.

It appears that the TDS and TSS concentrations in the Merrimack Station FGD influent exceed those reported at the Belews Creek and Allen plants and, as a result, Merrimack Station would not likely be able to achieve the levels of those plants, even if employing the exact same treatment system. Therefore, as this actual data and operating conditions suggest, PSNH would likely be challenged to achieve such unrepresentative low effluent levels at its station. And there is nothing in the record to suggest that the rest of the industry experiences the precise conditions at the Duke Energy plants that would make EPA's proposed biological treatment systems viable across the industry. The biological treatment system from which EPA attempts to model its proposed requirements for the entire industry is not an appropriate measure of what is actually achievable for the majority of power plants, and EPA would have realized this error had it considered a broader array of facilities, data, and operating conditions.

Comment Response:

Regarding the commenter's assertion that "[Belews Creek and Allen] vary greatly from many other stations, including PSNH's Merrimack Station, in that they are discharging into waters identified as having higher concentrations of selenium," EPA notes that the ELG are technology-based standards, meaning they are based on the effluent quality they can be achieved by the technology basis. They do not take into account the water quality of the receiving streams, nor should they. See responses to comments in comment code 6.c.

Regarding the specific comments related to the Merrimack Station, EPA notes that the plant already operates an evaporation system and therefore already operates technology that is capable of meeting the final numeric effluent limitations for FGD wastewater; therefore, the plant will not need to install a biological treatment system. EPA notes, however, that if the plant were to do so, the factors raised by the commenter would not preclude effective operation of the technology and the plant would be able to meet the effluent limitations.

Regarding the biological treatment system performance and FGD wastewater variability, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107.

Regarding the handling of the backwash from the biological treatment system, see response to DCN EPA-HQ-OW-2009-0819-4460-A1, Excerpt Number 41.

Commenter Name: Cari Boyce
Commenter Affiliation: Duke Energy
Document Control Number: EPA-HQ-OW-2009-0819-4305-A3
Comment Excerpt Number: 59
External Review Flag: Statistics
External Review Incorporated into Response: No

Comment Excerpt:

Nitrate/Nitrite (as Nitrogen) BAT limits

As with selenium, EPA established the proposed nitrate/nitrite as N limits based on data obtained from the FGD wastewater treatment system at Belews Creek and Allen Stations. A summary of the nitrate/nitrite-N self-monitoring data from Duke Energy's Allen Station compared with EPA's proposed BAT limits is provide in Table 1- 12.

Table 1-12. Compliance Rate with Proposed Nitrate/Nitrite Limits

Allen Station FGD WWTS Effluent: Treatment = Chemical Precipitation + Biological	
Parameter	**Nitrates/Nitrite as N (mg/L)**
Sampling Type	Self-monitoring
Number of Samples Collected	9
Number of Samples below Detection Limit	

	0	
Number of Samples DL> Proposed Limit	0/0	
Proposed Limit (daily, monthly)	(<=0.17 ppm,<=0.13 ppm)	
Compliant with BAT daily max	1/9	11.1%
Compliant with BAT monthly max	1/9	11.1%

Duke Energy's self-monitoring data for the Allen Station is limited to only nine sampling results for nitrates/nitrites (N). As shown in the table above, the Allen Station only achieved a 11.1% compliance rate with both the daily (0.170 mg/L) and the monthly average (0.130 mg/L) proposed limits. The dataset used by EPA to establish the nitrates/nitrates (N) limits indicates better performance; this dataset, however, is limited to only eight results, of which four were collected in the same week, from two stations, Allen and Belews Creek. Additional nitrates/nitrites (N) data from Belews Creek was presented by EPA, but this data should not be used, since the detection limits were two orders of magnitude greater than the proposed limits. EPA, therefore, has not acquired a sufficient dataset of the biological effluent to establish limits for nitrates/nitrites (N).

The poor performance in nitrate/nitrite removal at Allen Steam Station is due to nitrate/nitrite data collected during a test burn in December 2011 and has been traced to an increase in ORP in the scrubber purge. The fuel being tested during the trial is commonly used at stations in the Midwest. Therefore, it is unknown if the Midwest stations could comply with the proposed nitrate/nitrite limits after installing a similar biological system. As with the proposed BAT selenium limits, Duke Energy, therefore, recommends EPA not establish BAT limits for nitrates/nitrites for FGD wastewater in the ELGs and allow the state NPDES permitting authority to develop water quality-based effluent limits, as needed, for each station.

Comment Response:

As a result of public comments, EPA received self-monitoring data for nitrate/nitrite (as N) from Duke Energy. EPA incorporated these data, as appropriate, into the development of the final numeric limitations. The final rule establishes a nitrate/nitrite numeric limitation that is an order of magnitude larger than the limitation proposed. EPA has determined that plants will be able to meet the final effluent limitations. See the Statistical Support Document for Effluent Limitations. Also see Section 3 of the TDD for additional information on the data sources used in the development of the final rule.

See response to DCN EPA-HQ-OW-2009-0819-4305-A3, Excerpt Number 43.

Commenter Name: Tom DeLawrence
Commenter Affiliation: PowerSouth Energy Cooperative
Document Control Number: EPA-HQ-OW-2009-0819-4460-A1
Comment Excerpt Number: 32
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

EPA somehow proposes biological treatment as BAT in three of its four preferred regulatory options despite the fact that it essentially considered only one type of system— General Electric's ABMet system—at two facilities owned by Duke Energy: Belews Creek and Allen. The systems at those two plants are virtually identical. They have the same design and utilize substantially similar operating conditions due to those plants burning similar fuel mixes, meaning their FGD influents have similar concentrations of metals, nutrients, and other wastewater constituents. Further compounding this error, the FGD influents generated by both of these facilities have remarkably low levels of total suspended solids ("TSS"), total dissolved solids ("TDS"), and nitrate/nitrite levels, making them much easier to treat. In fact, the ABMet systems utilized at Allen and Belews Creek are not even designed to effectively remove nitrates/nitrites—only selenium—because the former do not require active treatment to comply with applicable standards.

It is very unlikely that other facilities within the industry could consistently meet the proposed limits EPA derived exclusively from the Allen and Belews Creek effluent data. The composition of FGD wastewaters at every other plant sampled by EPA provide some indication of the considerably higher levels of TSS, TDS, and nitrate/nitrite found in their respective FGD waste streams prior to entering their wastewater treatment systems. Indeed, the EPA-sampled pretreatment FGD wastewater at Hatfield's Ferry and Pleasant Prairie contain nitrate/nitrite influent levels that exceed the treatment design capacity of the GE ABMet biological treatment system. It is therefore likely that some if not all of the facilities EPA sampled could not consistently meet the limits achieved at Belews Creek and Allen even if the former installed and operated the exact same system used at the latter.[4] Nothing in the record suggests that the rest of the industry would have it any easier.

---

4 Notably, EPA has also failed to evaluate any biological treatment systems that optimize both selenium and nitrate/nitrite removal, particularly systems that receive higher than average selenium and nitrate/nitrite levels.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107.

Commenter Name: Quinlan J. Shea III
Commenter Affiliation: Edison Electric Institute (EEI)
Document Control Number: EPA-HQ-OW-2009-0819-4487-A1
Comment Excerpt Number: 40
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Chemical Precipitation Plus Biological Treatment are Insufficiently Proven.

EPA lists chemical precipitation plus biological treatment as the model technology option for FGD wastewater in BAT options 3b (scrubber capacity >2,000 MW), 3, and 4a.

EPA has failed to prove that chemical precipitation plus biological treatment is feasible for this industrial category because, as discussed above, its determination was based on flawed data and analyses. For example, the plants EPA chose to use for its cost effectiveness analysis (Belews Creek and Allen) have very similar influent characteristics. In contrast, other sampled plants have very different influents. Plants with such different influents will likely not be able to meet the proposed FGD limits without significantly more investment or additional technologies not considered by EPA cost estimates.

EPA's engineering assessment of biological treatment also does not fully reflect the complexity of such systems and the organisms providing treatment therein. For example, microorganisms in treatment systems are sensitive to changes in FGD wastewater characteristics such as (a) chloride levels, (b) temperature, (c) nitrate/nitrite levels, and (d) oxidation-reduction potential. As a result, biological treatment systems are subject to more frequent upsets (e.g., organism die-offs) than chemical systems due to changes in conditions and therefore must be constantly monitored and adjusted. EPA also needs to recognize the cold weather conditions affect the viability and cost of chemical and biological treatment options. In addition, biological treatment requires optimization for individual constituents and can result in ammonia level increases. Also, EPA is setting limits based on a single biological treatment vendor's proprietary system at two facilities, inappropriately assuming that the technology will be available and appropriate to use and equally effective at all facilities nationwide.

For these reasons, chemical precipitation plus biological treatment is not feasible or available, as required under CWA section 304(b) and should not be applied industry-wide.

Comment Response:

Regarding biological treatment system performance and FGD wastewater variability, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107.

Regarding the treatment of FGD wastewater with high nitrate/nitrite concentrations, see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 44 in Comment Code 10.b.

Regarding climate variations in the installation and implementation of the biological treatment system, see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 34 in Comment Code 10.b.

Regarding the market availability of biological treatment systems, see response to DCN EPA-HQ-OW-2009-0819-4607-A1, Excerpt Number 13.

Commenter Name: Tom DeLawrence
Commenter Affiliation: Public Service Company of New Hampshire(PSNH)
Document Control Number: EPA-HQ-OW-2009-0819-4633-A1
Comment Excerpt Number: 24
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

There is not sufficient data to support a conclusion that biological treatment is an available or effective technology in the steam electric power generating industry, or, more specifically, at PSNH's stations. This technology is new and has not been fully vetted, its effectiveness is unclear and contradictory, and evidence of its success is speculative at best, especially given the fact that each biological treatment system must be able to adapt to the conditions in its own plant in order to successfully remove any constituents. Changes in fuel type, FGD operations, temperatures, plant size, boiler type, testing capabilities, and other variables may all impact the operation of biological treatment. Because these variables vary greatly from plant to plant, this treatment option is anything but widely applicable; yet, EPA fails to account for these important considerations.

As discussed in further detail below, only a handful of plants in the country use biological treatment to treat FGD waste water, and of these, EPA considered only a small subset of biological treatment systems in its evaluation of that technology. Moreover, the biological treatment processes at these few plants have only been installed for a few years, meaning that a sufficient length of time has not yet passed to fully understand the successes and limitations associated with this technology.

Perhaps most significant is the fact that biological treatment systems have not been in operation for a sufficient length of time to demonstrate whether this technology (combined with physical/chemical treatment) represents BAT for FGD waste water discharge. Specifically, without a sufficient length of time to evaluate the system's success, it is difficult to know whether this technology can be sustained over the long-term, given the "unknowns" associated with the technology, including but not limited to: (1) the suitability of the construction materials used in these systems over time; and (2) the nature and extent of maintenance and/or component replacement required during routine operation and during outages.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107 regarding biological treatment system performance and FGD wastewater variability. In addition, for more information about the extensive data used to calculate effluent limits and to evaluate the performance of the BAT technology under a variety of conditions, see the Statistical Support Document for Effluent Limitations and DCN SE05846 (memorandum *Variability in Flue Gas Desulfurization Wastewater: Monitoring and Response.*

Regarding further evaluation on the suitability of construction materials and consideration of maintenance costs for biological treatment, see response to DCN EPA-HQ-OW-2009-0819-4489-A1, Excerpt Number 14.

Commenter Name: Daniel K. Plath
Commenter Affiliation: Northern Indiana Public Service Company (NIPSCO)
Document Control Number: EPA-HQ-OW-2009-0819-4508-A2
Comment Excerpt Number: 13
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Based on our reading of (1) the TDD, (2) USEPA's stated Incremental Costs, and (3) USEPA's Supplement to Incremental Cost documents, NIPSCO does not believe that USEPA can sufficiently technically support a position asserting that one-stage chemical precipitation followed by anoxic/anaerobic bioreactors will consistently achieve the proposed BAT concentrations. As NIPSCO understands these documents, the vendor (GE) could not provide the design basis, capital and operating costs, for installing anoxic/anaerobic bioreactors systems in colder climates. Our understanding is that USEPA based their information solely on two Duke Energy facilities operating GE built units in the Carolinas. GE did claim that longer residence time would be required due to slower biological activity; hence NIPSCO's systems would not be consistent with the two referenced full-scale operations in the Carolinas. It is documented that the preferred temperature of the microorganisms for these systems is between 90 °F and 95 °F and, though much data were provided, due to the operating systems cooling wastewater in warm to hot climates (i.e. in the Carolinas), no data were provided on the potential steam / energy requirements to keep these bioreactors at 90 °F. In addition, with only two full-scale treatment plants operating, it is not clear that the bioreactors can operate to BAT, particularly for nitrate+nitrite, for FGD wastewaters generated at power plants that utilize different types of coal than the two Duke facilities. GE has not guaranteed the performance of the bioreactor independent of influent characteristics, particularly influents with higher levels of nitrate. This lack of data on design and operations is of concern to NIPSCO who, under Options 3 and 4a, would be facing installation of the anoxic/anaerobic bioreactors at two power plants.

Comment Response:

Regarding biological treatment system performance and FGD wastewater variability, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107. Also see DCN SE05846 (memorandum *Variability in Flue Gas Desulfurization Wastewater: Monitoring and Response*).

Regarding additional biological treatment system costs for plants in extreme weather conditions, see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 34 in Comment Code 10.b. EPA included costs for plants located in certain cold climates to house the treatment system in a building.

Regarding the treatment of FGD wastewater with high nitrate/nitrite concentrations, see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 44 in Comment Code 10.b.

Commenter Name: Jerry Purvis
Commenter Affiliation: East Kentucky Power Cooperative, Inc. (EKPC)
Document Control Number: EPA-HQ-OW-2009-0819-4455-A1
Comment Excerpt Number: 4
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

There are also questions as to the technological achievability of the proposed BAT effluent limitations for FGD wastewaters. In the Technical Development Document for the Proposed ELG (EPA-821-R-12-002, April 13, 2013), EPA compares the proposed ELGs with data from two coal-fired stations operated by Duke Energy in North Carolina. (Technical Development Document at pp. 13-5, 13-25). With respect to the selenium effluent limitations deemed achievable by the use of biological treatment, EPA acknowledges that some of the selenium values from Belews Creek are above the proposed ELG limit of 16 ug/L as a daily max and 10 ug/L as a monthly average for total selenium. EPA concludes that these results are attributable to less than optimal performance and notes that there are steps that can be taken to optimize the performance of the biological treatment system to achieve the proposed effluent limitations. However, EPA has not documented that such steps were not being taken at the Duke Energy facilities when the exceedances occurred. EPA also suggests that results that are higher than the monthly proposed ELG would have been eliminated with more frequent sampling. However, EKPC could not find the evidence to support this statement. In fact, is it equally possible that more frequent sampling would have demonstrated just the opposite? Finally, the exceedances at the Duke Energy Belews Creek Station occurred during a period as late as six to nine months after the first data was collected, which seems to suggest the excursions are attributable to startup or failure to optimize the system. Accordingly, the record does not support the technological achievability of the proposed selenium limitations under the preferred options that are based upon use of biological treatment units in addition to physical/chemical precipitation.

Comment Response:

EPA's engineering review of the effluent limitations for the final rule is presented in the Statistical Support Document for Effluent Limitations. The two plants referenced by the commenter do not have effluent limitations selenium or nitrate/nitrite in their NPDES permits and are not operating their plant to ensure treatment systems operators are notified when changes that may affect the treatment system will be occurring, nor do the operators take prompt action to address significant changes in wastewater characteristics that could affect treatment system performance. See, e.g., treatment system and operating data submitted by Duke Energy subsequent to the proposed rule, showing sudden large changes in characteristics such as influent ORP or nitrates, without any indication that the plant took action to mitigate these characteristics. By targeting effluent performance at the long-term average (i.e., approximate 7.5 ug/L selenium, 1.3 mg/L nitrate-nitrite, 6 ug/L arsenic, and 159 ng/L mercury), including actively monitoring wastewater and treatment system characteristics and taking response action when warranted, plants such as Duke's will be able to meet the final effluent limitations. See the Statistical Support Document for Effluent Limitations, Section 13 of the TDD, and DCN SE05846 (memorandum *Variability in Flue Gas Desulfurization Wastewater: Monitoring and Response*).

Regarding the development of the numeric limitations, see response to DCN EPA-HQ-OW-2009-0819-4305-A3, Excerpt Number 58.

Commenter Name: Tim Pickett
Commenter Affiliation: Frontier Water Systems
Document Control Number: EPA-HQ-OW-2009-0819-4533-A2
Comment Excerpt Number: 1
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

As a water industry equipment provider and developer of biological treatment systems, I am writing to comment on emerging advances in the field. While early generation treatment systems applied to FGD treatment demonstrate the efficacy of a biological approach, initial systems installed to date reflect a large and expensive solution. This is in part due to relatively few equipment providers in the space. This dynamic is now changing as the market matures and brings forth more competition. Multiple new treatment options are on the horizon, and the power industry will benefit from these advances, with additional choices and more affordable options to chose from.

Frontier Water Systems offers one such option, with their line of pre-fabricated equipment packages for high rate treatment
of selenium, nitrate, arsenic and mercury from water and wastewater associated with power gene ration. This new, patent-pending system is slated for field demonstrations in late 2013 and will be available to the market in the summer of 2014. The system is tailored for compatibility with various wastewater streams such as FGD wastewater and coal combustion residual leachate, and incorporates new several advances to include:

- A novel, high-efficiency bioreactor design built around a core of proven biological treatment processes.
- A small footprint resulting in a transportable solution.
- Pre-fabricated modules resulting in minimal installation costs and related balance-of-plant infrastructure.
- Multiple contaminant removal to include mercury, selenium, nitrate, and arsenic.

We will be publishing our results as the field trials progress. There is a great deal of room for innovation in this field and equipment providers are rising to the challenge; the resulting advances will benefit industrial end users as well as the environment.

Comment Response:

EPA agrees with the commenter that the advancement in technologies will increase the market availability for treatment systems.

Commenter Name: Lisa M. Jaeger
Commenter Affiliation: Council of Industrial Boiler Owners (CIBO)
Document Control Number: EPA-HQ-OW-2009-0819-4486-A2
Comment Excerpt Number: 10
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Chemical Precipitation and Anaerobic Biological Treatment for Se, As, and Hg Removal

CIBO has concerns regarding the identification of anaerobic biological treatment systems as available technologies. The deployment and experience with these technologies are very limited and their ability to achieve the limits has not been demonstrated. EPA has taken testimony on the design and operational challenges of this technology and steam electric plants will document significant limitations of systems that EPA is currently studying. With the study and analysis of these systems still far from completion, the rule should not presume standards can be met by these technologies.

EPA should also re-consider its stance on co-mingling and surface impoundments. These are very critical to successful operation of some of the biological treatment systems that EPA has evaluated to establish anaerobic biological systems as BAT and BPT or Se, Hg, and As removal. Alternatively EPA could delay the identification of anaerobic biological systems as preferred treatment technology until this treatment option is better developed for treating FGD wastewaters. Companies and researchers are actively working to develop treatment systems specifically for the power industry.

Specifying anaerobic biological systems at this early stage of the development of the technology will be very costly for the power plants and this will increase the cost of electricity to CIBO members. Further, if EPA identifies this technology now as preferred, then the strong potential exists for state agencies to impose this treatment system on non-EGUs that have coal fired power plants, with very high costs for uncertain benefits.

Comment Response:

Regarding biological treatment system performance and FGD wastewater variability, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107. EPA does not agree with the commenter's portrayal of the technology as being in an early stage of development. The technology has been in operation for a number of years, even preceding the approximately 8 years at full-scale application for FGD wastewater (and longer when pilot testing is taken into account). EPA's record for the performance of this technology is extensive and this is a mature technology.

Regarding EPA reconsidering its stance on comingling and surface impoundments, please see preamble section VIII.G regarding the anti-circumvention provision in the final rule and preamble section VIII.C regarding the BAT determination for fly ash and bottom ash transport water, which many plants are currently treating using surface impoundments. The final rule does not necessarily preclude the use of surface impoundments to treat FGD wastewater, but EPA has determined that they do not represent the BAT level of control for generating units that are greater than 50 MW and that are not oil-fired. Furthermore, EPA does not consider the use of impoundments as critical to the treatment of FGD wastewater. For example, the data in the record show that the BAT basis of both chemical precipitation and biological treatment achieves pollutant removals far superior to the use of impoundments followed by biological treatment.

EPA notes that the requirements established in 40 CFR 423 are not applicable to non-electrical-generating-units. The "the strong potential exists for state agencies to impose this treatment system on non-EGUs" that commenter mentions is outside of the scope of this rule. However, permitting authorities may find that the BAT effluent limitations in 40 CFR 423 are a reasonable basis for NPDES effluent limitations established based on best professional judgment.

Commenter Name: Tom DeLawrence
Commenter Affiliation: Public Service Company of New Hampshire(PSNH)
Document Control Number: EPA-HQ-OW-2009-0819-4633-A1
Comment Excerpt Number: 26
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Moreover, total reliance on the lone Duke Energy scenario to support EPA's proposal to dictate to an entire industry the particular technology employed and effluent limits achieved in that scenario is worsened by the fact that both the Belews Creek and Allen plants produce FGD influent streams which are much easier to treat than the typical FGD influent at a coal-fired power plant. This is evident by simply reviewing the levels of total suspended solids (TSS) and total dissolved solids (TDS) in the FGD influents at the other plants which EPA sampled. All of these other plants experience higher – or much higher – TSS and TDS levels in their FGD waste streams prior to entering their waste water treatment systems. All of these other facilities also experience higher nitrate/nitrite levels than either Belews Creek or Allen, and the pretreatment FGD waste water at two facilities – Hatfield's Ferry and Pleasant Prairie – contain nitrate/nitrite influent levels beyond the design capacity of the GE ABMet biological treatment system that Duke Energy utilizes. It is therefore likely that those plants, for example, would be unable to meet the limits achieved at Belews Creek and Allen even if the former installed and operated the exact same system used at the latter.[9] There is nothing in the record to suggest that the rest of the industry would have it any easier.

9 Notably, EPA has also failed to evaluate any biological treatment systems that optimize both selenium and nitrate/nitrite removal, particularly systems that receive higher than average selenium and nitrate/nitrite levels.

Comment Response:

Regarding biological treatment system performance and FGD wastewater variability, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107.

Regarding the treatment of FGD wastewater with high nitrate/nitrite concentrations, see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 44 in Comment Code 10.b.

The commenter fails to explain why they believe that the BAT technology of chemical precipitation plus biological treatment is not optimized to remove both nitrate/nitrite and selenium, since the technology clearly provides optimum removal of selenium and the nitrate/nitrite is removed prior to selenium reduction. Thus, without question, the nitrate/nitrite removal is similarly optimized.

Commenter Name: Lisa M. Jaeger
Commenter Affiliation: Council of Industrial Boiler Owners (CIBO)
Document Control Number: EPA-HQ-OW-2009-0819-4486-A2
Comment Excerpt Number: 6
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Six of the eight proposed options have established limits for Se, As, Hg, and nitrates for FGD wastewaters. The limits are based on combined chemical precipitation and anaerobic biological treatment system. A major concern is the identification of anaerobic biological treatment systems as BAT and BPT. Anaerobic biological treatment of FGD wastewaters is a new use of this technology for this wastestream, is not widely used, and has had limited success for all three metals identified, especially at that limit. Based on the data available, the fixed-bed anaerobic biological systems do not reliably meet the proposed levels for Se. Research on their effectiveness for removing other metals of concern is ongoing.

Because much of this technology is largely unproven for these wastewater streams, alternative limits based on more proven and commercially available technologies should be considered. Once anaerobic biological systems are proven to be reliable on complex FGD streams, only then should they be considered as appropriate control technologies.

As and Hg removal is possible with physical/chemical treatment systems and these would be appropriate control technologies to identify. However, anaerobic biological systems applied to the power block have not been reliably demonstrated and should not be identified as available or required technologies.

Until more performance data are available for these technologies, alternative limits should be evaluated for Se. Anaerobic biological systems have not routinely met the levels proposed.

Comment Response:

EPA disagrees with the commenter's concern regarding the "identification of anaerobic biological treatment systems as BAT and BPT." EPA notes that the final rule does not establish BAT or BPT limitations for FGD wastewater based on anaerobic biological treatment. The final rule establishes BAT limitations for FGD wastewater discharges from units that are greater than 50 MW and that are not oil-fired based on chemical precipitation followed by anoxic/anaerobic biological treatment.

Regarding biological treatment system performance and FGD wastewater variability, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107. EPA does not agree that the technology is unproven for treatment of FGD wastewater. The availability and reliability of the technology is clearly demonstrated by the record, as is the pollutant removal efficacy.

Commenter Name: Stephen M. Frank
Commenter Affiliation: NRG Energy, Inc.
Document Control Number: EPA-HQ-OW-2009-0819-4510-A2
Comment Excerpt Number: 6
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Flow Minimization Increases Constituent Concentrations Inhibiting Biological Treatment

For FGD absorbers that can accommodate an increase in chlorides, preferred Options 1, 2, 3b, 3, 4a and 4 require flow minimization for plants with high FGD discharge flow rates (i.e., greater than 1,000 gpm). Implementation of flow minimization by cycling up chlorides and, consequently every other constituent concentration, would inhibit the effectiveness of biological treatment in the two EPA model plants.

In 2004-2005, the first in a series of pilot tests of an anoxic/anaerobic fixed film system on FGD purge water was conducted at NRG's Conemaugh Generating Station. We recognize that many changes to the anoxic/anaerobic fixed film system have occurred as a result of subsequent tests. However, in particular, the 2004-2005 testing was only successful in removing selenium from diluted Conemaugh Generating Station FGD purge water. (The use of diluted FGD purge water was specified by the other companies participating in the pilot test in order to reflect more accurately the chemical characteristics of those facilities' FGD purge water, which contained substantially lower concentrations of dissolved constituents.) When pilot testing used full strength Conemaugh FGD purge water, the pilot treatment system failed within a matter of days. Therefore, at that time, the anoxic/anaerobic fixed film technology was not capable of treating more concentrated FGD purge water with the chemical composition of Conemaugh FGD effluent.

Comment Response:

Regarding flow minimization, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107.

EPA acknowledges the pilot testing that occurred at the Conemaugh station and the failure of the biological treatment system to effectively treat the wastewater; however, EPA discussed the pilot testing conducted at the Conemaugh Station with the vendor GE. Based on those conversations, it is EPA's understanding that the commenter's reference to "full strength Conemaugh FGD purge water" means the FGD wastewater prior to chemical precipitation treatment. EPA would not expect the biological system to be able to successfully treat wastewater such as that because the TSS concentrations would be too high. This is part of the reason that the BAT basis for the final rule is chemical precipitation followed by biological treatment. Pilot testing and full scale operation of the technology since that time demonstrates the efficacy of the technology at treating FGD wastewater without any need to dilute the wastewater.

Commenter Name: Michalene Reilly
Commenter Affiliation: Hoosier Energy Rural Electric Cooperative
Document Control Number: EPA-HQ-OW-2009-0819-4471-A1
Comment Excerpt Number: 13
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

The nitrate/nitrite limits proposed for FGD wastewaters under Options 3, 3b, 4 and 4a are too low to be consistently met by biological treatment systems, including those studied by EPA. The ABMet systems at the Allen Station and Belews Creek are not capable of consistently meeting a daily limit of 0.17 mg/l and a monthly limit of 0.13 mg/l nitrate/nitrite as N. The EPA ignored data showing the variability in biological treatment systems and ignored the fundamentals of biological nitrification/denitrification. The Agency has assumed that "all" the nitrogen must be removed before removal of selenium will occur. It is not necessarily true that nitrogen would have to be reduced to sub-part per million levels to meet selenium discharge standards.

Other biological treatment plants, even those subject to the lowest nutrient standards, are not held to limits as low as those proposed by the rule. Arlington County's Water Pollution Control Plant, located in Arlington Virginia, discharges into the Chesapeake Bay watershed. The watershed is impaired for nutrients and Arlington County spent $568 million to upgrade the wastewater treatment plant, including a 'Limit of Technology' nutrient removal system to meet an anticipated Total Nitrogen (TN) limit of approximately 3 mg/L. TN includes more nitrogen species than nitrate and nitrite, but the proposed limit for FGD wastewaters is a magnitude of order lower than the limit expected to be met by a treatment plant using a fixed-film biological denitrification process.

Comment Response:

EPA revised the numeric limits for nitrate-nitrite concentrations in FGD wastewater for the final rule. See section 11 of the preamble for a summary of the final rule effluent limitations. EPA determined that plants will be able to meet the final effluent limitations at all times.

Commenter Name: Paul Chu
Commenter Affiliation: Electric Power Research Institute (EPRI)
Document Control Number: EPA-HQ-OW-2009-0819-4499-A1
Comment Excerpt Number: 55
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

5.4 Variations in the influent nitrate/nitrite may impact biological treatment performance, leading to additional challenges in meeting the selenium and nitrate/nitrite limits.

EPRI is currently conducting several FGD wastewater treatment pilot studies at a southeastern bituminous coal plant. A summary of the variability of the FGD wastewater nitrate data is illustrated in Figure 5-9. The variations can be significant, and the nitrate/nitrite chemistry in FGD waters is not well understood. It is clear that changes in plant operations, such as unit load, impact the nitrate/nitrite concentrations.

Varying nitrate levels in FGD water over a short timeframe may lead to challenges for some facilities in meeting the selenium and nitrate/nitrite limits with biological treatment. This is because the growth of the bacterial population within a bioreactor is directly proportional to the amount of influent nitrates and carbon feed, and therefore the nutrient feed needs are directly proportional to nitrate loadings. Since nitrate is removed prior to selenium in a biological treatment system, facilities may have difficulty meeting selenium and even nitrate limits if there are significant variations in influent nitrate over a short timeframe, as is seen in Figure 5-9. In addition, feeding excess carbon source (that is, when nitrate levels drop) may lead to operational issues, for example, generation of hydrogen sulfide with the system, which can pose a safety risk.

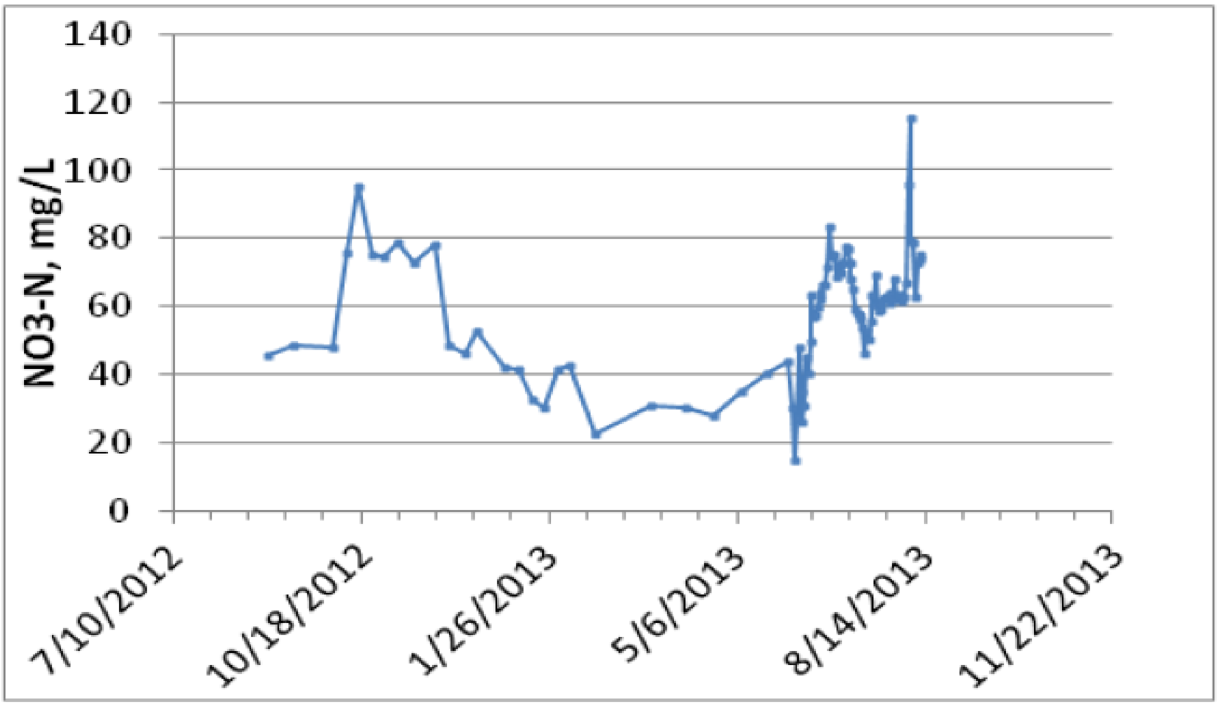


Figure 5-9
Measured Variability of Nitrate/Nitrite in FGD Wastewater

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107 regarding biological treatment system performance with varying nitrate-nitrite levels in FGD wastewater.

Additionally, EPA's design basis for the BAT basis of chemical precipitation plus biological treatment includes a 24-hour equalization tank along with all the residence time within the chemical precipitation system. The design of the treatment system ensures the biological system will generally receive gradual increases/decreases in the nitrate/nitrite concentrations, even if there are sudden fluctuations in the FGD purge stream. In addition to the mixing within the chemical precipitation stage and increasing the nutrient feed rate, there are other steps plants can take to manage sudden increases in nitrate levels for the FGD purge such as placing idle bioreactor cells into service and feeding a selenium-spiked additive into the bioreactor to spur additional microbial growth before the wastewater containing higher concentrations of nitrates reach the bioreactor. If need be, the plant can also direct the effluent to the equalization tank so that the wastewater is reprocessed before discharge. This also serves to give the microorganisms additional time to grow so that there will be more biomass available to treat the higher pollutant concentrations. Additionally, plants can gain additional time by diverting a portion (or all) of the FGD purge to the scrubber's maintenance tank, a normally empty tank that is typically used only when a plant needs to drain the absorber for maintenance. By diverting the FGD purge to the maintenance tank at times when the wastewater has extremely high nitrate levels or other characteristics of concern, the treatment system operators can "buy more time" to prepare for the treating the wastewater and it also allows them to "bleed" this stockpiled volume of wastewater into the treatment system at a slower rate.

Commenter Name: Stephen M. Frank
Commenter Affiliation: NRG Energy, Inc.
Document Control Number: EPA-HQ-OW-2009-0819-4510-A2
Comment Excerpt Number: 11
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Only One Technology may be Capable of Meeting Limits

EPA is imposing a low limit for selenium in FGD wastewater that incidentally only one technological system (GE ABMet) appears to be capable of meeting. Yet EPA has, in the past, suggested that it is improper to impose any particular technology on a discharger when promulgating ELGs. See, e.g., Iowa League of Cities v. EPA, 711 F.3d 84, 856 (8th Cir. 2013) ("The EPA has interpreted this [ELG] regime as precluding it from imposing any particular technology on a discharger."); NPDES Permit Writers' Manual at 5-14 to 5-15 (Each facility has the discretion to select any technology design and process changes necessary to meet the performance-based discharge limitations and standards specified by the effluent guidelines."). Regardless of whether the GE ABMet technology is demonstrated at a small number of plants, there is an inadequate basis in the record for EPA to conclude that such technology would work at plants, such as the Cheswick, Conemaugh, Keystone, Morgantown, Dickerson, Chalk Point, WA Parish, Homer City Power Generating Stations, with different influents and operating parameters. And while there may be ongoing research efforts with respect to other systems, no other technology has been demonstrated to achieve selenium levels as low as 10 ppb. If only one technology is capable of satisfying a regulation, the owner of such technology is landed monopoly pricing power.

Comment Response:

EPA disagrees with the commenter that "only one technology may be capable of meeting limits." The ABMet® system, which EPA evaluated as the BAT biological treatment technology, is an anoxic/anaerobic fixed film bioreactor that uses common biological chemistry concentrations for denitrification and selenium reduction. See response to DCN EPA-HQ-OW-2009-0819-4607-A1, Excerpt Number 13 regarding the market availability of biological treatment systems.

EPA notes that the developer of the ABMet process has a new biological treatment system that has begun pilot testing on FGD wastewater. EPA has not obtained information on the performance of the pilot testing, but expects that this vendor, along with others, will create other alternatives capable of meeting the final numeric limitations applicable to FGD wastewater.

There are also other technology solutions available today that are capable of meeting the ELGs. See response to DCN EPA-HQ-OW-2009-0819-5552-A2, Excerpt Number 7.

Commenter Name: Thomas N. Effinger
Commenter Affiliation: South Carolina Electric & Gas (SCE&G)
Document Control Number: EPA-HQ-OW-2009-0819-4593-A1
Comment Excerpt Number: 3
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Pilot Plant Performance Treating FGD Wastewater

In June 2013, SCE&G implemented a pilot treatment technology program for FGD wastewater. We have three biological pilot systems and one chemical system at our Wateree Station. The purpose of these pilots is to identify the operational and performance characteristics of four potential wastewater treatment technologies with the same FGD wastewater. Chart 7 shows selenium removal data for the three biological treatment systems.

Over the pilot testing period, none of the biological technologies were able to meet the proposed limits for selenium. In fact, none of the systems has been even close to consistently meeting the proposed limit. This data from the pilot testing show that not all FGD wastewaters will be amenable to effective biological treatment and that the ELG proposed limits are not appropriate. We recommend that the EPA reconsider the proposed ELG limits for FGD wastewater, taking into account that biological treatment has a very limited ability to remove selenium. The proposed limits are not attainable with the proposed BAT, making compliance with the ELG virtually impossible.

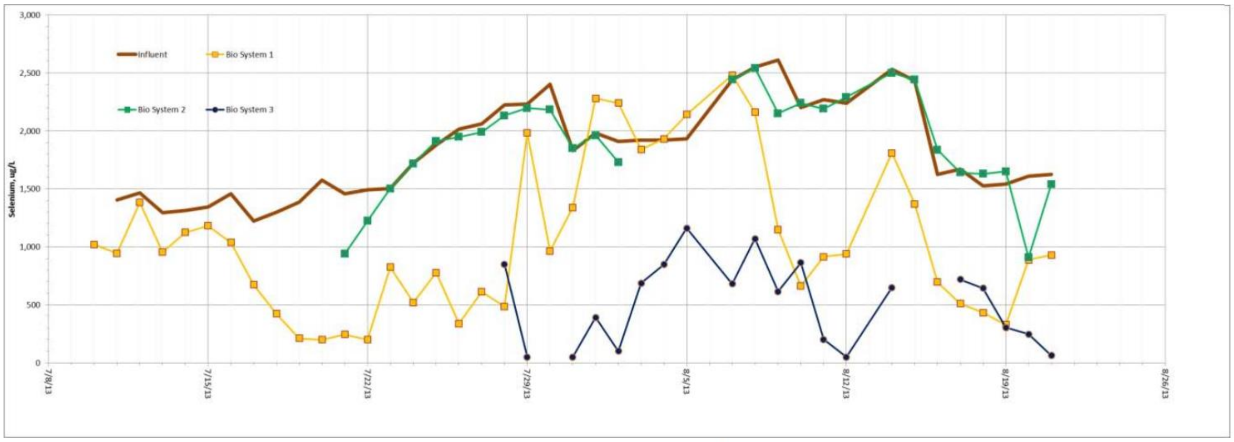


Chart 7: Selenium removal data for pilot test

Comment Response:

EPA has discussed the results of the pilot testing at the Wateree Station with both SCANA and the vendor GE. Based on the discussion with GE, EPA learned that the pilot testing conducted at the Wateree Station was initially evaluating the treatment of the FGD wastewater only in biological treatment systems after a surface impoundment and did not include an upstream chemical precipitation system, as is included in EPA's BAT basis. Additionally, GE evaluated the toxicity of the FGD wastewater to the biological microbes at various points in the FGD wastewater path and determined that the FGD wastewater after the surface impoundment was extremely toxic to the microbes. It was determined later on during the testing that the wastewater contained high ORP levels caused by oxidants. Because this was not identified until later on in the testing, the microbes in the system may have been wiped out from the extended exposure, such that – even after the plant added pretreatment steps to the pilot testing, including a hydroxide and sulfide chemical precipitation system and addition of a reducing agent – the biological treatment system did not have enough microbes to show acceptable performance. Additionally, subsequent testing showed that the method that was being used to measure the free oxidants present in the wastewater did not substantially quantify the amount of reducing agent that would be needed to reduce the oxidants. This was later corrected by using a different method to measure free oxidants, but these corrections came too late in the pilot testing to alter the chemical preconditioning process and fully evaluate how the performance of the pilot treatment technologies would change. Since that time, GE has continued conducting pilot tests, and it has evaluated at least one plant with high ORP levels and has shown that, with appropriate pretreatment, the biological system can meet the final effluent limitations. The data in the record also show that plants operating full-scale biological treatment systems are able to identify the presence of free oxidants and take steps to mitigate this situation so that they are able to meet the final effluent limitations.

See response to DCN EPA-HQ-OW-2009-0819-4593-A1, Excerpt Number 2 in Comment Code 8.c regarding Wateree's pilot testing study results for the biological treatment of FGD wastewater.

Commenter Name: Michalene Reilly
Commenter Affiliation: Hoosier Energy Rural Electric Cooperative
Document Control Number: EPA-HQ-OW-2009-0819-4471-A1
Comment Excerpt Number: 4
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

The next concern is whether EPA should be specifying a process where there is only one commercially available option. Biological systems rely on living organisms to reduce selenium to a form readily removable by filtration. As living organisms, they are sensitive to certain conditions, including high chloride and nitrate/nitrite concentrations, temperature extremes and rapid temperature changes, and oxidation reduction potential (ORP) excursions. FGD system upsets could lead to some of these conditions, which could lead to killing these organisms. Reestablishing a thriving colony of organisms, ready to reduce selenium, can take as long as a couple of weeks. The rule needs to be written in such a way to allow for this inevitability. Storage of the blowdown is not feasible as two weeks' worth of FGD blowdown at 200 gpm would require four millions gallons of storage, for a medium sized plant like Merom, if this has to be retained until the biological system is operating successfully again.

Comment Response:

Regarding biological treatment system performance and FGD wastewater variability, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107. Also see DCN SE05846 (memorandum *Variability in Flue Gas Desulfurization Wastewater: Monitoring and Response.*

Regarding upset and bypass accommodations, see response to DCN EPA-HQ-OW-2009-0819-5140-A2, Excerpt Number 60.

Regarding the market availability of biological treatment systems, see response to DCN EPA-HQ-OW-2009-0819-4607-A1, Excerpt Number 13.

Commenter Name: John W. Myers
Commenter Affiliation: Tennessee Valley Authority (TVA)
Document Control Number: EPA-HQ-OW-2009-0819-4607-A1
Comment Excerpt Number: 11
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

4. Biological systems considered under EPA's preferred options (3b, 3, and 4a) for FGD wastewater treatment are much more sensitive to upset than traditional physical/chemical

treatment systems. Bioreactors are subject to microorganism die-offs that could be caused by variability in feedwater chemistry and ambient weather conditions among other factors. It is not apparent from review of the proposed rule and supporting documentation that EPA has considered in its analyses the cost of replacement power in the probable event of microorganism die-offs. In short, the ability of biological treatment systems to reliably achieve the proposed ELGs has not been fully demonstrated by EPA as achievable and should not be classified as BAT. The regulated community should have a reasonable level of certainty that compliance with the new BAT-based ELGs proposed by EPA can be achieved given the considerable costs of installing, maintaining and operating the complex treatment systems that will be required.

Comment Response:

Regarding biological treatment system performance and FGD wastewater variability, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107.

Regarding upset and bypass accommodations, see response to DCN EPA-HQ-OW-2009-0819-5140-A2, Excerpt Number 60.

Commenter Name: John McManus
Commenter Affiliation: American Electric Power System (AEP)
Document Control Number: EPA-HQ-OW-2009-0819-4448-A1
Comment Excerpt Number: 20
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

d. EPA needs to include additional FGD treatment systems besides Allen and Belews Creek in its analysis of FGD wastewater.

EPA has based a significant portion of its FGD wastewater treatment technology analysis on Duke Energy's Allen and Belews Creek Stations, which could be a large factor in the discrepancy between the EPA and AEP capital cost estimates. The FGD wastewater from these facilities is not representative of that generated by the majority of the industry. They are owned and operated by the same company, burn similar coals and use the same operating systems and therefore do not adequately represent the range of facility operations across the country. AEP and its partners own and operate six such facilities, but only two were considered when the agency was developing the proposed ELG revisions. FGD treatment system data from a variety of facilities, which burn different coals and are operated using different practices, need to be incorporated into the agency's analysis.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107.

Commenter Name: Doris Cooksey
Commenter Affiliation: City Public Service of San Antonio (CPS Energy)
Document Control Number: EPA-HQ-OW-2009-0819-4283-A1
Comment Excerpt Number: 12
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Additionally, requiring biological treatment to meet permit limits (as BAT) raises utility concerns because of the complexity to operate and the instability of these systems. Biological systems are temperamental and subject to upsets that can last days to weeks. Upsets can be caused due to a number of changes in unit operations, fuel composition, ambient temperature, nutrient supply, etc. which may make it difficult to pinpoint the cause of a problem. Power generation is critical infrastructure and grid reliability paramount for the immediate health and safety of citizens. The Electric Reliability Council of Texas has had concerns about not meeting peak generation demands at certain times of the year and unscheduled outages at large power plants at such times has been a significant concern. Because of the difficulty to operate and diagnose the cause of upsets, biological treatment poses an undesirable threat to the reliability of the power grid during times of peak consumption.

Comment Response:

Regarding biological treatment system performance and FGD wastewater variability, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107.

Regarding upset and bypass accommodations, see response to DCN EPA-HQ-OW-2009-0819-5140-A2, Excerpt Number 60. Note that the record shows that plants have operated the biological treatment technology for years and the treatment has not caused any plant to cease generating electricity or provide power to the electric grid.

Commenter Name: John W. Myers
Commenter Affiliation: Tennessee Valley Authority (TVA)
Document Control Number: EPA-HQ-OW-2009-0819-4607-A1
Comment Excerpt Number: 9
External Review Flag: Statistics
External Review Incorporated into Response: No

Comment Excerpt:

2. Duke Energy, the owner of the Allen and Belews Creek facilities utilized as the basis for biological treatment has expressed concerns[1] that their treatment systems could not meet the

NPDES permit limits proposed for Public Service of New Hampshire's Merrimack Station developed by EPA Region 1 let alone the more restrictive arsenic and selenium limits currently proposed by EPA in this rulemaking. It is also important to acknowledge that the performance of an FGD scrubber system at a facility can change dramatically based on the constituents within the coal, the nature of the combustion process, the effectiveness of the air pollutant control technology and other factors related to the techniques used to manage the resultant wastewater.

---

[1] Duke Energy comments on the Merrimack Station draft NPDES permit can be found at:

http://www.epa.gov/region1/npdes/merrimackstation/pdfs/comments/PC-12.pdf

Comment Response:

Regarding biological treatment system performance and FGD wastewater variability, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107.

Regarding concerned expressed by Duke Energy, see response to DCN EPA-HQ-OW-2009-0819-4305-A3, Excerpt Number 58-59.

Commenter Name: Stephen M. Frank
Commenter Affiliation: NRG Energy, Inc.
Document Control Number: EPA-HQ-OW-2009-0819-4510-A2
Comment Excerpt Number: 5
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

At Homer City Generating Station and most likely other northern stations, chloride levels can vary by season and can increase dramatically in winter months as road salts are pulled into the influent. The bacteria in any biological treatment system might not be able to handle such fluctuations in chloride levels, thereby calling into question whether a monthly average limit of 10 ug/l selenium is achievable.

The consistent removal of nitrate/nitrite, as nitrogen to the proposed effluent limits is not reliable given the concentration of ammonia present in the resultant effluent (as demonstrated in Table 10-5) and potential for partial nitrification in subsequent processes. NRG's Morgantown, Dickerson, and Chalk Point plants have state of the art equipment for nutrient removal and cannot consistently meet these proposed nitrate/nitrite effluent limits despite years of optimization.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107 regarding biological treatment system performance and FGD wastewater variability. Additionally, the final rule establishes nitrate/nitrite limitations that are an order of magnitude higher than the proposed limitation. Furthermore, the technology in place at the plants cited by the commenter is not the BAT technology of chemical precipitation plus biological treatment upon which the effluent limitations are based.

Commenter Name: Jimmy Daukas
Commenter Affiliation: American Farmland Trust (AFT)
Document Control Number: EPA-HQ-OW-2009-0819-4514-A2
Comment Excerpt Number: 1
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Our comments are focused solely on the treatment of nitrogen in the proposed rule.

The rule fails to adequately consider needs for nitrogen removal.

EPA data indicate that steam electric power plants annually discharge 225,000 lbs of selenium and 33,000,000 lbs of nitrogen. This ratio of 133 lbs of nitrogen for every pound of selenium would imply that nitrogen removal from the waste stream could be considered more than a simple by-product of limiting selenium. While the proposed rule argues that use of biological treatments reduce nitrates as an ancillary benefit to biological treatment of selenium, it is very likely that some situations will have higher influent concentrations of nitrogen—in amounts that will not be removed as a by-product. EPA must consider such situations of excess nitrogen and suggest avenues for nitrogen reduction other than as an ancillary benefit.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 44 in Comment Code 10.b. The record demonstrates that the BAT technology will effectively remove the nitrate-nitrite form of nitrogen.

Commenter Name: Elizabeth E. Aldridge, Hunton & Williams
Commenter Affiliation: UWAG
Document Control Number: EPA-HQ-OW-2009-0819-4655
Comment Excerpt Number: 131
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

EPA has failed to prove that chemical precipitation plus biological treatment is feasible across a wide range of plants. The plants EPA chose to use for its cost-effectiveness analysis (Belews Creek and Allen) have similar influent characteristics. In contrast, all the other sampled plants have very different influents, being much higher in TDS and nitrates/nitrites. This means that the influents at these other plants are much harder to treat than the Belews Creek and Allen influents. Therefore, the plants with influents of this type will likely not be able to meet the proposed FGD limits. Also, biological treatment systems are subject to organism die-offs and must be constantly monitored and adjusted. For these reasons, chemical precipitation plus biological treatment is not feasible or available and should not be applied industrywide.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4655-A2, Excerpt Number 20 in Comment Code 8.c and EPA-HQ-OW-2009-0819-4655, Excerpt Number 107 regarding the representation of plants used to evaluate the BAT basis.

Commenter Name: Paul Chu
Commenter Affiliation: Electric Power Research Institute (EPRI)
Document Control Number: EPA-HQ-OW-2009-0819-4499-A1
Comment Excerpt Number: 45
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

3.5.3 *The anaerobic biological treatment process may produce ammonia, requiring some facilities to install further treatment at additional cost.*

Within the anaerobic biological treatment process, the nitrate is converted to nitrogen gas. In the process, some ammonia can be produced, probably from microbial degradation. Facilities facing discharge limits for ammonia or whole effluent toxicity limits may require further treatment and incur additional cost.

Figures 3-4 and 3-5 show long-term self-monitoring data for ammonia in the effluent of the biological treatment systems at Allen and Belews Creek, respectively. EPA has not considered the type or cost of post-treatment required to remove ammonia. Adding this cost would further increase the overall industry cost, as well as impact the cost/benefit assessment for biological treatment.

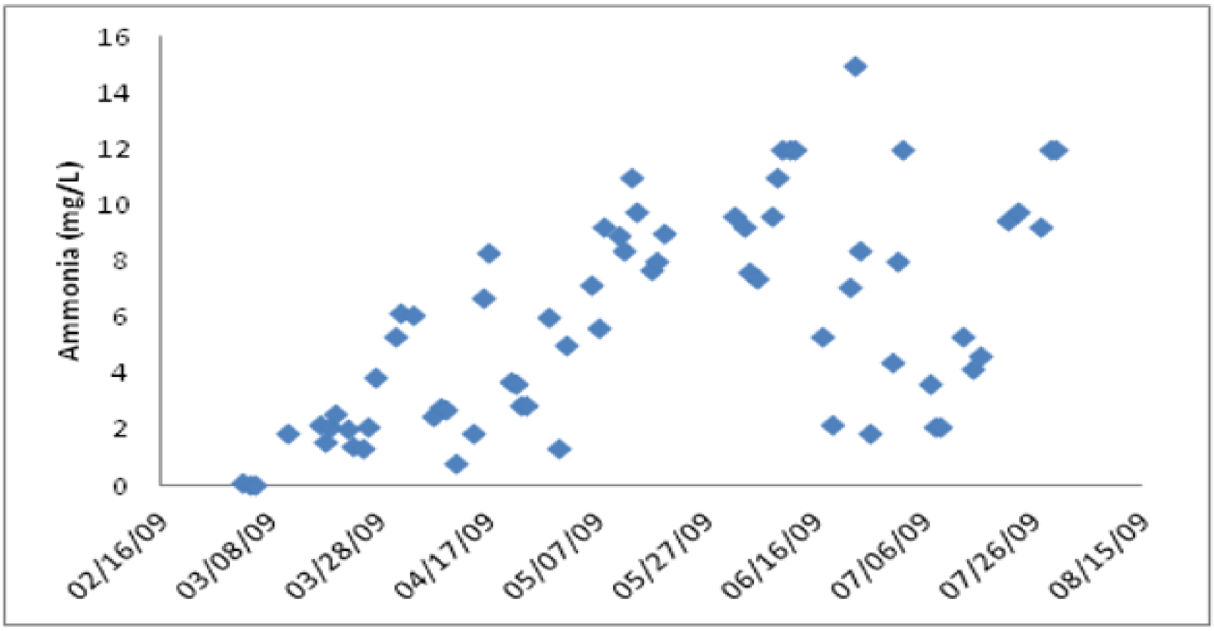


Figure 3-4
FGD Wastewater Bioreactor Effluent Ammonia at Allen Station
Source: EPA, 2009a

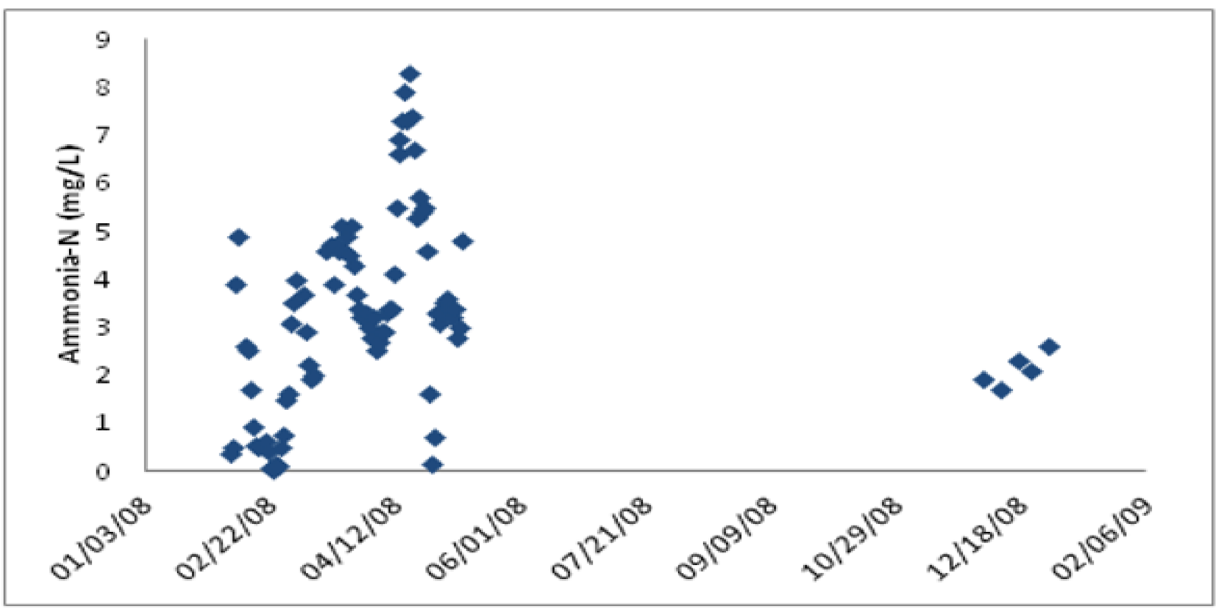


Figure 3-5
FGD Wastewater Bioreactor Effluent Ammonia at Belews Creek Station
Source: EPA, 2009b

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107.

Commenter Name: Chris M. Hobson
Commenter Affiliation: Southern Company
Document Control Number: EPA-HQ-OW-2009-0819-4379-A1
Comment Excerpt Number: 92
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

EPA has failed to prove that chemical precipitation plus biological treatment is feasible across a wide range of plants. The plants EPA chose to use for its cost-effectiveness analysis (Belews Creek and Allen) have similar influent characteristics. In contrast, all the other sampled plants have very different influents, being much higher in TDS and nitrates/nitrites. This means that the influents at these other plants are much harder to treat than the Belews Creek and Allen influents. Therefore, the plants with influents of this type will likely not be able to meet the proposed FGD limits. Also, biological treatment systems are subject to organism die-offs and must be constantly monitored and adjusted. For these reasons, chemical precipitation plus biological treatment is not feasible or available and should not be applied industry-wide.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4655-A2, Excerpt Number 20 in Comment Code 8.c and EPA-HQ-OW-2009-0819-4655, Excerpt Number 107 regarding the representation of plants used to evaluate the BAT basis of chemical precipitation plus biological treatment.

Commenter Name: Michael G. Cashin
Commenter Affiliation: Minnesota Power (ALLETE)
Document Control Number: EPA-HQ-OW-2009-0819-4768-A2
Comment Excerpt Number: 5
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

4. EPA consideration of site specific climate variations. Seasonal conditions for temperature and precipitation affect the performance and viability of water and waste treatment system design. For example, Minnesota's cold winter climate would certainly have an effect on the work-ability of biological treatment systems and the length and nature of construction seasons for treatment system installation. MP comments that ELG effective dates and requirements specifics to the outcome of biological treatment activities need to be flexible and goal based in recognition of the uniqueness of each wet- scrubbed system and the climate it is operated within.

FGD outcomes should also allow for the use of alternative BAT if it is shown over time to substantially meet the final ELG limitation requirements for FGD wastewaters.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107 regarding biological treatment system performance during extreme weather conditions. Additionally, EPA notes that the regulations do not require facilities to implement the specific technologies that form the bases of the technology options, but only that the appropriate effluent limitations and standards be achieved.

Regarding the compliance timing, see response to DCN EPA-HQ-OW-2009-0819-4379-A1, Excerpt Number 126.

Commenter Name: John McManus
Commenter Affiliation: American Electric Power System (AEP)
Document Control Number: EPA-HQ-OW-2009-0819-4448-A1
Comment Excerpt Number: 25
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

As with any process, the influent conditions can affect the process performance, particularly that of biological systems. This can be a significant issue when a unit is returned to service after an extended outage. AEP experienced such a condition when returning a unit to service after an extended outage and it took the selenium removal process over a week to recover. This was probably due to the effect the long outage had on the microbes and the time it took to stabilize the FGD chemistry. AEP bioreactor experience is with an FGD that operates at an ORP of 150-200mv, and as such, controlling the ORP of the bioreactor to -150mv is accomplished relatively easily. However, a number of FGDs operate at high ORP levels and reduction to the bioreactor's ORP to -150mv would be more difficult and costly.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107.

Also see the AEP's March 2014 data submittal to EPA, which presents analytical data for the treatment system at Mountaineer (the plant the commenter refers to), as well as electricity generation data, FGD system data, and other information related to operation of the FGD and wastewater treatment system. Presumably, the extended outage referred to by the commenter was the 104-day outage reflected in the data. The commenter is unclear about what "condition" they experienced that "took the selenium removal process over a week to recover." What is clear, however, is that all effluent data following the extended outage were lower than the final 5 ug/L daily maximum selenium limitation – demonstrating the treatment system had no trouble at all restarting following the outage and produced effluent concentrations substantially lower than the effluent limitations.

Commenter Name: Thomas N. Effinger
Commenter Affiliation: South Carolina Electric & Gas (SCE&G)
Document Control Number: EPA-HQ-OW-2009-0819-4593-A1
Comment Excerpt Number: 12
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

As discussed above, SCE&G does not believe that EPA satisfactorily considered the number and range of plant variables that interact to make the proposed FGD BAT limits impossible to meet. Despite the multiple issues regarding the inputs used to weigh the cost of implementing the rules to the associated environmental benefit (i.e., the cost-to-benefit ratio or cost/benefit), SCE&G does not believe that chemical precipitation meets the historical cost/benefit of past rules, especially for smaller generating units/flows. While chemical precipitation may in some cases be a cost-effective and reliable means to treat FGD wastewater across all geographical regions and a wide range of fuels, the incremental cost/benefit of additional biological treatment is truly not justified.

Comment Response:

Regarding the performance and reliability of the BAT technology under differing conditions, see the response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107.

For the role of cost-effectiveness in EPA's decisions for the final rule, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 27 in Comment Code 6.h.

Regarding the role of cost-benefit analysis in EPA's decisions on the final steam electric ELGs, see response to DCN EPA-HQ-2009-0819-4464-A1, Excerpt Number 3 (in comment code 6.e).

Commenter Name: Thomas N. Effinger
Commenter Affiliation: South Carolina Electric & Gas (SCE&G)
Document Control Number: EPA-HQ-OW-2009-0819-4593-A1
Comment Excerpt Number: 1
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

The EPA has identified eight options that may be considered Best Available Technology (BAT) in a final rule. We believe the basis EPA used to establish BAT-based limits for flue gas desulphurization (FGD) wastewater is not appropriate to determine realistic BAT-based limits. In the development of BAT, the EPA relied on data from two existing power plants which used biological treatment. Our review of that data, along with our recent experience operating FGD wastewater treatment systems, leads us to conclude that the EPA's data is wholly inadequate and is not representative of the broad range of power plants across the country. We further conclude that the technologies proposed by the EPA as BAT will not be capable of consistently meeting the proposed limits.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4655-A2, Excerpt Number 20 in Comment Code 8.c and EPA-HQ-OW-2009-0819-4655, Excerpt Number 107 regarding the representation of plants used to evaluate the BAT basis.

Commenter Name: Paul Carpmone
Commenter Affiliation: Tampa Electric Company (TEC)
Document Control Number: EPA-HQ-OW-2009-0819-4520-A2
Comment Excerpt Number: 7
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

<u>EPA Should Reconsider Requiring Biological Treatment for FGD Wastewater</u>

Due to the variations in FGD wastewater flow and quality enumerated previously, it does not directly follow that if the two plants studied have achieved particular pollutant removals using the biological treatment that all coal-burning plants will achieve the same performance. The plants currently operating these treatment systems share a common operator, fuel type, and geographic region. Biological treatment with organisms that are sensitive to changes in temperature, food source and chemicals will experience upsets with an influent that fluctuates in flow and quality as the FGD wastewater stream does.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107.

Commenter Name: Dennis Wene
Commenter Affiliation: Alcoa Inc.'s Warrick Operations
Document Control Number: EPA-HQ-OW-2009-0819-4765-A1

Comment Excerpt Number: 13
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

In addition to the cost of the facility, operability is a concern. The FGD scrubber water is high in total dissolved solids, which creates a problem for the wastewater stream to use biological wastewater treatment. The biomass struggles to adjust quickly to changing feedstocks and changing weather conditions particularly elevated temperatures that can be experienced in peak summer months. Degradation of treatment in July and August due to these elevated temperatures is anticipated and with the monitoring requirements at the effluent discharge of this treatment system, Alcoa-Warrick cannot determine whether these requirements are achievable during the warm weather months.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107.

Commenter Name: Dennis Leonard
Commenter Affiliation: DTE Energy Company
Document Control Number: EPA-HQ-OW-2009-0819-4517-A2
Comment Excerpt Number: 6
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Efficacy of Biological Treatment will be Reduced

EPA has only examined the efficacy of biological treatment of FGD blowdown at plants burning bituminous coals or blends of similar bituminous coals that do not change markedly from day to day. The same degree of biological treatment that EPA expects of those units cannot be expected at a plant the fuel flexes more dramatically, like the Monroe Power Plant between bituminous and sub-bituminous coal. A basic tenant of biological treatment is the efficacy of treatment is enhanced by steady state conditions and degraded by upsets. At Monroe, 3 key biological variables; flow, ORP and nitrate levels are varying widely.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107.

Commenter Name: Stephen M. Frank
Commenter Affiliation: NRG Energy, Inc.
Document Control Number: EPA-HQ-OW-2009-0819-4510-A2
Comment Excerpt Number: 9
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Creates Effluent Concentrations of Ammonia Exceeding the Aquatic Life Ambient Water Quality Criteria

The whole effluent toxicity from anaerobic biological treatment is likely greater than effluent discharged from chemical precipitation process due to the resultant increase in ammonia concentrations. On August 22, 2013, EPA published in the Federal Register Final Aquatic Life Ambient Water Quality Criteria for Ammonia – Freshwater 2013. At a pH=7 and 30 degrees Celsius, the chronic criteria (30 day rolling average) for ammonia is 0.99 mg TAN/L. This criterion appears to be more stringent if freshwater mussels are present in the receiving water.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107 regarding the generation of ammonia byproduct in the biological treatment system. Additionally, EPA notes that the average concentrations of the ammonia in the chemical precipitation system for all seven plants included in EPA's sampling data are above the 0.99 mg/L included in the analysis. Therefore, if such water quality-based limits were applied to the plants, the plant would likely need to add treatment regardless of whether there was biological treatment. EPA has not identified any plants with NPDES effluent limits for ammonia and does not anticipate that any ammonia generated by the biological treatment would lead to such limits. If necessary, there are steps plants can take (e.g., reformulate the nutrient feed) to minimize any increase in the ammonia discharged in FGD wastewater.

Commenter Name: John W. Myers
Commenter Affiliation: Tennessee Valley Authority (TVA)
Document Control Number: EPA-HQ-OW-2009-0819-4607-A1
Comment Excerpt Number: 13
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

In addition, EPA is proposing limits that are based on a single vendor's proprietary system. EPA should not exclude legitimate alternatives in its analysis that are potentially as effective and significantly less costly. Prior to selecting the BAT limits, EPA should confirm the achievability of these limits as well as further evaluate the capabilities of alternate treatment systems for removal of selenium and nitrates. Based on the limited operating history and the variable performance of the biotreatment systems, it is clear that biological treatment does not rise to the standard of 'best available technology'.

Comment Response:

The selection of BAT is based on EPA's evaluation of the technologies that are available and that have been demonstrated to effectively treat FGD wastewater. However, EPA notes that the regulations do not require facilities to implement the specific technologies that form the bases of the final limitations and standards, but only that the appropriate effluent limitations and standards be achieved. As described in preamble section V, there has been and continues to be advancement in technologies for the treatment of FGD wastewater that will open the market for many treatment options for plants to select. See the response to DCN EPA-HQ-OW-2009-0819-5552-A2, Excerpt Number 7.

Commenter Name: Stephen M. Frank
Commenter Affiliation: NRG Energy, Inc.
Document Control Number: EPA-HQ-OW-2009-0819-4510-A2
Comment Excerpt Number: 7
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Organic Acid Additives Create Speciated Selenium Compounds Not as Amenable to Biologic Treatment

The 2013 TDD assumes that because the biological treatment process used as the basis for Regulatory Options 3 and 4a reduces both selenate and selenite to its elemental form; the form of selenium present in the wastewater does not impact the removals achieved by the preferred options. However, the use of organic acid additives creates organic/unknown speciated selenium compounds and nitrogen species in the FGD wastewater. These species are not as amenable to biologic treatment.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 58 regarding biological treatment of selenium species. The combination of chemical precipitation and biological treatment has demonstrated that it effectively removes all forms of selenium present in FGD wastewater.

Commenter Name: Thomas N. Effinger
Commenter Affiliation: South Carolina Electric & Gas (SCE&G)
Document Control Number: EPA-HQ-OW-2009-0819-4593-A1
Comment Excerpt Number: 10
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

The EPA has proposed limits for FGD wastewater that are not appropriate or representative of the range of FGD systems across the US. We have shown, with data from just one facility, that there will be significant water quality variations in FGD wastewater that could cause exceedances with the proposed limits. Our testing has demonstrated that the proposed limits for FGD wastewater cannot be met reliably. We have shown with our pilot testing of three biological processes that selenium removal to the proposed BAT limits cannot be achieved consistently, if at all.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107 regarding biological treatment system performance and FGD wastewater variability.

Also, see response to DCN EPA-HQ-OW-2009-0819-4593-A1, Excerpt Number 2 in Comment Code 8.c and Excerpt Number 3 in this comment code regarding Wateree's pilot testing study results for the biological treatment of FGD wastewater.

Commenter Name: Pamela F. Faggert
Commenter Affiliation: Dominion Resources, Inc.
Document Control Number: EPA-HQ-OW-2009-0819-4631-A1
Comment Excerpt Number: 39
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Both Belews Creek and Allen deploy the same GE ABMet technology which comes from a single vendor, General Electric. Accordingly, we are concerned that a national effluent standard based on an advanced technology from a single vendor amounts to vendor capture which raises reliability concerns should the single vendor technology fail to adapt to different facilities. A single vendor solution also raises costs concerns as costs generally rise significantly when there is a large demand and no alternative source to meet that demand.

Comment Response:

Regarding the market availability of biological treatment systems, see response to DCN EPA-HQ-OW-2009-0819-4607-A1, Excerpt Number 13 and DCN EPA-HQ-OW-2009-0819-5552-A2, Excerpt Number 7.

Commenter Name: Michael G. Cashin
Commenter Affiliation: Minnesota Power (MP)
Document Control Number: EPA-HQ-OW-2009-0819-4484-A1
Comment Excerpt Number: 21
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Site specific unique FGD treatment needs. MP supports the comments from UWAG, EEI and EPRI that FGD wastewater treatment methods are unproven. Yet, three of the four EPA preferred outcomes for FGD wastewater regulations contain BAT requirements which include the use of unproven, biological treatment (FR page 34451). The performance of FGD wastewater treatment systems is unique for each wet-scrubbed unit given numerous affective variables including coal type, boiler characteristics, climate, etc.

Comment Response:

EPA disagrees with the commenter that the BAT basis is an unproven method of FGD wastewater treatment. EPA defines the BAT basis for FGD wastewater as chemical precipitation followed by biological treatment. Chemical precipitation has proven to be an effective technology for accommodating variable wastewater characteristics. See response to DCN EPA-HQ-OW-2009-0819-4448-A1, Excerpt Number 24 in Comment Code 9.a regarding chemical precipitation performance. See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107 regarding biological treatment performance and FGD wastewater variability.

Commenter Name: Cari Boyce
Commenter Affiliation: Duke Energy
Document Control Number: EPA-HQ-OW-2009-0819-4305-A3
Comment Excerpt Number: 34
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Biological treatment has been demonstrated to be effective at removing dissolved forms of selenium, nickel and zinc and nitrates/nitrites as (N), but this demonstration has been limited to two stations, burning primarily Central Appalachian Coal and limited to one technology supplier

(GE). Furthermore, the removal of these constituents is a just a small incremental removal on a TWPE basis when compared with the constituents removed in the chemical precipitation system.

Comment Response:

Regarding biological treatment system performance and FGD wastewater variability, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107.

Regarding the incremental removals for the biological system, see response to DCN EPA-HQ-OW-2009-0819-4305-A3, Excerpt Number 52 in Comment Code 10.c.

Regarding the market availability of biological treatment systems, see response to DCN EPA-HQ-OW-2009-0819-4607-A1, Excerpt Number 13.

Regarding evaluation of the chemical precipitation system and biological treatment systems separately, see response to DCN EPA-HQ-OW-2009-0819-4305-A3, Excerpt Number 52 in Comment Code 10.c.

Commenter Name: Mike Roddy
Commenter Affiliation: Seminole Electric Cooperative, Inc. (SECI)
Document Control Number: EPA-HQ-OW-2009-0819-4518-A2
Comment Excerpt Number: 5
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Duke energy, whose power plants acted as test subjects for biological treatment, have publicly stated they cannot consistently meet the limits as proposed by EPA. SECI believes the reasonable expected costs are excessive. Additionally, it has not been demonstrated that the technology can consistently meet the limits EPA is proposing. Therefore, SECI believes that options 2, 3, 4, and 4a do not represent realistic solutions to meeting EPA's proposed limits.

Comment Response:

Regarding biological treatment system performance and FGD wastewater variability, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107.

Regarding Duke Energy's claims, see response to DCN EPA-HQ-OW-2009-0819-4305-A3, Excerpt Number 58 and 59.

Regarding whether the costs are excessive, EPA has determined that the costs are economically achievable, as described in preamble sections VIII and IX.

Commenter Name: Cari Boyce
Commenter Affiliation: Duke Energy
Document Control Number: EPA-HQ-OW-2009-0819-4305-A3
Comment Excerpt Number: 56
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

This section will demonstrate that the BAT limits proposed for FGD effluent will be challenging to meet, even for facilities that utilize the technology the limits were based on. Duke Energy evaluated the proposed limits with sampling data collected by EPA during their field tests, along with self-monitoring data from these same stations to determine the compliance rate with these limits. The data used in this evaluation is included in Appendix A.

Comment Response:

See responses to DCN EPA-HQ-OW-2009-0819-4305-A3, Excerpt Number 57 in Comment Code 9.a and Excerpt Numbers 58 and 59 in this comment code. Regarding the achievability of the effluent limits, also see the Statistical Support Document for Effluent Limitations.

Commenter Name: Nancy A. Evans
Commenter Affiliation: PPL Services Corporation
Document Control Number: EPA-HQ-OW-2009-0819-4348-A2
Comment Excerpt Number: 9
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

With respect to the proposed metals limits, EPA did not properly evaluate the technologies and what they can consistently achieve. The limits are unsupported by a necessary and proper evaluation, which could not have been performed in any case since the data on which it was based was completely inadequate. The proposed metals and nitrate/nitrite limits cannot be met with the proposed treatment technologies and therefore should be revised.

Comment Response:

Regarding biological treatment system performance and FGD wastewater variability, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107.

Regarding the representativeness of the data, see response to DCN EPA-HQ-OW-2009-0819-4655-A2, Excerpt Number 20 in Comment Code 8.c.

Commenter Name: Pamela F. Faggert
Commenter Affiliation: Dominion Resources, Inc.
Document Control Number: EPA-HQ-OW-2009-0819-4631-A1
Comment Excerpt Number: 36
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

the proposed biological limitations assume influent data from Allen and Belews Creek is representative of average influents at other facilities. However, the nitrate/nitrite levels in the Allen and Belew Creek influents are low compared to other facilities. Facilities with higher nitrate/nitrite levels cannot be expected to operate biological treatment in the same manner as plants with very low nitrate/nitrite levels.

Comment Response:

Regarding biological treatment system performance and FGD wastewater variability, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107.

Regarding the treatment of FGD wastewater with high nitrate/nitrite concentrations, see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 44 in Comment Code 10.b.

Commenter Name: Jerry Purvis
Commenter Affiliation: East Kentucky Power Cooperative, Inc. (EKPC)
Document Control Number: EPA-HQ-OW-2009-0819-4455-A1
Comment Excerpt Number: 2
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

It appears from the proposed rule and technical support document that the additional anaerobic biological treatment step that would follow chemical precipitation is largely focused on removal of dissolved selenium. EKPC believes requiring the additional biological treatment unit is unjustified, especially for smaller generating stations such as those with total wet scrubbed capacity of less than 2,000 MW

Comment Response:

EPA disagrees with the commenter that "the additional biological treatment unit is unjustified." See preamble section VIII of the preamble regarding EPA's selection of the BAT technology for FGD wastewater treatment.

Regarding EPA's evaluation of size thresholds, see response to DCN EPA-HQ-OW-2009-0819-4477-A1, Excerpt Number 15 in Comment Code 5.c.

Commenter Name: Stephen M. Frank
Commenter Affiliation: NRG Energy, Inc.
Document Control Number: EPA-HQ-OW-2009-0819-4510-A2
Comment Excerpt Number: 13
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

The model technology of an anaerobic biological system for the removal of selenium and nitrate-nitrite has not been proven in FGD wastewaters containing:

- Organic acid additives,
- High chloride concentrations, and/or
- High nutrient loadings.

EPA should present long-term effluent data to support the use of this biological treatment at higher chloride and nitrate-nitrite concentrations.

Comment Response:

Regarding the treatment of FGD wastewater with high chlorides concentrations, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107.

Regarding the treatment of FGD wastewater with high nitrate/nitrite concentrations, see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 44 in Comment Code 10.b.

Regarding organic acid additives, see responses to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 58 and DCN EPA-HQ-OW-2009-0819-4510-A2, Excerpt Number 7.

Commenter Name: Elizabeth E. Aldridge, Hunton & Williams
Commenter Affiliation: UWAG
Document Control Number: EPA-HQ-OW-2009-0819-4655
Comment Excerpt Number: 183

External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

5. Incremental Biological Treatment of FGD Wastewater Is Not Reliable or Cost-Effective

The unpredictability of biological treatment systems creates concerns about meeting the FGD wastewater PSES/PSNS standards. The reliability of biological systems is unproven, especially when intermittent and variable pollutant loadings to the treatment system are taken into account.

Comment Response:

Regarding biological treatment system performance and FGD wastewater variability, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107.

Regarding the cost effectiveness of the BAT basis, see response to DCN EPA-HQ-OW-2009-0819-4305-A3, Excerpt Number 54 in Comment Code 10.c.

Commenter Name: Chris M. Hobson
Commenter Affiliation: Southern Company
Document Control Number: EPA-HQ-OW-2009-0819-4379-A1
Comment Excerpt Number: 146
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Incremental Biological Treatment of FGD Wastewater is not Reliable or Cost-Effective

The unpredictability of biological treatment systems creates concerns about meeting the FGD wastewater PSES/PSNS standards. The reliability of biological systems is unproven, especially when intermittent and variable pollutant loadings to the treatment system are taken into account.

Comment Response:

Regarding biological treatment system performance and FGD wastewater variability, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107.

Regarding the cost effectiveness of the BAT basis, see response to DCN EPA-HQ-OW-2009-0819-4305-A3, Excerpt Number 54 in Comment Code 10.c.

Commenter Name: Quinlan J. Shea III
Commenter Affiliation: Edison Electric Institute (EEI)
Document Control Number: EPA-HQ-OW-2009-0819-4487-A1
Comment Excerpt Number: 83
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Incremental Biological Treatment of FGD Wastewater is Not Reliable or Cost-Effective.

The unpredictability of biological treatment systems creates concerns about meeting the FGD wastewater PSES/PSNS standards. The reliability of biological systems is unproven, especially when intermittent and variable pollutant loadings to the treatment system are taken into account.

Comment Response:

Regarding biological treatment system performance and FGD wastewater variability, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107.

Regarding the cost effectiveness of the BAT basis, see response to DCN EPA-HQ-OW-2009-0819-4305-A3, Excerpt Number 54 in Comment Code 10.c.

Commenter Name: Julia M. Blankenship
Commenter Affiliation: American Municipal Power, Inc. (AMP)
Document Control Number: EPA-HQ-OW-2009-0819-4670-A2
Comment Excerpt Number: 6
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

<u>Biological treatment of FGD wastewater</u>: AMP is concerned that this aspect of EPA's preferred Options 3 and 4a would, if adopted, present significant additional compliance costs and difficult maintenance issues, as biological treatment systems can prove temperamental under various operating conditions, which could impact electric generation.

Comment Response:

Regarding biological treatment system performance and FGD wastewater variability, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107.

EPA disagrees with the commenter that the biological treatment system has "difficult maintenance issues." Based on discussions with Duke Energy during the site visits, the primary maintenance of the system relates to the backwashing and degassing of the reactors, which is an automated process and just requires the operators to learn when the system needs to be backwashed/degassed.

EPA agrees with the commenter that the treatment system has compliance costs, but EPA has determined that the final limitations are economically achievable, as described in preamble section VIII.

Commenter Name: Lisa M. Jaeger
Commenter Affiliation: Council of Industrial Boiler Owners (CIBO)
Document Control Number: EPA-HQ-OW-2009-0819-4486-A2
Comment Excerpt Number: 24
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Reconsider the use of anaerobic biological treatment for Se removal in FGD wastewaters as this technology is not largely proven in the industry. At the least, re-evaluate the proposed limits for Se, As, and Hg because it is not proven that existing systems in operation are meeting these limits consistently.

Comment Response:

Regarding biological treatment system performance and FGD wastewater variability, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107.

Regarding the effluent limitations, in response to public comments, EPA revised the final limitations based on additional data. See section 3 of the TDD for details data used in development of the final effluent limitations. EPA notes that the arsenic and mercury effluent limitations are based on the performance of the chemical precipitation system, not the biological treatment system.

Commenter Name: Nancy A. Evans
Commenter Affiliation: PPL Services Corporation
Document Control Number: EPA-HQ-OW-2009-0819-4348-A2
Comment Excerpt Number: 12
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Biological treatment at many plants is infeasible due to factors including cost, physical constraints and the low numerical limits in the ELGs. EPA has not adequately demonstrated that biological treatment is BAT, therefore, PPL requests EPA to remove any biological treatment requirements from Option 3.

Comment Response:

Regarding biological treatment system performance and FGD wastewater variability, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107. See preamble section VIII regarding EPA's selection of the biological treatment system as the BAT basis for FGD wastewater discharges from units that are greater than 50 MW and that are not oil-fired.

Commenter Name: Jay Hudson
Commenter Affiliation: Santee Cooper
Document Control Number: EPA-HQ-OW-2009-0819-4476-A1
Comment Excerpt Number: 7
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Among other things, Santee Cooper is concerned that operational patterns at some EGUs may preclude the use of biological treatment due to an inability to maintain the viability of microbial populations under the full range of operating conditions at existing EGUs, especially during extended downtimes.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107.

Commenter Name: Nancy A. Evans
Commenter Affiliation: PPL Services Corporation
Document Control Number: EPA-HQ-OW-2009-0819-4348-A2
Comment Excerpt Number: 7
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

With respect to the proposed nitrate/nitrite limit, EPA relied on effluent data from the Allen and Belews Creek plants. As demonstrated through data submitted by the Utility Water Act Group, nitrate/nitrite levels in those plants' influent streams are unrepresentative of most power plants.

Comment Response:

Regarding biological treatment system performance and FGD wastewater variability, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107.

Regarding the treatment of FGD wastewater with high nitrate/nitrite concentrations, see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 44 in Comment Code 10.b.

Commenter Name: Michael G. Cashin
Commenter Affiliation: Minnesota Power (ALLETE)
Document Control Number: EPA-HQ-OW-2009-0819-4768-A2
Comment Excerpt Number: 18
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

MP supports the comments from UWAG, EEI and EPRI that FGD wastewater treatment methods are unproven. Yet, three of the four EPA preferred outcomes for FGD wastewater regulations contain BAT requirements which include the use of unproven, biological treatment (FR page 34451).

Comment Response:

Regarding biological treatment system performance and FGD wastewater variability, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107.

Commenter Name: Raven Power Holdings, LLC
Commenter Affiliation: Raven Power Holdings, LLC
Document Control Number: EPA-HQ-OW-2009-0819-4467-A1
Comment Excerpt Number: 25
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Raven Power contends that, based on in-house operating experience, elevated TDS concentrations have a negative impact on biological treatment system performance in FGD wastewater treatment service and require reduction prior to introduction into the bioreactors.

Comment Response:

Regarding the impact of TDS on biological treatment of FGD wastewater, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107.

Commenter Name: Tom DeLawrence
Commenter Affiliation: PowerSouth Energy Cooperative
Document Control Number: EPA-HQ-OW-2009-0819-4460-A1
Comment Excerpt Number: 28
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Regardless, the evaluation of biological treatment included in the Draft Rule selectively ignores a number of shortcomings with this technology and the difficulties it would present at various facilities throughout the country based on site-specific factors.

Comment Response:

EPA cannot respond to the commenter's concerns without additional information on "site-specific factors" that would present difficulties in treatment. Regarding biological treatment system performance and FGD wastewater variability, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107.

Commenter Name: Paul Chu
Commenter Affiliation: Electric Power Research Institute (EPRI)
Document Control Number: EPA-HQ-OW-2009-0819-4499-A1
Comment Excerpt Number: 6
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Key Comments on the Proposed Numeric Limits for FGD Wastewater

The proposed limits for selenium, arsenic, and mercury in FGD wastewater may not be achievable for all power plants employing the proposed best available technology (BAT).

Comment Response:

In response to public comments, EPA revised the final effluent limits for selenium, arsenic, and mercury. See preamble section XI of the preamble for a summary of the final effluent limitations for FGD wastewater and Section 3 of the TDD for data used in development of the final limitations. Regarding complying with the arsenic and mercury limitations, see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 131 in Comment Code 9.a and DCN EPA-HQ-OW-2009-0819-4305-A3, Excerpt Number 57 also in Comment Code 9.a. Regarding complying with the selenium limitations, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107.

Commenter Name: Paul Chu
Commenter Affiliation: Electric Power Research Institute (EPRI)
Document Control Number: EPA-HQ-OW-2009-0819-4499-A1
Comment Excerpt Number: 13
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

The FGD wastewater at some facilities may periodically include selenium compounds— other than the typical selenite and selenate species—that may have reduced capture rates in biological treatment systems.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 58.

Commenter Name: Paul Chu
Commenter Affiliation: Electric Power Research Institute (EPRI)
Document Control Number: EPA-HQ-OW-2009-0819-4499-A1
Comment Excerpt Number: 8
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Some facilities may have challenges in meeting the proposed numeric limits for mercury and arsenic using chemical precipitation, and the limits for selenium using biological treatment following CP.

Comment Response:

In response to public comments, EPA revised the final effluent limits for selenium, arsenic, and mercury. See preamble section XI of the preamble for a summary of the final effluent limitations for FGD wastewater and Section 3 of the TDD for the data used in development of the final limitations. Regarding complying with the arsenic and mercury limitations, see response to DCN

EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 131 in Comment Code 9.a and DCN EPA-HQ-OW-2009-0819-4305-A3, Excerpt Number 57 also in Comment Code 9.a. Regarding complying with the selenium limitations, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107.

Commenter Name: Betsy Natz
Commenter Affiliation: Institute of Clean Air Companies (ICAC)
Document Control Number: EPA-HQ-OW-2009-0819-4549-A1
Comment Excerpt Number: 5
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

The same narrow focus was applied to biological systems. Only (2) were evaluated, both of which are Duke Energy plants located in North Carolina, operating approximately 100 miles apart.

Comment Response:

Regarding biological treatment system performance and FGD wastewater variability, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107.

Commenter Name: Paul Chu
Commenter Affiliation: Electric Power Research Institute (EPRI)
Document Control Number: EPA-HQ-OW-2009-0819-4499-A1
Comment Excerpt Number: 11
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Variations in the influent nitrate/nitrite may impact biological treatment performance, leading to additional challenges in meeting the selenium, as well as nitrate, limits

Comment Response:

Regarding biological treatment system performance and FGD wastewater variability, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107.

Regarding the treatment of FGD wastewater with high nitrate/nitrite concentrations, see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 44 in Comment Code 10.b.

Commenter Name: Shellie Chard-McClary
Commenter Affiliation: Oklahoma Department of Environmental Quality (DEQ)
Document Control Number: EPA-HQ-OW-2009-0819-4181-A2
Comment Excerpt Number: 3
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Some of EPA's proposed options for FGD Wastewater include the requirement of using Chemical Precipitation and Biological Treatment for treating the wastewater. The Average Effluent Pollutant Concentrations for One-Stage Chemical Precipitation Systems with Biological Treatment, presented in Table 10-5 of the Technical Development Document , appear to be reasonable treatment targets. However, we are uncertain as to whether Biological Treatment, in addition to Chemical Precipitation, is an appropriate standard for a well-operated facility, which would justify inclusion in a BAT standard. If EPA's analysis and supporting information show that Biological Treatment should be included in the BAT standard for FGD, the final rule should clearly provide that analysis and supporting information . Otherwise, the BAT standard for FGD should be limited to Chemical Precipitation.

Comment Response:

EPA's record includes information that demonstrates the performance of both the chemical precipitation with hydroxide and sulfide precipitation with iron co-precipitation and the fixed film anoxic/anaerobic biological treatment technology. See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107.

Commenter Name: Thomas Cmar
Commenter Affiliation: Earthjustice, et al.
Document Control Number: EPA-HQ-OW-2009-0819-4702-A7
Comment Excerpt Number: 5
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Although other biological treatment systems have been used to remove Se from WFGD wastewater, the downflow anoxic/anaerobic system is currently the most common biological technology used for full-scale Se removal. Most data is available for the ABMet® process provided by GE Water and Power (GE Corporation, 2013). EPA used the operating performance data from two full-scale ABMet® systems owned by Duke Energy (Allen Steam Station, NC ("Allen") and Belews Creek Steam Station, NC ("Belews")). In addition to these plants this report also evaluates additional full-scale ABMet® operating data on a WFGD wastewater and leachate from a coal-fired power plant in the northeast USA ("NE USA") (Harwood, 2012).

The biological treatment technology option proposed by EPA in the alternatives cited above (78 Fed. Reg. at 34,490, Table X-1), is preceded by chemical precipitation involving both hydroxide and polysulfide treatment, as well as iron co-precipitation (TDD at 13-16). Both the Allen and Belews Creek WFGD treatment systems are designed to employ both hydroxide and polysulfide chemical precipitation followed by an anoxic/anaerobic biological system, but neither treatment system was undertaking polysulfide precipitation at the time that the operators and EPA gathered data regarding removal of Se and Hg (TDD at 13-17). The NE USA ABMet® anoxic/anaerobic unit that EPA did not evaluate was preceded by hydroxide and polysulfide chemical precipitation and therefore better demonstrates the removals possible through the full technology proposed by EPA. The performance of the downflow ABMET® technology is discussed in detail in the following section.

The ABMet® Process

The ABMet® process as configured in the three WFGD wastewater treatment systems identified above consists of two downflow granular activated carbon columns in series. First-stage chemical precipitation process effluent was pH adjusted then fed to the first of the granular carbon columns together with a molasses-based nutrient solution. The function of this nutrient solution is to (i) provide the carbon source that is necessary for the growth of the bacteria that remove the nitrate and nitrite so that the proper ORP for selenate/selenite reduction to Se metal can be achieved; and (ii) provide inorganic nutrients (especially phosphate) for the microbial growth.

The biological removal of nitrite and nitrate occurs by denitrification during which both nitrogen gas and microbial biomass are produced. Se removal results in the accumulation of particles of metallic Se in the biomass matrix. Because the biomass and the nitrogen gas can both interfere with the passage of liquid through the downflow carbon columns, provision is made to: (i) hydraulically pulse ("bump") the carbon columns to release the nitrogen gas, and; (ii) backwash the columns to remove excess biomass and metallic Se particles. The excess biomass containing metallic Se particles can be dewatered to produce a sludge cake which can be disposed of either separately or together with the chemical solids produced in the chemical precipitation stage.

Process control is necessary to maintain the correct ORP conditions for Se removal. This requires the installation of ORP sensor and control instrumentation on each of the individual anaerobic treatment units. The ORP sensor signal regulates the molasses dosing rate which in turn decreases (more molasses added) or increases (less molasses added) the ORP. Furthermore, it is necessary to maintain the biological system pH in a range that is favorable for selenate/selenite reduction to Se metal but is not high enough to lead to the precipitation of calcium carbonate in the carbon columns. The installation of adequate pH sensor and control instrumentation in the biological system is required to achieve this. As detailed in EPA's proposed technology option, the influent to the biological system has already gone through an equalization stage, and the first- stage chemical precipitation steps require pH adjustment. Thus, the influent pH should be predictable and readily adjustable to suit the requirements of the biological system. Harwood, 2013 has indicated that the ABMet® effluent does not require an aerobic polishing step for meeting the EPA-proposed effluent limitations.

ABMet® Process Performance Evaluation

I evaluated the performance of the Allen and Belews Creek ABMet® biological systems using only the industry-supplied performance monitoring data. This choice of data was made because these are the very same data that the discharger would use to determine whether their plant was in compliance with the effluent total Se limitations. Like EPA, non-detect Se values were given a value equal to the average of zero and the stated detection limit (DL).

The Allen ABMet® Plant

Data on the performance of the Allen ABMet® Se removal system were collected by Duke Energy for approximately 26 months (March 2009 to May 2011) (DCN SE 01809 Allen industry data). With the exception of a short period during June and July 2009, the Se removal performance of the treatment system was compliant with the EPA-proposed daily maximum and monthly average effluent limitations for WFGD treatment by chemical precipitation and biological treatment alternative (78 Fed. Reg. at 34,490, Table X-1). These data are shown in Figures 1 and 2, below. In developing the effluent total Se limitations, EPA did not use the data taken during the early part of the Allen ABMet® plant operation (see data inside the black oval on Figures 1 and 2) because EPA indicated that these data were influenced by various factors associated with "plant start-up" and "process optimization" (78 Fed. Reg. at 34,486-87). While such factors can indeed be present (especially for anaerobic biological wastewater treatment units), I could not locate in the record specific evidence that such factors were at play in the early days of the Allen ABMet® plant operation.

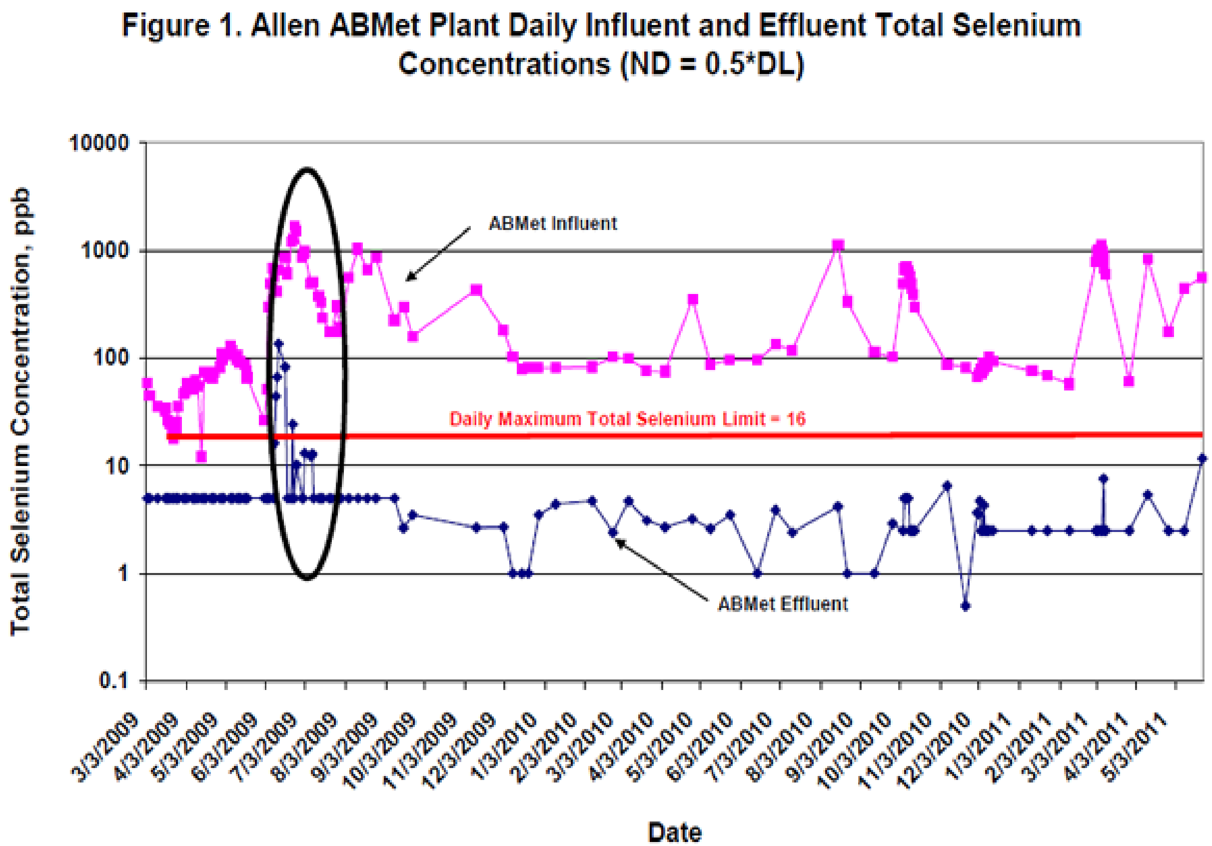
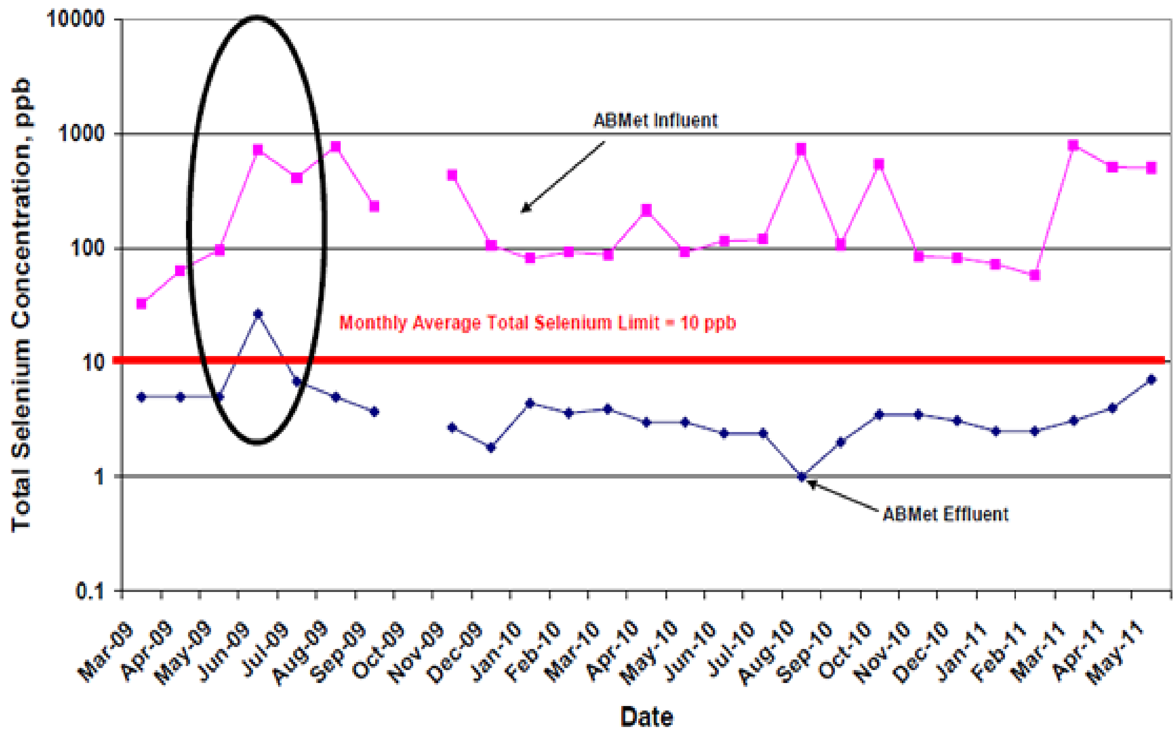


Figure 1. Allen ABMet Plant Daily Influent and Effluent Total Selenium Concentrations (ND = 0.5*DL)
Total Selenium Concentration, ppb
10000
1000
100
10
1
0.1
ABMet Influent
Daily Maximum Total Selenium Limit = 16
ABMet Effluent
3/3/2009
4/3/2009
5/3/2009
6/3/2009
7/3/2009
8/3/2009
9/3/2009
10/3/2009
11/3/2009
12/3/2009
1/3/2010
2/3/2010
3/3/2010
4/3/2010
5/3/2010
6/3/2010
7/3/2010
8/3/2010
9/3/2010
10/3/2010
11/3/2010
12/3/2010
1/3/2011
2/3/2011
3/3/2011
4/3/2011
5/3/2011
Date

Figure 2. Allen ABMet Plant Monthly Average Influent and Effluent Total Selenium Concentations (ND = 0.5*DL)



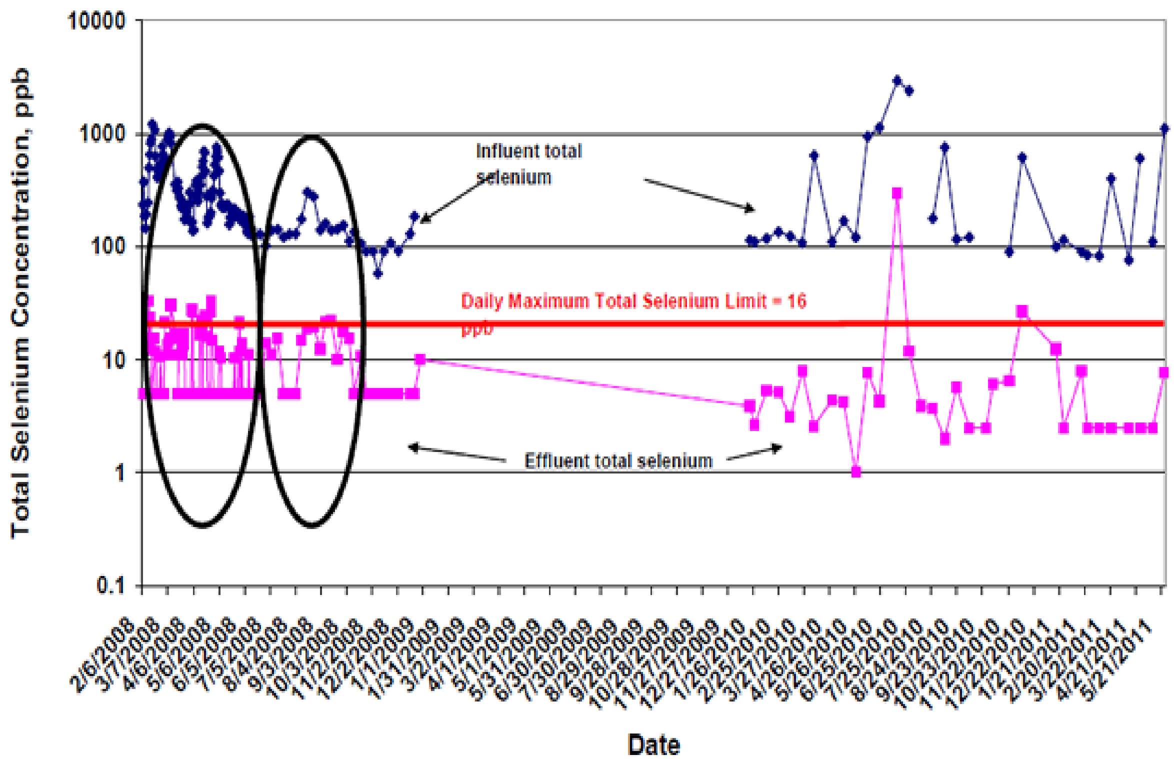
However, examination of Figure 1 shows that during the period prior to the high ABMet® effluent Se concentration experienced in June and July 2009, the ABMet® influent total Se concentration was in the approximate range of 50 -100 ppb. Immediately prior to, and during, the period when the effluent total Se exceeded the proposed EPA effluent total Se limitations, the influent total Se increased by up to approximately 50-fold. Such an increase to a recently started, and therefore poorly acclimated, anoxic/anaerobic biological unit is sure to cause an upset. It should be noted that, later on in the operation of this ABMet® unit (when it is likely that proper acclimation/maturation had occurred) significant fluctuations in the influent total Se concentration were well-tolerated with the effluent total Se limitations always being met. (Figures 1 and 2) Thus, it is my opinion that EPA's omission of the June-July 2009 "plant start-up" and "process optimization" data is justified. As I will discuss below, after exclusion of these unrepresentative data, EPA's proposed effluent total Se limitations are technically achievable by the Allen ABMet® system.

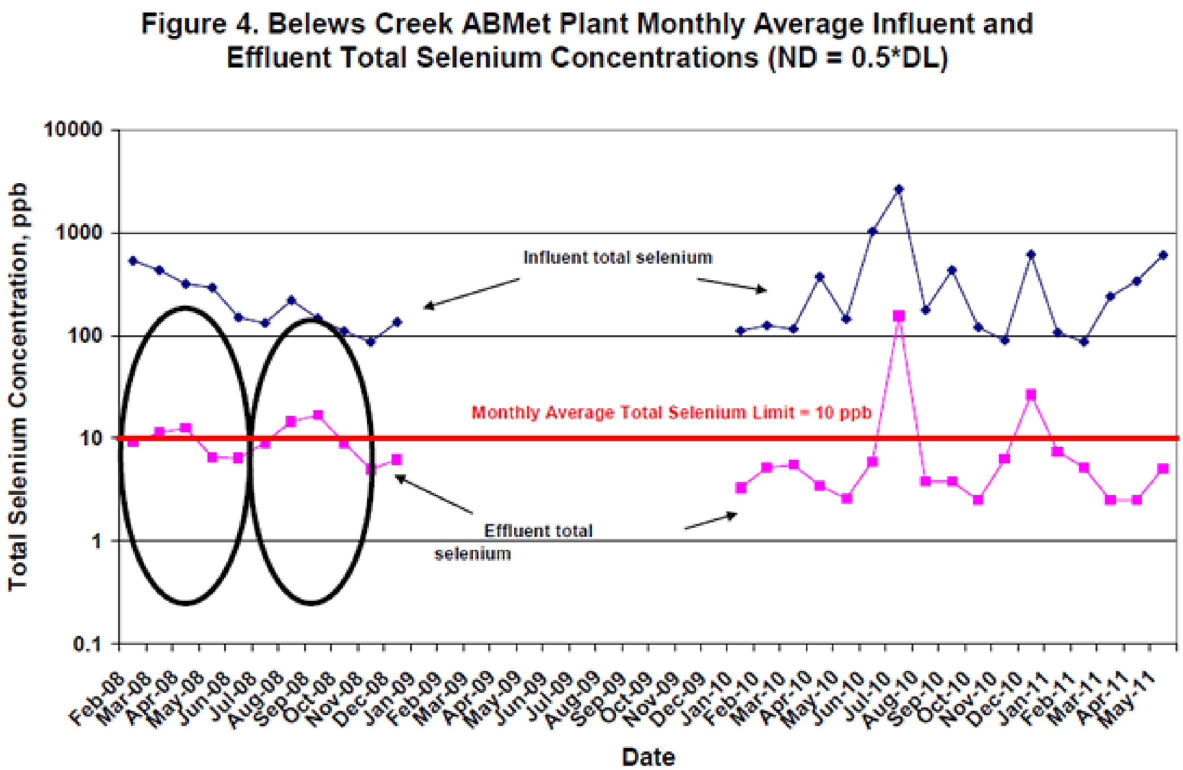
The Belews Creek ABMet® Plant

Data on the performance of the ABMet® Se removal system at Belews Creek was collected during the period from February 2008 to May 2011. There were two separate data collection campaigns: from February 2008 to January 2009 and from February 2010 to May 2011. (DCN SE 01808 Belews Creek industry data)

During a large part of the first data collection campaign the effluent daily maximum and monthly average total Se concentration exceeded the EPA-proposed limitations (Figures 3 and 4). EPA apparently did not use most of the data during the early part of the Belews Creek ABMet® plant operation because they indicated that it was influenced by various factors associated with plant start-up and process optimization (indicated in Figures 3 and 4 by the black ovals). I did not locate in the record any specific evidence that such factors were at play during the periods that EPA designated as "initial commissioning period" and "first 3 months of operation."(78 Fed. Reg. at 34,486-87).

Figure 3. Belews Creek ABMet Daily Plant Influent and Effluent Total Selenium Concentrations (ND = 0.5*DL)





Figures 3 and 4 show that, like the Allen ABMet® unit, the Belews Creek ABMet® system also experienced significant influent total Se concentration fluctuations during the first sampling campaign. However these fluctuations were not as extreme as those for the Allen ABMet® unit. Apparently EPA did not use the Belews Creek ABMet® system effluent total Se data from approximately the first 7 months of operation in formulating its total Se effluent limitations.

Unlike the Allen ABMet® unit, the effluent total Se from the Belews Creek ABMet® system was not fully compliant with the proposed EPA total effluent Se limitations even after the periods designated as "start-up", "initial commissioning", and "first 3 months of operation." Specifically, there were two exceedences that both seemed to be associated with spikes in influent total Se concentration. These exceedences occurred on July 14, 2010 and December 8, 2010.

It is possible that the less consistent performance of the Belews Creek ABMet® system can be attributed to the lesser degree of process control compared to that at Allen. Both plants are operated by Duke Energy, and Duke reported to EPA that "the major improvement of the Allen biological treatment system over the Belews Creek system is the inclusion of oxidation-reduction potential (ORP) and pH probes on each individual cell (the Belews Creek system has one ORP for each stage). Additionally, the Allen system has sampling points on the effluent from the second stage (Belews Creek has sampling points on the effluent from the second stage recycle). These improvements have resulted in greater ease of operations for the biological system at Allen." (See Final Site Visit Notes: Duke Energy's Allen Steam Station, at 11, EPA-HQ-OW-2009-0819- 0598).

The superior performance of the Allen system indicates that proper and comprehensive monitoring and process control of the biological system are critical to achieving the effluent Se limitations established by EPA. Monitoring of the ORP on each individual cell allows the operator to take corrective action such as adjusting the nutrient (molasses) flow into the cell.

The NE USA ABMet® Plant

In addition to the Allen and Belews Creek data sets that EPA used, I obtained a summary of performance data from a full-scale (350 gpm) ABMet® system treating a combination of the effluent of a WFGD + leachate wastewater chemical precipitation system using lime, iron and sulfide additions (Harwood, 2013). The design WFGD wastewater contained 1000-2000 ppb total Se and 40-50 mg nitrate-N/L; the design effluent total Se concentration was <25 ppb.

Operating data was available for an approximate 1-year period. For a WFGD influent total Se concentration in the approximate range 200-900 ppb (mean 381 ppb) the ABMet® unit consistently produced an effluent with a total Se level below 7.2 ppb and with many values in the 1-2 ppb range (Figures 5 and 6) making it fully compliant with the EPA's proposed daily maximum and monthly average total Se limitations. It appears that these data were not available at the time EPA began its analysis in support of the proposed standards. The performance of the ABMet® system at the NE USA plant supports my conclusion that EPA's proposed effluent total Se limitations are achievable.

Figure 5. NE USA ABMet Plant Daily Influent and Effluent Total Se Concentrations (ND = 0.5*DL) (Harwood, 2013)

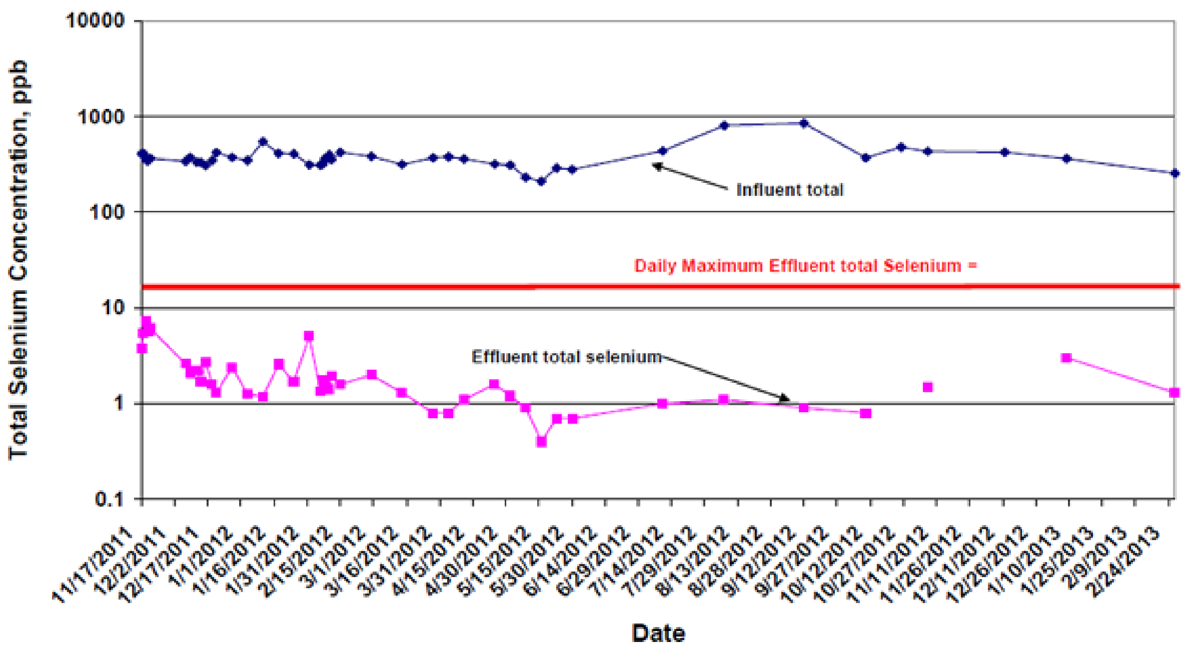
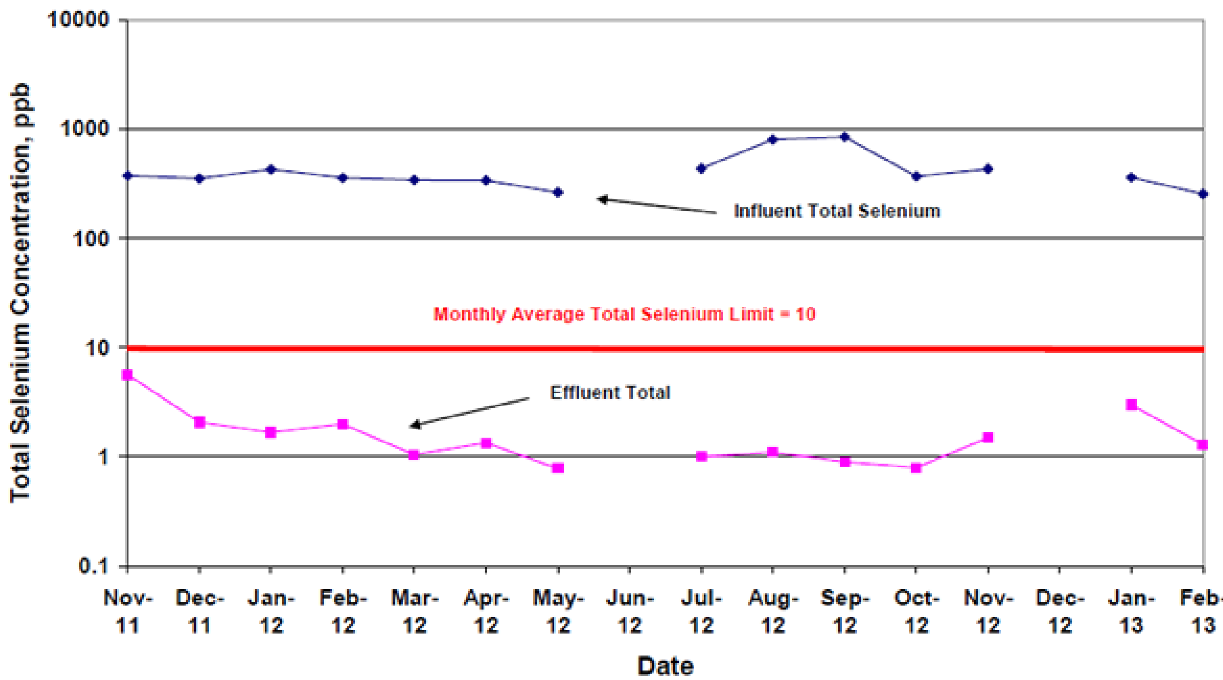


Figure 6. NE USA ABMET Plant Monthly Average Influent and Effluent Total Selenium Concentrations (ND = 0.5*DL) (Harwood, 2012)



Comment Response:

EPA agrees with the commenter that process control is necessary to maintain ORP conditions that are optimal for selenium, as well as nitrate-nitrite, removal. In EPA's review of the data received from industry and based on further discussion with plants on the possible factors influencing their data, EPA determined that some data were not usable due to analytical and/or operational issues. A summary of EPA's data exclusions are presented in the Statistical Support Document for Effluent Limitations.

EPA did not use the data associated with the "NE USA" plant because the biological treatment system receives FGD wastewater and combustion residual leachate. As such, it does not represent only FGD wastewater and, therefore, was not used to develop the limitations for FGD wastewater. The influent wastewater might have been diluted from the addition of the combustion residual leachate. However, EPA agrees with the commenter that the data do support that the biological treatment system is capable of meeting the limitations.

Commenter Name: Thomas Cmar
Commenter Affiliation: Earthjustice, et al.
Document Control Number: EPA-HQ-OW-2009-0819-4702-A7
Comment Excerpt Number: 10

External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

1. Biological removal of Se from wastewaters can be achieved by reducing Se species to the sparingly soluble Se metal and by incorporating the Se species in biomass.
2. Selenate/selenite-reducing microorganisms are ubiquitous and have been used for almost 20 years for Se removal from wastewater streams.
3. Currently anoxic/anaerobic biological selenate/selenite reducing processes are used for treating wastewaters from the following: agricultural drainage water; mining and metals processing wastewaters; oil refinery wastewater effluents, and pre-precipitated WFGD wastewaters.
4. Compared to the wastewaters listed in 3. above, WFGD pre-precipitated wastewater presents additional challenges to anoxic/anaerobic Se removal processes because of its high concentrations of dissolved salts and its variable composition. These challenges are manageable through proper acclimation, monitoring and operation of the system.
5. For the proposed WFGD treatment process alternative of hydroxide plus polysulfide precipitation plus anoxic/anaerobic treatment EPA has proposed effluent total Se limitations of: daily maximum concentration = 16 ppb; monthly average concentration = 10 ppb.
6. Based on a review and analysis of prototype plant chemical precipitation plus anoxic/anaerobic process operating data it is concluded that the proposed effluent total Se limitations can be achieved with the following conditions: (i) an adequate start-up, commissioning period is allowed; (ii) sufficient equalization upstream of the biological process is provided to prevent significant changes in influent composition; (iii) adequate instrumentation and control of process operating conditions such as ORP and pH be provided, and (iv) skilled personnel are dedicated to the operation of the WFGD wastewater treatment plant.
7. The EPA proposed effluent total Hg limitations of daily maximum concentration = 242 ppt and monthly average concentration = 119 ppt can be readily achieved by either hydroxide precipitation + anoxic/anaerobic biological treatment or by hydroxide/sulfide precipitation + anoxic/anaerobic biological treatment.
8. The anoxic/anaerobic step of these process combinations will provide further significant reduction of the total Hg concentration over and above that achieved by a chemical precipitation step alone.
9. The effluent total Hg concentration achievable by anoxic/anaerobic biological treatment appears to be a function of the influent total Hg concentration over the approximate range of influent total Hg concentration from 1000 ppt to approximately 20 ppt. Below an influent total Hg concentration of approximately 20 ppt the effluent total Hg concentration does not decrease below the approximate range of 1-4 ppt.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4702-A7, Excerpt Numbers 1-6, 8, and 9.

Commenter Name: Thomas Cmar
Commenter Affiliation: Earthjustice, et al.
Document Control Number: EPA-HQ-OW-2009-0819-4702-A7
Comment Excerpt Number: 3
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Biological Se Removal Processes

There is a wide range of microorganisms that can reduce selenate and selenite to Se metal (Doran, 1982; Oremland, 1993). These microorganisms are widely distributed throughout the bacterial domain and present in environments that range from pristine to contaminated (Stoltz and Oremland, 1999). Significant and abrupt changes in the pH, temperature and salinity of the medium can disrupt selenate/selenite reduction to Se metal. (Steinberg and Oremland, 1998; Stoltz and Oremland, 1999; Zhang et al., 2003). Selenate and selenite reduction has variously been reported to occur in the pH range from 7.0 to 9.0 (Lortie et al., 1992; Wan et al., 2008). The temperature optimum for selenate/selenite reduction is 30oC (Fujita et al., 1997; Wan et al., 2008) although the ABMet® anaerobic biological Se removal process (GE Corporation, 2013) is guaranteed to perform in the temperature range from 5oC to 40oC (GE Power & Water, 2013).

Microbial oxidation/reduction reactions occur within specific ranges of oxidizing/reducing conditions. These ranges are defined by a parameter called the oxidation/reduction potential (ORP) which is expressed in millivolts (mV). High positive ORP values indicate highly oxidizing conditions and high negative ORP values indicate highly reducing conditions. ORP can be monitored with an inexpensive sensor known as an ORP meter. Selenate/selenite reduction to Se metal has been variously reported to occur in the approximate ORP ranges from +50 to -200 mV (Sandy and Disanti, 2010) and from -150 to -350 mV (Lau et al., 2012). WFGD wastewaters also contain nitrate. Since the ORP values required for selenate/selenite reduction to Se metal cannot be achieved in the presence of nitrate, it must be removed. This removal can be achieved biologically under anoxic conditions in the presence of a readily biodegradable organic substrate such as molasses.

The aforementioned Se conversions can be achieved by a variety of biological processes that include: (i) reduction of selenate and selenite to Se metal in variously-configured, anoxic/anaerobic reactors; (ii) algal/bacterial Se uptake in stabilization ponds and; (iii) Se uptake and biological reduction in constructed wetlands. Because, in all of these processes, the Se is incorporated in a solid phase the final step of the Se removal process is to remove, and safely dispose of, the Se-containing solids without allowing the release of the Se back into the dissolved state.

Comment Response:

EPA agrees with the commenter that the biological treatment of selenium is a proven process and that there are other alternative methods for selenium reduction that are available to the industry. EPA notes that the ELGs do not require facilities to implement the specific technologies that form the bases of the final limitations, but only that the appropriate effluent limitations and standards be achieved. Plants may find that these options may be able to achieve the limitations.

Commenter Name: Thomas Cmar
Commenter Affiliation: Earthjustice, et al.
Document Control Number: EPA-HQ-OW-2009-0819-4702-A7
Comment Excerpt Number: 6
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Summary of Prototype ABMet® System Total Se Removal Performance

The total Se removal performance of the three full-scale ABMet® biological Se removal processes operating on hydroxide chemically-precipitated WFGD wastewater (Allen and Belews Creek) and on hydroxide and polysulfide chemically-precipitated WFGD wastewater and leachate (NE USA Plant) demonstrates that the process will remove total Se to levels that comply with the EPA-proposed effluent limitations if the following conditions are present:

1. An adequate start-up/commissioning period should be allowed to provide for development of specific process control parameters and acclimation of biological processes. In the performance data that I reviewed, I observed that periods of up to approximately 7 months could be required for these purposes.
2. Sudden and/or large variations in the influent composition including total dissolved solids concentration, and Se concentration/loading to the biological process, due to, for example, changes in coal quality, in upstream treatment processes and in the mix of influent wastewaters treated, should be avoided. Most of the instances in which effluent total Se concentration exceeded the proposed EPA limitations could be associated with such variations. In order to ensure that this type of event does not occur, it will be necessary to provide adequate equalization capacity within and/or between the first-stage chemical precipitation process and the biological treatment stage. In addition to this equalization, it would be helpful to monitor the influent total Se concentrations in the wastewater leaving the first-stage chemical precipitation system.
3. Sudden large variations in the influent temperature to the anaerobic biological units should be avoided.
4. The full-scale total Se removal performance data suggest that tight process control is necessary to provide consistently low effluent total Se levels. To allow this it will be necessary to provide adequate sensing and control capabilities for parameters such as pH and ORP.

5. As is true for all types of biological wastewater treatment processes, the anoxic/anaerobic biological Se removal process will require skilled operation to produce a consistently compliant effluent quality.

Comment Response:

EPA acknowledges that there is a necessary commissioning period to optimize the operation of a plant's FGD wastewater treatment technology based on the anticipated variability in a plant's day-to-day operations and FGD wastewater characteristics. In EPA's cost methodology, EPA incorporated costs for additional instrumentation to allow for appropriate monitoring and control of the FGD wastewater characteristics entering treatment. See sections 6.1 and 6.2 of the *Incremental Costs and Pollutant Removals for the Final Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category* (Cost & Loads Report) (DCN SE05831/SE05832) for details on the design and costs associated with the components of the BAT basis. EPA also accounted for a commissioning period for the FGD wastewater treatment technology in the timing for implementation for the final rule. See preamble section XVI and 40 CFR 423.11(t).

EPA also agrees with the commenter that sufficient equalization is necessary to control sudden fluctuations in the FGD wastewater concentrations and to allow the biological system to see a more gradual increase in the concentrations.

Commenter Name: Thomas Cmar
Commenter Affiliation: Earthjustice, et al.
Document Control Number: EPA-HQ-OW-2009-0819-4702-A7
Comment Excerpt Number: 9
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Summary of Prototype ABMet® System Total Hg Removal Performance

1. The total Hg removal performance of the three full-scale ABMet® biological Se removal processes operating on chemically-precipitated WFGD wastewater demonstrates that it is possible for the process to remove total Hg to levels that are significantly lower than those achieved by hydroxide plus polysulfide precipitation. Under proper operating conditions, a plant operating hydroxide precipitation followed by the ABMet system would easily comply with the EPA-proposed effluent limitations.
2. There was no evidence that the use of a polysulfide precipitant in the chemical co-precipitation stage exerted any toxic effects on either the microorganisms in the biological treatment system or on the biota that might be present in the receiving waters.

3. Since the biological effluent total Hg concentration appears to be a function of the biological system influent total Hg concentration it is advantageous to provide as efficient an Hg removal as possible in the chemical precipitation stage.
4. The effluent total Hg results obtained by the combined chemical co- precipitation + ABMet® biological treatment process train suggest that it could well meet effluent total Hg limitations much lower than those proposed by EPA. This finding is in agreement with the statement made by EPA (TDD, 8-7) that "the amount of mercury and other pollutants removed by the biological treatment stage of the treatment system, above and beyond the amount of pollutants removed in the chemical precipitation treatment stage preceding the bioreactor, can be substantial."

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4702-A7, Excerpt Number 7. EPA agrees that the implementation of the biological treatment system will achieve additional mercury removal. See Section 11 of the *Incremental Costs and Pollutant Removals for the Final Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category* (Cost & Loads Report) (DCN SE05831/SE05832) for additional information on EPA's review of pollutant-specific treatment effectiveness.

Commenter Name: J. Madras
Commenter Affiliation: Missouri Department of Natural Resources
Document Control Number: EPA-HQ-OW-2009-0819-4383-A1
Comment Excerpt Number: 7
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

3. Biological Treatment

Biological treatment is included in the proposed options for FGD treatment. The average effluent pollutant concentrations for one-stage chemical precipitation systems with biological treatment, presented in Table 10-5 of the Technical Development Document, appear to be reasonable treatment targets. However, it is unclear whether biological treatment rises to the level of being the standard for a well-operated facility, justifying the inclusion as a BAT standard.

FGD wastewater composition can vary significantly from plant to plant. In the Department's limited review ofFGD and biological treatment, it appears the difference in Powder River Basin and Eastern Bituminous coals can affect the chemistry and operations of the treatment systems. Powder River Basin coal is largely burned at Missouri plants; however there are a number of plants that run a mix of Powder River Basin, Eastern Bituminous coal and a few that use tire derived fuel. The quantity and quality is affected by the size of the boiler, scrubber chloride concentrations, efficiency of fly ash removal, type and efficiency of the gypsum dewatering system, type of FGD process used, type ofNOx control, and composition of the coal, limestone and make-up water. This makes the use of biological treatment a challenge for facilities to achieve effluent limits under the proposed ELG.

Comment Response:

EPA agrees with the commenter that wastewater characteristics can vary due to a number of operating variables; however, EPA defines the BAT basis for FGD wastewater as chemical precipitation followed by biological treatment. Chemical precipitation has proven to be an effective technology for accommodating variable wastewater characteristics. See response to DCN EPA-HQ-OW-2009-0819-4448-A1, Excerpt Number 24 in Comment Code 9.a regarding chemical precipitation performance. See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107 regarding biological treatment performance and FGD wastewater variability.

Commenter Name: Thomas Cmar
Commenter Affiliation: Earthjustice, et al.
Document Control Number: EPA-HQ-OW-2009-0819-4684-A1
Comment Excerpt Number: 87
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Nor does the record support that plants operating different types of scrubbers will have difficulty meeting these standards. The effluent from forced oxidation scrubbers, like those at Belews Creek and Allen, contains a higher percentage of selenate as compared to selenite.[339] Selenate is harder to remove than selenite—therefore evaluating data from forced oxidation scrubbers provides a stringent test of the capability of the ABMet system.[340] Moreover, as EPA notes, most plants operating nat ural and inhibited oxidation sytems do not discharge FGD wastewater because they completely recycle or passively evaporate the water.[341] Therefore, the record supports EPA's conclusion that plants operating natural and inhibited oxidation scrubber systems will not have difficulty complying with the biological treatment option.

---

[339] TDD at 6-2 to 6-3.

[340] *Id.*

[341] *Id.*

Comment Response:

EPA agrees that selenate is more difficult to treat than selenite. Both selenate and selenite are treated through biological reduction of the compounds to elemental selenium, as described in GE's technical paper "ABMet: Setting the Standard for Selenium Removal" (IWC-10-18) (DCN SE02040).

EPA did not receive additional data through public comments from plants operating inhibited or natural oxidation systems and, therefore, cannot further evaluate the FGD wastewater characteristics from these systems. Based on the available data and on EPA's knowledge of the operation of inhibited and natural oxidation systems, EPA determined that the wastewater characteristics generated from this system fall within the range observed for forced oxidation systems. Also, see the response to DCN EPA-HQ-OW-2009-0819-4448-A1, Excerpt Number 24.

Commenter Name: Thomas Cmar
Commenter Affiliation: Earthjustice, et al.
Document Control Number: EPA-HQ-OW-2009-0819-4702-A7
Comment Excerpt Number: 2
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Selenium can be a pollutant of concern in the wastewaters associated with several industries, including: irrigated agriculture, mining and metals processing, petroleum refining, and electricity generation by coal-fired plants. The methods that have been used (prototype experience) and/or evaluated (laboratory or pilot plant experience) for Se removal from wastewaters have recently been summarized and reviewed by Sandy and DiSante (2010). A wide variety of chemical, physical and biological Se removal methods have been investigated. All of the biological methods rely on the anaerobic conversion of the "soluble," "oxidized" forms of Se (selenite and selenate) into its more "sparingly-soluble," "reduced" forms (most commonly Se metal). Alternatively, the more soluble oxidized forms of Se can be removed by incorporation into algal/plant/bacterial biomass.

Comment Response:

EPA agrees with the commenter that "anaerobic conversion" of selenium is most typical type of treatment used to remove selenium from wastewater.

Commenter Name: W. Creal
Commenter Affiliation: Michigan Department of Environmental Quality

Document Control Number: EPA-HQ-OW-2009-0819-5510-A2
Comment Excerpt Number: 5
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

In addition, although the USEPA states that data from the six facilities utilizing biological treatment does not support concerns over the sensitivity and unpredictable nature of biological treatment, Michigan is concerned that this evaluation may not have been sufficient to dismiss concerns about the inclusion of biological treatment as BAT. Biological treatment systems are known to be sensitive to fluctuations in wastewater flow, wastewater composition, and temperature. With the limited number of steam electric power facilities utilizing biological treatment for treatment of FGD wastewater, Michigan is not sure that all of the potential variables related to different fuel sources, daily variations in fuel blends, capacity utilization rates, the FGD operations, and concerns with colder temperatures have been sufficiently evaluated.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107.

Commenter Name: Thomas Cmar
Commenter Affiliation: Earthjustice, et al.
Document Control Number: EPA-HQ-OW-2009-0819-4684-A1
Comment Excerpt Number: 86
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Plants burning a lower-sulfur, lower-chlorine coal will have FGD wastewater purges that are lower in concentrations of metals and other constituents (such as chlorides) that would affect the bioreactor.

Comment Response:

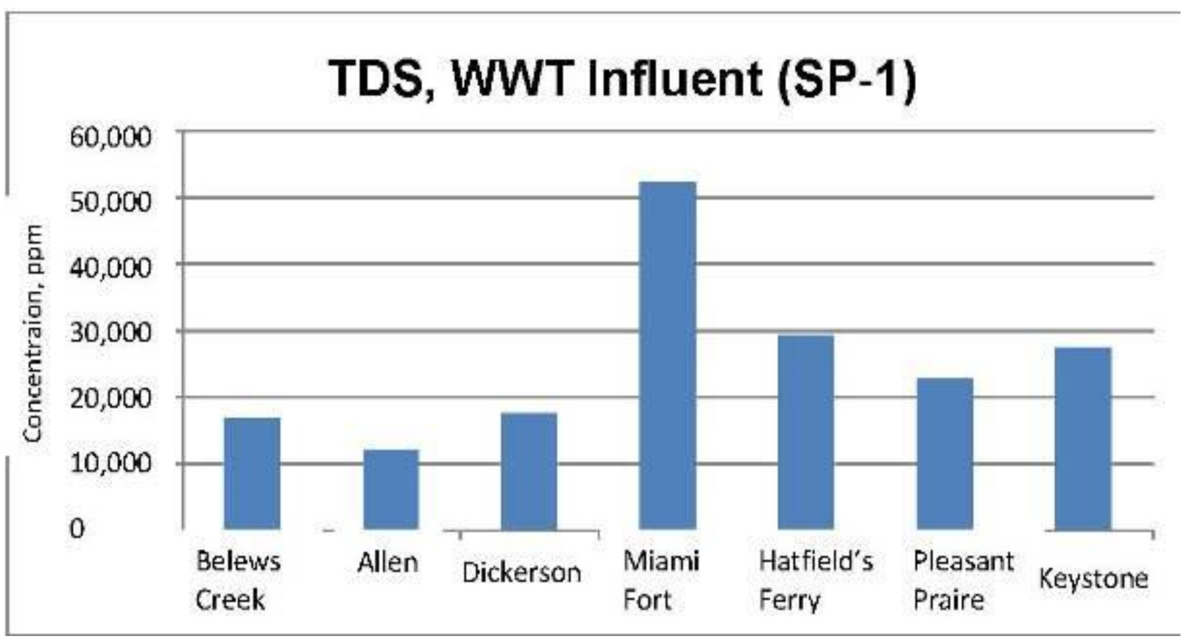
EPA disagrees with the commenter that "[p]lants burning a lower-sulfur, lower-chlorine coal will have FGD wastewater purges that are lower in concentrations of metals and other constituents." The type of coal is not the only variable that affects the FGD wastewater characteristics and, therefore, this generalization may not always be the case, even if it is true for certain plants. Regarding biological treatment performance and FGD wastewater variability, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107.

Commenter Name: Chris M. Hobson
Commenter Affiliation: Southern Company
Document Control Number: EPA-HQ-OW-2009-0819-4379-A1
Comment Excerpt Number: 56
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

The two plants EPA used for assessment of chemical precipitation plus biological treatment – Duke's Belews Creek and Allen facilities – have influents with very low levels of total dissolved solids (TDS). It is very unlikely that other plants with FGD systems will be able to consistently meet the proposed limits derived from Allen and Belews Creek effluent data only. *See* Figure 3 below for a comparison of the influents from the seven sampling program plants. The TDS levels for Belews Creek and Allen are lower than any of the other sampled plants.

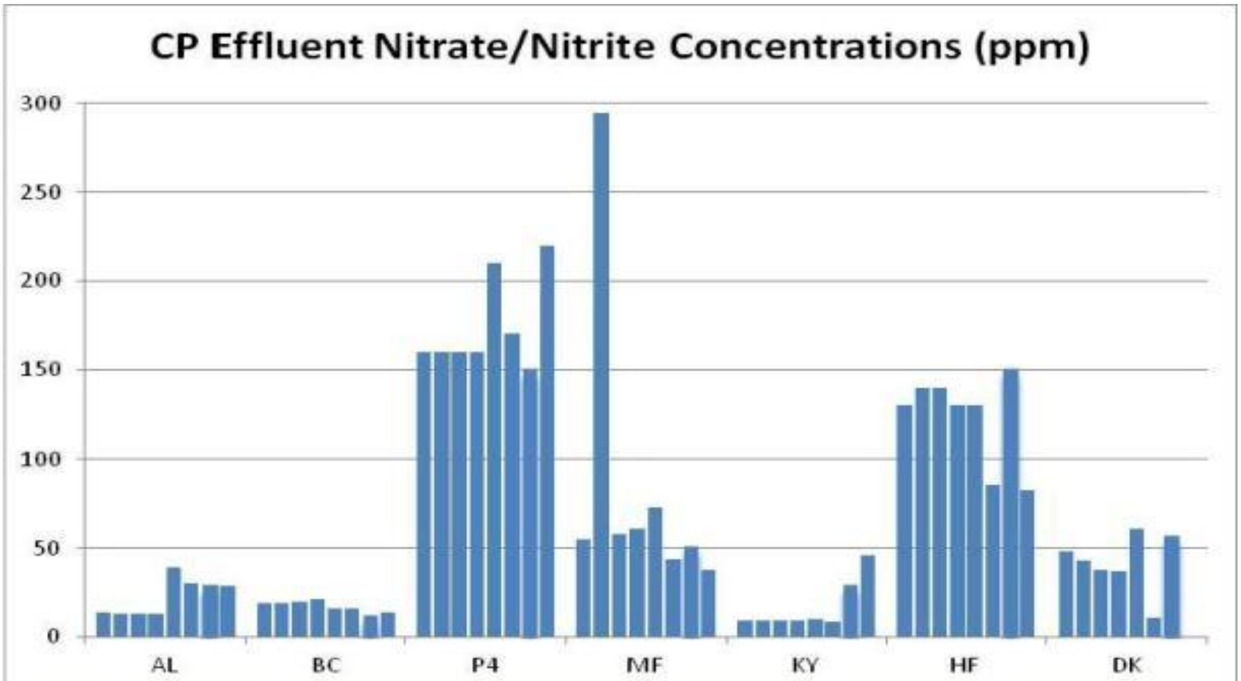
Figure 3: Comparison of TDS Levels in FGD Influent of the Seven Facilities Sampled by EPA



Also, Belews Creek and Allen have lower nitrate/nitrite-N levels than Dickerson, Miami Fort, Hatfield's Ferry, and Pleasant Prairie. Hatfield's Ferry, Miami Fort and Pleasant Prairie have nitrate/nitrite-N influent levels that are greater than the 100 mg/L design specification for the GE ABMet biological treatment system. EPA's own sampling data show that nitrate/nitrate-N concentrations vary greatly between plants. The chemical precipitation effluent for these plants range from <10 to 300 mg/L. (EPA Sampling Episode Reports). Figure 4 below shows the nitrate/nitrite-N concentrations for both the 4-day and the monthly sampling events.

Belews Creek and Allen biological treatment systems target selenium removal but not nitrogen removal. EPA has not evaluated any biological treatment systems that optimize both selenium and nitrate/nitrite removal, and in particular, treatment systems that receive higher selenium *and* higher nitrate/nitrite levels.

Figure 4: Nitrate/Nitrite-N Levels in Treated Chemical Precipitation Effluent for the Seven Plants EPA Sampled



Comment Response:

Regarding biological treatment system performance and FGD wastewater variability, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107.

Regarding the treatment of FGD wastewater with high nitrate/nitrite concentrations, see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 44 in Comment Code 10.b.

10.b. FGD Bio – Costs

Commenter Name: David Y. Chung
Commenter Affiliation: Homer City Generation, L.P
Document Control Number: EPA-HQ-OW-2009-0819-5552-A2
Comment Excerpt Number: 6
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

C. EPA's Proposed Limits For FGD Wastewater Are Not Economically Feasible

Although EPA has discretion to impose ELGs even when costs outweigh benefits, EPA must nevertheless ensure that the "BAT determination remains economically feasible for the industry as a whole." *Texas Oil & Gas Ass'n v. EPA*, 161 F.3d 923, 936 (5th Cir. 1998); *see also* 67 Fed. Reg. 64,216, 64,233 (Oct. 17, 2002) (concluding that a proposed option was not BAT for the iron and steel manufacturing point source category because that option "is not economically achievable" and could result in "two closures and 500 job losses"). EPA must also weigh whether it is feasible to retrofit existing plants in light of the age of those plants. *See Am. Iron & Steel Inst. v. EPA*, 526 F.2d 1027, 1048 (3d Cir. 1975) ("Where we believe the Administrator erred, however, was in his failure to consider age as it had a bearing on the cost or feasibility of retrofitting plants."). The record for EPA's proposed rule does not demonstrate that it would be feasible for the industry, particularly for older plants such as the Homer City Generating Station, to treat FGD wastewater by chemical precipitation combined with biological treatment down to EPA's proposed limits. Thus, EPA should propose new limits using a more robust data set. Because such new limits are likely to deviate significantly from those in the proposed rule, EPA should allow for additional review and comment on those limits.

EPA's analysis of the feasibility of biological treatment rests on data from two Duke Energy plants (Allen and Belews Creek) that burn similar coals and have similar influent characteristics. *See* EPA-HQ-OW-2009-0819-1953 at Section 7. In particular, the nitrate-nitrite influent for these plants is quite low, which makes it easier for those plants to meet both the proposed nitrate-nitrite and selenium limits. *See id.* at Section 7.3.2 (Allen: mean of 22.5 mg/L and maximum of 39.0 mg/L; Belews Creek: mean of 17.1 mg/L and maximum of 21.0 mg/L). At other plants, where nitrate-nitrite influents are much higher, additional treatment will be required prior to selenium removal; otherwise, the bacteria in the biological treatment system will primarily lower nitrate-nitrite levels, but not selenium. Specifically, at Homer City, the nitrate-nitrite influents are considerably higher (from 2004 to 2013: mean of 162 mg/L; maximum of 440 mg/L) than those at Allen and Belews Creek, which will make it much more costly to treat down to 10 ppb selenium.[3] Moreover, to help illustrate the unreasonableness of EPA's proposed limit for selenium, Homer City's existing NPDES permit contains a water quality-based effluent limitation for selenium of *800 ppb*. Accordingly, the selenium limits proposed by EPA are not even necessary to protect water quality. This observation is likely true at other power stations across the country that have influents that are more difficult to treat than those at Allen and Belews Creek.

Moreover, EPA assumes that because the biological treatment system that forms the basis for its proposed limits reduces both selenate and selenite to its elemental form, the form of selenium present in the FGD wastewater does not impact the removals achieved by the preferred regulatory options. However, the use of organic acid additives creates organic/unknown speciated selenium compounds and nitrogen species in the FGD wastewater. These species are not as amendable to biological treatment.

---

[3]According to EPA's data, the nitrate/nitrite influent to the FGD wastewater treatment system at the Pleasant Prairie appears comparably high (four-day average of 158 mg/L). *See* EPA-HQ-OW-2009-0819-0758, at 4-3. Such high levels may make the proposed selenium and nitrate/nitrite limits unachievable.

Comment Response:

EPA determined that the selected option for the final rule is technologically available and economically achievable. See the preamble and RIA for the final rule for more details on EPA's determination that the ELGs are economically achievable. In addition, EPA did consider the age of facilities when considering whether subcategorization would be appropriate and found that establishing different requirements based on the age of the facility or generating units at a facility was not warranted. See response to DCN EPA-HQ-OW-2009-0819-4670-A2, Excerpt Number 2.

EPA received additional data as a result of the public comment period and incorporated it into its calculation of the effluent limitations for the final rule, as appropriate. EPA disagrees that just because it used additional data to supplement its dataset for the final rule that a new notice and comment period is warranted. The public was on notice of EPA's criteria for selecting data for use in the final rule, as well as EPA's methodology for calculating the final limitations. *BASF Wyandotte Corp. v. EPA*, 598 F.2d 637, 644-646 (1st Cir. 1979) ("It is perfectly predictable that new data will come in during the comment period, either submitted by the public with comments or collected by the agency in a continuing effort to give the regulations a more accurate foundation. The agency should be encouraged to use such information in its final calculations without thereby risking the requirement of a new comment period."); *Am. Coke & Coal Chems. Inst. v. EPA*, 452 F.3d 930 (D.C. Cir. 2006); *Chem. Mfrs. Ass'n v. EPA*, 870 F.2d 177, 202 (5th Cir. 1989) ("EPA's use of the updated and expanded . . . data base was a logical and reasonable development based on industry comments and as such did not require further notice and comment."). See response to DCN EPA-HQ-OW-2009-0819-4448-A1, Excerpt Number 6.

Regarding the feasibility of biological treatment and meeting the selenium and nitrate/nitrite limitations, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107 and DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 58. In addition, see the response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 44 regarding the costs associated with high nitrate/nitrite levels. For the Homer City Generating Station, EPA estimated costs for a denitrification system to implement the BAT option. Some plants have opted to implement technologies more advanced than the combination of chemical precipitation and biological treatment, such as the evaporation technology that is the basis for the NSPS and the voluntary incentives program BAT requirements established by the ELGs. Additionally, other plants have decided to implement processes that completely eliminate the discharge of FGD wastewater, such as using the wastewater from a wet scrubber as the makeup water for a dry scrubber.

EPA evaluated data for the various forms of selenium present in FGD wastewater and found that the combination of chemical precipitation and biological treatment effectively removes all forms. Some species are more effectively treated by chemical precipitation and others by biological treatment. No species of selenium were found to not be effectively removed by the BAT technology.

See response to DCN EPA-HQ-OW-2009-0819-4305-A3, Excerpt Number 61 in Comment Code 6.c regarding the difference between categorical technology-based standards versus water-quality based standards.

Commenter Name: David Y. Chung
Commenter Affiliation: Homer City Generation, L.P
Document Control Number: EPA-HQ-OW-2009-0819-5552-A2
Comment Excerpt Number: 8
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

In light of the foregoing concerns, EPA must reconsider its proposed FGD wastewater limits and adopt a standard that is economically feasible. In reconsidering the technological availability and economic achievability of its proposed FGD limits, EPA must take into account the magnitude and complexity of process changes and new equipment installations that would be required at facilities to meet the requirements of the rule. *See, e.g., Am. Iron & Steel Inst.*, 526 F.2d at 1048.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 44. Based on the results of the Steam Electric Survey, which collected detailed technical and financial data for every coal-fired plant in the country and similar data for a subset of all other steam electric power plants, EPA considered the existing conditions at every power plant estimated to incur costs to implement the ELGs and evaluated the specific changes that would likely occur to implement the BAT technologies. This information was used to determine the technological availability of the BAT technologies and estimate the compliance costs for each plant. That information, in turn, was used in EPA's assessment of economic achievability. As explained in preamble section VIII, EPA determined that the final rule is technologically available, economically achievable, and has acceptable non-water quality environmental impacts.

Commenter Name: Paul Chu
Commenter Affiliation: Electric Power Research Institute (EPRI)
Document Control Number: EPA-HQ-OW-2009-0819-4499-A1
Comment Excerpt Number: 30
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

3.2 EPA underestimated the cost of biological treatment for the industry. As with its chemical precipitation treatment estimates, the Agency did not incorporate all the cost factors necessary to extrapolate from vendor equipment costs to total installed costs.

EPRI reviewed EPA's cost estimates for biological treatment and identified departures from standard practices similar to those made in estimating chemical precipitation treatment costs. The major differences between estimates made by EPA and EPRI include the following:

- The cost factors used to calculate a total installed cost from the vendor purchased equipment estimates are underestimated by EPA. Standard industry practice for developing budgetary cost estimates uses cost factors that are more typical of an engineering estimate; these engineering cost factors should be used.
- A contingency for miscellaneous unidentified costs was not included by EPA. EPRI applied a 20% contingency to its estimate, which is standard industry practice for the class of estimates appropriate for the limited design/definition work at this stage.
- The mean, instead of the median, should be used when applying capacity factors to calculate peak flow rate from average flow rate. The mean is statistically appropriate, as the flow rates are used to calculate plant-specific costs which are then summed to calculate an industry total.
- EPA's use of reduced FGD wastewater flow rates, calculated for plants with discharge flow rates greater than 1,000 gallons per minute (gpm), is likely to be incorrect. The evaluation EPA performed was incomplete and did not take into account additional costs beyond the cost of recycle conveyance. As an example, if wastewater flow rates were set to minimize fine particulates, reducing the flow rate would require other investments, such as treatment to remove these fine solids, to mitigate the possibility of line pluggage and other impacts of higher fines concentrations.

Comment Response:

In response to comments, EPA recalculated its direct and indirect capital cost factors for the final rule. These revised cost factors are consistent with typical engineering factors in accordance with standard engineering practice.

<u>Direct capital cost factor</u>

Regarding the direct capital cost factor for the chemical precipitation portion of the system, see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 24 in Comment Code 9.b.

Regarding the direct capital cost factor for the biological portion of the system, EPA determined that the installation cost factor used during proposal is higher than the 8% installation factor used by the commenter. EPA's final rule is based on the installation cost factor used at proposal, rather than the commenter's lower suggested cost factor. EPA did, however, add the "tie-in allowance" cost factor of 5% after determining that this allowance was not included in the vendor estimates.

Regarding the heat exchanger included at certain plants, EPA used essentially the same direct capital cost factor that is being used for the chemical precipitation system, as the more standard cost factors can be applied to the heat exchanger installation. Section 6.2.5.6 of the *Incremental Costs and Pollutant Removals for the Final Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category* (Cost & Loads Report) (DCN SE05831/SE05832) report contains additional details on the direct capital cost factors.

<u>Indirect capital cost factor</u>

Indirect capital costs include costs for engineering, construction, other contractor's fees and contingency.

For the final rule, as recommended by the commenter, EPA derived its indirect capital cost factor from typical engineering factors. EPA developed an indirect capital cost factor of 0.43, which accounts for engineering and supervision, construction expenses, contractor's fee, and contingency, based on information provided in Peters and Timmerhaus' *Plant Design and Economics for Chemical Engineers.* Section 6.2.5.7 (Indirect Capital Cost) of the *Incremental Costs and Pollutant Removals for the Final Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category* (Cost & Loads Report) (DCN SE05831/SE05832) contains additional information.

Regarding use of median versus mean flows for capacity factor, see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 26 in Comment Code 9.b.

Regarding reduced FGD wastewater flow rates for certain plants, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 102 in Comment Code 8.

Commenter Name: Paul Chu
Commenter Affiliation: Electric Power Research Institute (EPRI)
Document Control Number: EPA-HQ-OW-2009-0819-4499-A1
Comment Excerpt Number: 105
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

A.2Cost Estimating Summary for Biological Treatment of Flue Gas Desulfurization Wastewater

A.2.1*Summary*

The Electric Power Research Institute (EPRI) estimated the cost of biological treatment of flue gas desulfurization (FGD) wastewater to the steam electric industry. This technical memorandum describes the method for calculation of costs of biological treatment for an individual plant, the assumptions associated with the cost calculations, and the estimated costs for biological treatment to the steam electric industry. Table A-8 outlines the cost to the current industry for the cost of biological treatment (excluding required chemical precipitation pretreatment), and the total cost of biological treatment for the industry including required chemical precipitation pretreatment.

Table A-8
Biological Treatment Costs to Industry for FGD Wastewater

Industry	Capital Cost ($M)	Operations and Maintenance Cost ($M per year)	Annualized Cost ($M per year)
Incremental biological cost	2,018	73	263
Biological treatment cost including physical/chemical pretreatment	7,088	203	872

Annualized cost based on 20-year equipment life and 7% interest rate.
$ = U.S. dollars
M = million

EPRI used a different cost curve supplied by General Electric Power & Water (GE) than EPA. EPRI obtained a confidential cost curve from GE. Since EPA's cost curves are also confidential, the two estimates cannot be compared to evaluate the differences between them.

A.2.2 *Introduction*

The U.S. Environmental Protection Agency (EPA) is updating the Steam Electric Power Generating effluent limitation guidelines (ELGs) through a comprehensive information collection request (ICR) and sampling at FGD wastewater treatment systems. EPRI estimated the costs of three FGD wastewater treatment technologies for commenting on EPA's draft ELG rule. The treatment technologies evaluated were (1) chemical precipitation, (2) biological, and (3) chemical precipitation with vapor-compression evaporation/atmospheric crystallization (CP + VCE). The technologies are discussed in separate Appendices A.1 through A.3. The cost evaluation results were extrapolated industry-wide.

A.2.3 *Biological Treatment Overview*

The biological treatment system used to evaluate costs for the industry consists of a heat exchanger for water cooling and an Advanced Biological Metals Removal Process (ABMet®) system. The treatment train for the ABMet® system consists of an anoxic/anaerobic biological reactor and a nutrient feed system. The bioreactor is filled with granular activated carbon (GAC), which provides a growth medium for microbes. Microbial growth is supported by nutrients added through feed water, and by an additional substrate in case the feed water does not have sufficient amounts or kinds of nutrients. A backwash water supply tank is also provided. It is assumed that backwashed solids are handled and dewatered as part of an upstream physical/chemical treatment process, so the cost for dewatering equipment is not included in the incremental cost estimate for biological treatment.

Considering practices used at several full-scale FGD wastewater systems currently in service, a heat exchanger will be needed to cool the FGD wastewater prior to entry into the ABMet® system for some plants. To estimate costs for the industry, EPRI assumed that 38 plants will require heat exchangers, based on EPA's geographical analysis. Figure A-2 shows a block flow diagram of the biological treatment process.

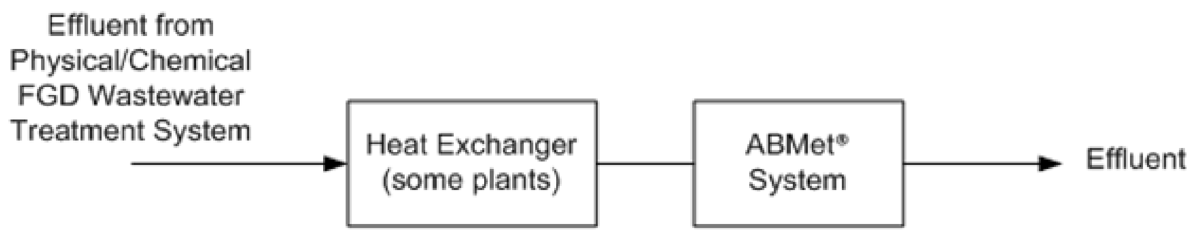


Figure A-2
Biological Wastewater Treatment System

The biological treatment system requires pretreatment achievable with a chemical precipitation FGD wastewater treatment system. Figure A-3 shows the typical physical/chemical treatment plant that would precede the biological treatment system. The physical/chemical treatment system consists of the following unit processes: equalization, desaturation, chemical addition to enhance metals removal, clarification, neutralization, media filtration, and solids dewatering. The assumptions regarding development of chemical precipitation treatment system costs are provided in Appendix A.1.

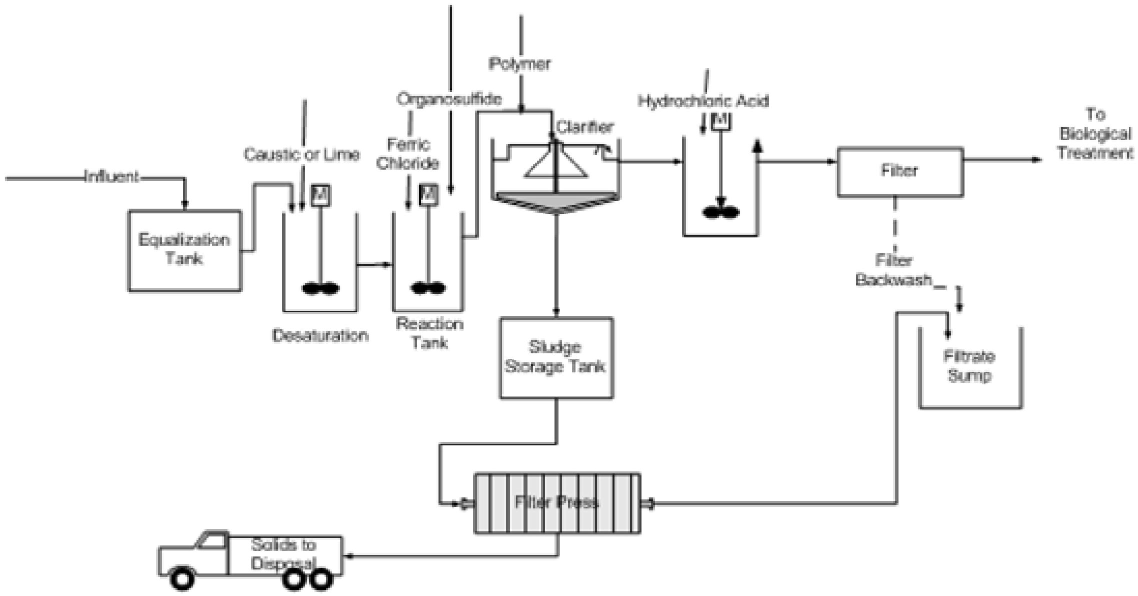


Figure A-3
Process Flow Diagram for Chemical Precipitation Treatment System

A.2.4 *Conceptual Design Basis*

The design basis for the cost estimate is described in this section.

A.2.4.1 Flow Rate Basis

Flow rate assumptions are presented in Appendix A.1.

A.2.4.2 Feed Water Quality Characteristics

Chemical precipitation treatment occurs before FGD solids enter the ABMet® system. This pretreatment reduces influent total suspended solids (TSS) to less than 30 milligrams per liter (mg/L). The temperature of the FGD wastewater chemical precipitation treatment system effluent must be less than 105 degrees Fahrenheit (°F).

GE provided EPRI with the following feed water quality requirements for influent to the ABMet® system:

- Feed TSS – less than 30 mg/L
- Feed chlorides – 10,000 to 25,000 mg/L
- Feed temperature – 50 °F to 105 °F
- Feed pH – 6 to 7.5
- Feed oxidation reduction potential (ORP) – Less than +300 millivolts (mV)
- Feed nitrate – 20 to 100 mg/L

- Feed total selenium (Se) – 1 to 8 mg/L (oxidized forms only [Se(VI) and Se(IV)], no reduced species [selenocyanate])

A.2.4.3 Effluent Water Quality Characteristics

GE provided the following water quality characteristics expected for effluent from the ABMet® system:

- Effluent total selenium – less than 0.01 mg/L
- Effluent nitrate – less than 1 mg/L, which is greater than the proposed ELG limitation for nitrate (0.13 mg/L average monthly and 0.17 mg/L daily maximum).

A.2.5 *Cost Development Methods*

A.2.5.1 Equipment Cost Assumptions

A.2.5.1.1 ABMet® System

GE provided the cost curve based on wastewater flow rate (in $US/gallons per minute [gpm]) to estimate capital costs of the ABMet® system. The cost curve is intended to provide a representative budgetary value only, within the constraints of the design basis specified in this memorandum. The cost curve was provided by GE in October 2012 and extrapolated to June 2010 pricing. Many variables can dramatically influence the cost, such as geography, differences in water chemistry, effluent requirements, client equipment specifications, alternative project structure, unionized versus non-unionized labor, site geotechnical profile, and inflation. The cost curve represents average conditions across the industry.

EPRI compared the cost curves generated by EPRI with the available information provided by EPA in the appendices of *Incremental Costs and Pollutant Removals for the Proposed Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category* [EPA, 2013]. EPRI also reviewed the available design assumptions presented in the appendices of this document.

GE provided the following assumptions about plant design, project execution, and geography:

- Plant location is suitable for outdoor bioreactor installation, and freeze protection i s incorporated for piping
- Contractor labor is unionized
- No special seismic or wind loading criteria are incorporated
- Soil bearing capacity is greater than 3,000 pounds per square foot
- Costs are based on executing the project as a consortium between GE and the contractor, with balance-of-plant engineering provided as a subcontract to the consortium
- The ABMet® system is an "island"; integration into the full power plant system (for example, distributed control system [DCS] interfaces, tie-in with existing wastewater plant, etc.) is not included in the GE cost, but is included in the cost model adders

- The ABMet® system is integrated into the larger wastewater facility; for example, the system is installed downstream of the conventional physical/chemical treatment, and backwash waste is recycled to the conventional system for solids removal

A.2.5.1.1.1 Scope of Costs

The following equipment and components are included in the ABMet® system cost provided by GE:

- All process pumps, valves, and instruments
- Process and instrument compressed air system, valves, and lines
- Nutrient system, storage tank, and pumping
- Compressed instrument and control air system
- All process piping and supports within the ABMet® island
- Process equipment building (block structure with steel roof and concrete floor); heating, ventilation, and air conditioning
- Fiberglass reinforced plastic (FRP) pre-fabricated bioreactor tanks (for systems less than 500 gpm)
- FRP pre-fabricated backwash supply and backwash waste tanks (for systems less than 500 gpm)
- Concrete bioreactor tank walls and floor with epoxy-coated rebar and epoxy flake-glass coating (for systems greater than 500 gpm)
- Concrete backwash supply and backwash waste tank walls and floor with epoxy-coated rebar and epoxy flake-glass coating (for systems greater than 500 gpm)
- Concrete process and utility sump with pumps
- Support steel, access stairs, walkways, grating, and handrails
- System motor control center (MCC) with variable frequency drives (VFDs)
- Programmable logic controller (PLC)-based control system, including hardware and software
- Interconnecting electrical within ABMet® island
- Engineering, commissioning, and project management labor for ABMet® island
- Construction equipment, materials, and labor for ABMet® island
- Insurance to include builder's risk, commercial liability, and worker's compensation for scope of project only
- Permitting support
- Equipment warranty (18 months from delivery or 12 months from start-up, whichever comes first)
- Effluent performance guarantee through defined test period following start-up

A.2.5.1.1.2 *Omissions*

The following items are not included in the costs provided by GE:

- Owner overhead and labor

- Plant tie-in/integration (for example, DCS interface, feed water to ABMet® boundary, effluent water line from boundary limits to discharge)
- Insurance (unless noted)
- Bonds
- Environmental and other permits and approvals by permitting authorities having jurisdiction for installation of the treatment plant
- Financing charges
- Other wastewater processes such as pre- or post-treatment, dewatering
- Backwash waste disposal/solids handling
- Preparing the treatment plant site so it is "pad ready," meaning graded and level with direct access from roadway
- Geotechnical investigation report
- Determining that soil bearing capacity is equal to or greater than 3,000 pounds per square foot with 1 inch or less of settlement
- Supports such as pilings and caissons
- Temporary roadways, construction employee parking, and laydown area adjacent to the treatment plant location
- Temporary service water for use during construction
- Lube oils after first fill
- Disposal and change of chemicals and lube oil following first fill
- Performance test analytical testing

A.2.5.1.2 Heat Exchanger

The chlorides level of the physical/chemical treatment plant effluent may be as high as 25,000 mg/L; therefore, it is assumed that specialized construction materials are required for the heat exchanger, which is a shell-and-tube type with welded tubes made of titanium that resists high chlorides levels.

A.2.6 ***Capital Cost Assumptions***

A.2.6.1 *Classification of Estimate*

For capital cost assumptions, see Appendix A.1.6.

GE stated that the level of accuracy of the cost curve it provided is +30 percent/-20 percent. Considering the addition of the heat exchanger equipment and lack of site-specific conditions to determine how the system will be integrated into a plant, the project definition falls within the range of a Class 4 estimate for the biological treatment alternative. These estimates were prepared to guide evaluation of the technology, and are based solely on the information available at the time of the estimate. Actual final costs will depend on the actual labor and material costs, competitive market conditions, site conditions, final project scope, implementation schedule, and other variable factors.

A.2.6.2 Cost Model Factors

System-wide cost factors were applied to develop the cost estimate (Table A-9).

Table A-9
Model Cost Factors

Additional Cost Items	Typical Suggested Range (%)		Value Used (%)	Rationale for Selected Value
Site work	3	5	1	Assumes ABMet island will be co-located with physical/chemical treatment plant. Site will be made "pad ready" as required by GE.
Concrete	15	20	–	Concrete for the ABMet island is included in GE cost.
Piping	6	8	–	Piping for the ABMet island is included in GE cost. Other piping included with tie-in allowance.
Miscellaneous metals, finishes	5	15	–	GE cost curve provides miscellaneous metals costs for items within ABMet island. Items outside of ABMet island are covered by tie-in allowance.
Mechanical, heating/ventilation/air conditioning	5	10	–	GE cost curve provides building, HVAC.
Electrical	14	30	10	Applied to heat exchanger cost only, lower than typical range due to lack of motorized equipment.
Instrumentation and control	10	20	10	Applied to heat exchanger cost only.
General contractor general conditions	11	14	5	Used lower number as majority of equipment is ABMet island.

Additional Cost Items	Typical Suggested Range (%)		Value Used (%)	Rationale for Selected Value
Tie-in/Integration			5	This includes items such as integrating ABMet controls into the plant DCS and SCADA; pipe interconnections; and extending power, control wires, and piping to the ABMet island.
Bonding and insurance	2.70	3	2	GE provides some insurance as part of its cost curve: builder's risk, commercial liability, and worker's compensation for scope of project only.
General contractor profit	14.10	14.40	12	Used lower number, as majority of equipment is ABMet island.
Miscellaneous unidentified cost	10	30	20	Contingency of 20 percent is consistent with a Class 4 estimate
Engineering (tie-ins and heat exchanger only)	15	25	20	Engineering for heat exchanger & tie-ins only provided. Other engineering provided as part of GE cost curve.

ABMet = Advanced Biological Metals Removal Process
DCS = distributed control system
GE = General Electric
HVAC = heating, ventilation, and air conditioning
SCADA = supervisory control and data acquisition

A.2.6.3 Major Assumptions

The following additional assumptions were made:

- A tie-in/integration allowance of 5 percent of total equipment cost (this includes such items as integrating ABMet controls into the plant DCS and SCADA; pipe interconnections; and extending power, control wires, and piping to the ABMet island).
- Costs are presented in June 2010 dollars. Construction Cost Index values, as published by Engineering News Record (ENR), were used to escalate costs to June 2010 pricing.
- A physical/chemical wastewater treatment system will be used upstream of the biological treatment system for TSS removal and has been excluded from the estimate for incremental biological costs.
- Post-treatment after ABMet® system, such as an aeration tank to increase the dissolved oxygen from zero (0) to potential discharge limit of > 3.0 mg/L, is not included.
- The biological treatment system will be co-located with the physical/chemical treatment system.
- Materials resistant to high chloride concentrations will be needed for treatment equipment.
- Installation cost estimates (for heat exchanger only) are based on national averages. Installed cost is provided by GE for the ABMet® system.
- Freight cost will be 4 percent of the installed equipment cost.
- No costs were included to provide cold weather protection for equipment installed outdoors (for example, heat tracing [except freeze protection for piping], insulation), installation of new utility services, new site development (for example, significant

excavation), or installation in areas of limited footprint or remote locations involving delivery issues. These types of cost factors would increase cost estimates for the biological treatment system.
- Project will be sales-tax exempt.

A.2.7 *Operations and Maintenance Costs Assumptions*

A.2.7.1 Cost Elements

O&M requirements for this estimate include the following cost elements:

- Chemicals
- Electricity
- Residuals disposal
- Equipment maintenance
- Labor
- Compliance monitoring

A.2.7.2 Major Assumptions

The major assumptions used in calculating these estimated O&M costs were:

- Costs are presented in June 2010 dollars. Construction Cost Index values, as published by Engineering News Record (ENR), were used to escalate costs to June 2010 pricing.
- Labor: a total of 2.5 full-time equivalents (FTE) operators at $42/hour to account for extra labor associated with operation of the biological treatment system.
- Treatment system operates 90% of the time.
- All solids will be Resource Conservation and Recovery Act (RCRA) nonhazardous solids with a disposal unit cost of $17.10 per wet ton. The disposal cost was developed as a weighted average using on-site and off-site disposal costs provided in *Incremental Costs and Pollutant Removals for the Proposed Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category* [EPA, 2013]. EPRI assumed 75 percent of plants would use on-site disposal facilities at $40.41 per dry ton, and 25 percent of plants would use off-site disposal facilities at $49.82 per dry ton. EPRI assumed 40 percent solids to convert to a wet ton basis.
- Chemical and energy costs were based on the estimate provided by GE of $0.3/1,000 gallons.
- Annual equipment maintenance costs will be 3 percent of the total installed equipment costs for the facility.
- Biological treatment system will operate 24 hours per day, year-round. It is estimated that the biological treatment system will be off-line 10 percent of the time, due to scheduled outages and other plant-related events.
- Compliance monitoring costs include costs for sampling and analysis of FGD wastewater effluent discharge.

A.2.8 ***Example Cost Estimate***

The cost estimate for biological treatment for an example system with peak design flow rate of 300 gpm and n+1 redundancy is provided in the following subsections.

A.2.8.1 Capital Costs

An example worksheet that shows the total estimated capital costs for a 300-gpm biological treatment is provided in Table A-10. The equipment costs are based on cost curves provided by the equipment vendors. The cost model factors shown in Table A-9 are then added to the purchased equipment cost to obtain a total estimated capital cost for the system.

Table A-10
Summary of Estimated Incremental Biological Treatment Capital Costs for a 300-Gallons-per-Minute System

Cost Element	Biological Treatment ($)
GE ABMet system (from cost curve) (Escalated from October 2012 to June 2010 Pricing)	10,393,000
Support equipment	
Heat exchanger (Escalated from October 2012 to June 2010 Pricing)	162,000
Freight (4%) and taxes (0%)	426,000
Subtotal – Purchased Support Equipment Cost as Delivered	**162,000**
Subtotal – Purchased Equipment Cost as Delivered	**10,554,000**
Additional cost items	
Site work	110,000
Piping	0
Mechanical/HVAC	0
I&C (applied to heat exchanger only)	17,000
Electrical (applied to heat exchanger only)	17,000
Concrete	0
Miscellaneous metals, finishes	0
Tie-in allowance	549,000
General contractor general conditions	584,000
Bonding and insurance	233,000
Engineering (tie-ins and heat exchanger only)	142,000
Subtotal – Direct Costs	**12,629,000**
General contractor profit	1,515,000
Subtotal	**14,144,000**

Cost Element	Biological Treatment ($)
Miscellaneous unidentified cost	2,829,000
Subtotal – Estimated Construction Cost	**16,973,000**
Permitting	83,000
Total Estimated Capital Cost ($M)	**17**
Total Estimated Capital Cost ($M) +50%	**26**
Total Estimated Capital Cost ($M) –30%	**12**

$ = U.S. dollars
M = million
HVAC = heating, ventilation, and air conditioning
I&C = Instrumentation and controls

A.2.8.2 Operations and Maintenance Costs and Quantities

The total estimated O&M costs for biological treatment for a 300-gpm treatment system are provided in Table A-11.

Table A-11
Summary of Incremental Biological Treatment Annual Operations and Maintenance Costs for a 300-Gallons-per-Minute System

Cost Element	Quantity	Cost ($)	Assumptions
Energy and chemicals (1000 gallons per year)	157,680	47,300	$0.3 per 1,000 gallons
Residuals, non-hazardous on-site landfill disposal (tons)	109	1,871	$17.10 per wet ton (assumes 40 percent solids). All wastes are assumed to be RCRA nonhazardous solids. Assume TSS = 30 mg/L; nitrate-N = 100 mg/L; influent Se = 8 mg/L
Maintenance		316,636	3% of total installed equipment cost
Labor (FTEs)	2.5	218,400	$42 per hour for operator
Total Estimated O&M Cost ($M per year)		**0.5**	

Plant is on-line 90 percent of the time; factor applied to energy, chemicals, residuals, maintenance
$ = U.S. dollars
M = milion
FTE = full time equivalent
mg/L = milligrams per liter
RCRA = Resource Conservation and Recovery Act
Se = selenium
TSS = total suspended solids

A.2.8.3 Annualized Costs

Capital cost estimates (Table A-10) and O&M cost estimates (Table A-11) were used to calculate total annualized costs for biological treatment. Capital costs were annualized assuming an equipment lifetime of 20 years and 7 percent interest rate. As an example, using these values, the annualized cost for a 300 gpm n+1 redundancy system is $2.1 million per year.

A.2.9 *Industry Cost Extrapolation*

Industry costs were estimated for the current industry. Assumptions used to develop the list of 116 plants for industry extrapolation are presented in Appendix A.1.9.

The following additional assumptions were made to estimate the cost of biological treatment to the industry:

- Of the 116 plants identified for the industry extrapolation, plants that had either biological treatment or VCE treatment already installed in their facility were not included in the cost calculation. EPA identified five plants with existing biological systems, and one plant with existing VCE. This evaluation assumed that those six plants would continue to use their existing treatment systems, so costs were not included for these systems. Cost of pond closure was not included in the cost calculation for facilities that currently have FGD wastewater ponds installed.
- A total of 38 plants include costs for heat exchangers. Heat exchanger costs were applied to plants in the geographic area outlined by EPA as requiring heat exchangers [EPA, 2013].

Table A-12 summarizes biological treatment costs to the current industry. This estimate indicates incremental cost for biological treatment only and cost of physical/chemical pretreatment and biological treatment.

Table A-12
Biological Treatment Costs to Industry for FGD Wastewater

Industry	Capital Cost ($M)	Operations and Maintenance Cost ($M per year)	Annualized Cost ($M per year)
Incremental biological cost	2,018	73	263
Biological treatment cost including physical/chemical pretreatment	7,088	203	872

Annualized cost based on 20-year equipment life and 7% interest rate.
$ = U.S. dollars
M = million

Comment Response:

The absence of cost curves due to the presence of CBI prevents EPA from comparing the differences between EPA's costs and the commenter's costs for the biological treatment system. Section 6.2 of the *Incremental Costs and Pollutant Removals for the Final Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category* (Cost & Loads Report) (DCN SE05831/SE05832) contains information on the cost components included in the cost curves GE provided in its purchased equipment and installed cost curves, which EPA used to estimate costs for the biological treatment system. EPA included additional costs on top of the biological treatment system to account for plants that may operate in extreme cold and hot weather conditions.

Commenter Name: Paul Chu
Commenter Affiliation: Electric Power Research Institute (EPRI)
Document Control Number: EPA-HQ-OW-2009-0819-4499-A1
Comment Excerpt Number: 44
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

3.5.2 *Sites with high (greater than 100 mg/L) influent nitrate/nitrite levels may incur additional capital and operating costs to meet EPA's proposed nitrate/nitrite limits.*

EPA did not evaluate any biological treatment system that optimizes both selenium and nitrate/nitrite removal. The two systems evaluated, Belews Creek and Allen, are optimized for selenium removal and produce ancillary nitrogen removal as a precursor to selenium removal. However, both of these systems have low selenium and nitrate/nitrite concentrations in their influent. EPA presents no data on selenium or nitrogen removal levels achieved in biological treatment systems that receive higher (greater than 100 mg/L) influent concentrations of selenium and nitrogen.

Belews Creek and Allen have very similar influents, and thus do not capture the true variability of FGD wastewater within the industry. Influent nitrate/nitrite concentrations varied widely among facilities where EPA conducted sampling (Figure 3-3). Influent nitrate/nitrite levels at the Belews Creek and Allen facilities are low in comparison to the other sites tested. Figure 3-3 shows nitrate/nitrite levels of up to 290 mg/L based on EPA sampling or CWA 308 plant monitoring [EPA, 2012a–g].

In correspondence to EPRI, GE Power & Water has stated that the cost curves EPRI used in its estimate are based on a maximum 100 mg/L influent nitrate in the FGD wastewater [GE, 2012]. Thus, sites with higher influent nitrate concentrations may incur additional capital cost due to the need for pretreatment facilities and increased reactor sizing. These sites may also experience increased O&M costs in meeting the selenium and nitrite/nitrate limit. Adding these costs would further increase the overall industry cost, as well as impact the cost/benefit assessment for biological treatment.

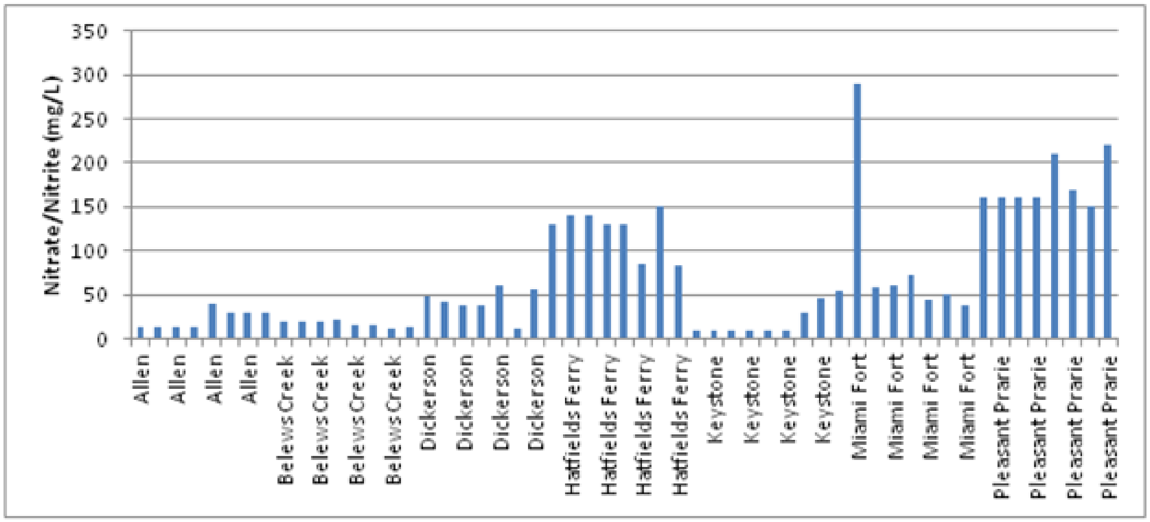


Figure 3-3
Influent Nitrate/Nitrite Data for EPA Sites
Source: EPA 2012a – EPA 2012g

Comment Response:

The commenter asserts that "[t]he two systems evaluated, Belews Creek and Allen, are optimized for selenium removal and produce ancillary nitrogen removal as a precursor to selenium removal." However, EPA finds that even if these two systems were not necessarily "optimized" for nitrate/nitrite removal, the systems demonstrate significant removal of the pollutant. In fact, for the biological treatment technology to effectively remove selenium it must remove nitrate-nitrite. The data for these two plants, as well as data for AEP's Mountaineer plant and a pilot study at IPL Petersburg, all demonstrate that the biological treatment technology effectively removes nitrate-nitrite to levels below the final effluent limitations.

EPA determined that selenium and nitrate-nitrite are effectively treated by the chemical precipitation plus biological treatment BAT basis. The biological treatment system design (i.e., its treatment capacity as determined by factors including the expected pollutant loads and effective bed contact time of the bioreactor) that EPA used to estimate compliance costs is based on a maximum 100 mg/L influent nitrate-nitrite as N concentration. Higher levels of influent nitrate-nitrite could be accommodated by a larger bioreactor, but it is usually more economical to employ a traditional denitrification step as part of the treatment system to reduce the nitrate-nitrite concentrations below 100 mg/L prior to the wastewater entering the bioreactor. EPA included cost estimates in the final rule for plants identified as exceeding 100 mg/L influent nitrate/nitrite as N to install and operate a denitrification system downstream of the chemical precipitation system and upstream of the anoxic/anaerobic biological treatment system. Section 6.2.1 of the *Incremental Costs and Pollutant Removals for the Final Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category* (Cost

& Loads Report) (DCN SE05831/SE05832) contains further information on the costs estimated for denitrification systems.

Regarding operation of the biological treatment system and high nitrate/nitrite (as N) concentrations and variability in FGD wastewater see response to DCN EPA-HQ-OW-2009-0819-4655 excerpt 107 in Comment Code 10.a. Also see DCN SE05846 (memorandum *Variability in Flue Gas Desulfurization Wastewater: Monitoring and Response*).

Commenter Name: Patrick O'Loughlin
Commenter Affiliation: Buckeye Power, Inc.
Document Control Number: EPA-HQ-OW-2009-0819-4183-A2
Comment Excerpt Number: 4
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

In conjunction with its FGD emissions control system construction project, Buckeye Power installed state-of-the-art wastewater treatment systems at a cost of approximately $45 million. However, Buckeye Power has concluded that its modern treatment plant will not be able to consistently achieve the proposed effluent standards. To do so, Buckeye Power would be required to upgrade its treatment plants at a cost of approximately $35 million - a cost that is not justified by the incremental additional amount of metals and nitrate/nitrite removal.

Comment Response:

EPA commends Buckeye Power for installing FGD wastewater treatment systems beyond just a settling pond. However, EPA determined that the chemical precipitation followed by biological treatment system is the best available technology economically achievable for control of pollutants in discharges of FGD wastewater (for units greater than 50 MW and that are not oil-fired) and, therefore, an upgrade to the commenter's treatment system may be needed to meet the final BAT limitations. EPA determined that the BAT basis is technologically available and economically achievable. See preamble section VIII for an explanation of the rationale for EPA's selection of the BAT basis. For the role of cost-effectiveness in EPA's decisions for the final rule, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 27 in Comment Code 6.h.

Commenter Name: Paul Chu
Commenter Affiliation: Electric Power Research Institute (EPRI)
Document Control Number: EPA-HQ-OW-2009-0819-4499-A1
Comment Excerpt Number: 46

External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

3.5.4 *The cost of biological treatment is likely underestimated by not considering post-treatment for any facilities.*

Anaerobic biological treatment, which EPA defines as Best Available Technology Economically Achievable (BAT), has effluent residual carbon from overfeeding bacteria on carbon food sources to ensure effective treatment. This effluent residual organic carbon will create biochemical oxygen demand (BOD). Some facilities that discharge their FGD wastewater to a receiving water body will need to aerate the biological treatment system effluent to meet BOD limits. In some applications, post-treatment—such as the use of a pond (for example, at Allen and Belews Creek) or a moving bed bioreactor—may be necessary to raise dissolved oxygen levels within the effluent so that the effluent discharged into a receiving water body is anoxic. Neither EPA nor EPRI included post-treatment cost in calculating industry cost. However, post-treatment will be required by some facilities, so the cost of this additional treatment should be considered when calculating the cost of biological treatment for the industry. Additional study would be needed to assess which plants might require post-treatment to add this cost to the total industry cost estimate.

Table 3-8 provides an example total estimated capital and operating costs for post-treatment using a moving bed bioreactor for a 300 gpm system. The costs are only for the addition of post-treatment to an existing biological treatment plant.

Table 3-8
Cost of Adding Post-Treatment (Moving Bed Bioreactor) to an Existing 300 gpm Biological Treatment Plant

	Total Installed Capital Costs ($)	Operating Costs ($ per year)
Post-treatment for biological system	870,000	5,000

$ = U.S. dollars

Comment Response:

Regarding the commenter's assertion that "[s]ome facilities that discharge their FGD wastewater to a receiving water body will need to aerate the biological treatment system effluent to meet BOD limits," EPA notes that the BOD in the biological treatment system effluent from the Allen and Belews Creek plants are lower than the BOD levels in the chemical precipitation effluent. As such, EPA determined that the biological treatment system does not result in an increase of the BOD to levels that would require additional treatment. In addition, EPA notes that the biological system is designed to periodically backwash the granular filter media, which acts to control the level of biomass in the system. Plants experiencing problems with high levels of biomass (detected as BOD or COD) could increase the frequency and/or duration of their backwash. After backwashing, the excess BOD is removed in the chemical precipitation system and collected with the other treatment solids, not discharged to a receiving water body.

Regarding dissolved oxygen, commenters on the proposed rule did not provide any data associated with the dissolved oxygen levels in the effluent from the biological treatment system. EPA notes that plants may choose to send their FGD wastewater into impoundments or commingle the wastewater after treatment to raise the dissolved oxygen levels, if needed. Plants already typically commingle their FGD wastewater with other wastewater streams prior to discharge. Furthermore, EPA did not identify any plants that treat FGD wastewater with biological treatment systems that have needed to take steps to raise the dissolved oxygen levels in their discharge.

Commenter Name: Paul Chu
Commenter Affiliation: Electric Power Research Institute (EPRI)
Document Control Number: EPA-HQ-OW-2009-0819-4499-A1
Comment Excerpt Number: 43
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

3.5.1 *Treatment costs for selenium may be underestimated for those facilities with high influent selenium concentrations.*

Coagulation and physical separation are used as part of the chemical precipitation process to remove particulate selenium. Anaerobic biological treatment is used as the technical basis to remove dissolved selenium. Figure 3-2 shows that the fraction or split of particulate and dissolved selenium (as compared with total selenium) within a facility varies widely among plants. The fraction of dissolved selenium is critical, as this is the more challenging fraction to treat. The fraction of dissolved selenium also varies widely between plants, and at a given facility over time. Based on the long-term self-monitoring data that EPA received from Belews Creek, the average total selenium concentration in the FGD purge stream is 5,676 µg/L but the influent dissolved selenium concentration is 542 µg/L. Various sites shown in Figure 3-2 [EPRI, 2010a] have influent dissolved selenium concentrations that are much greater than the average Belews Creek dissolved selenium levels.

In correspondence with EPRI, GE Power & Water has stated that the cost curves EPRI used in its estimate are based on a maximum of 8,000 µg/L influent selenium in the FGD wastewater [GE, 2012]. Thus, sites with higher influent selenium concentrations may incur additional capital cost due to the need for pretreatment facilities and increased reactor sizing. These sites may also experience increased O&M costs in meeting the selenium limit. Adding these costs would impact the cost-effectivenss assessment for biological treatment.

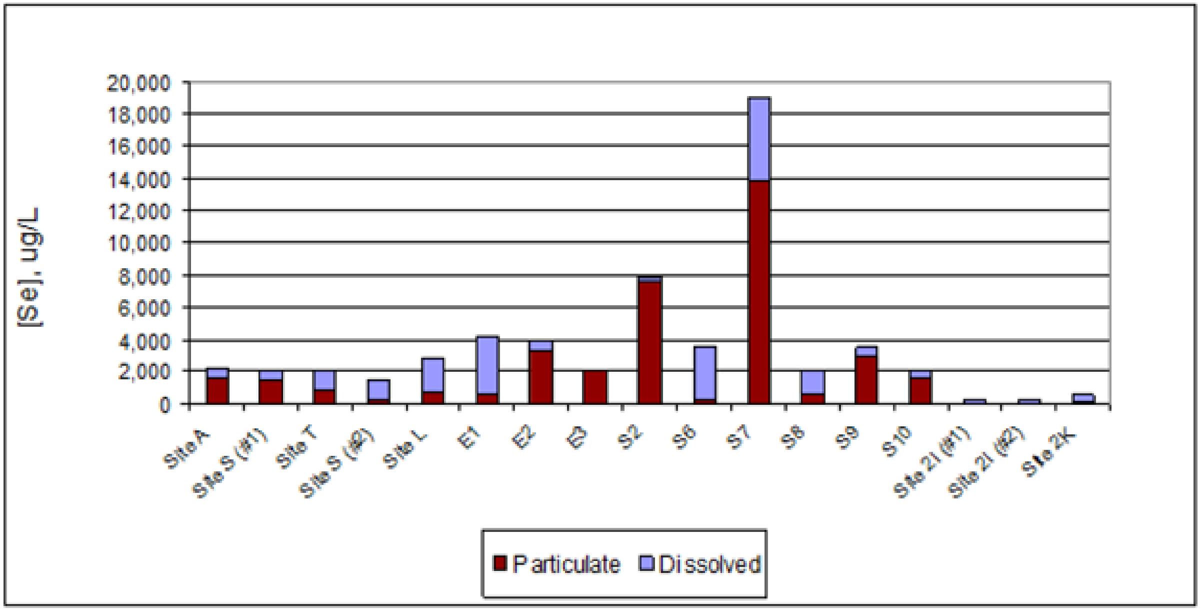
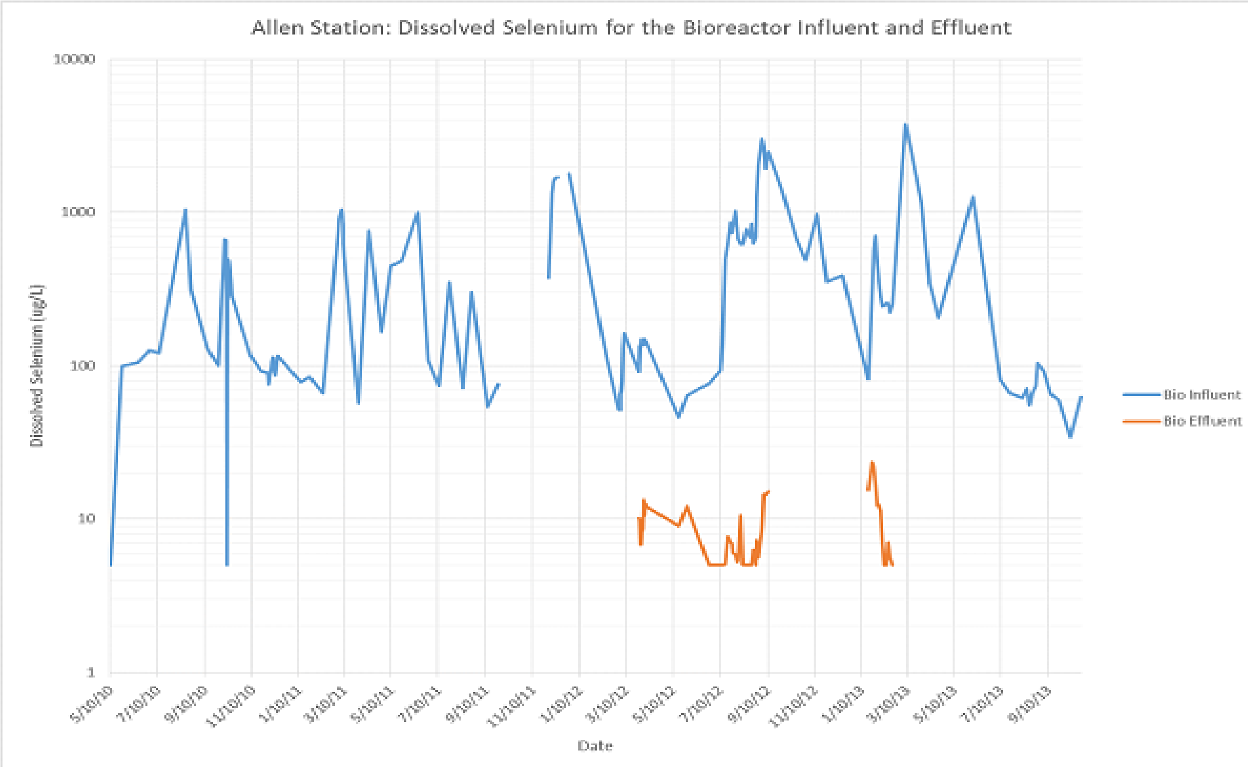
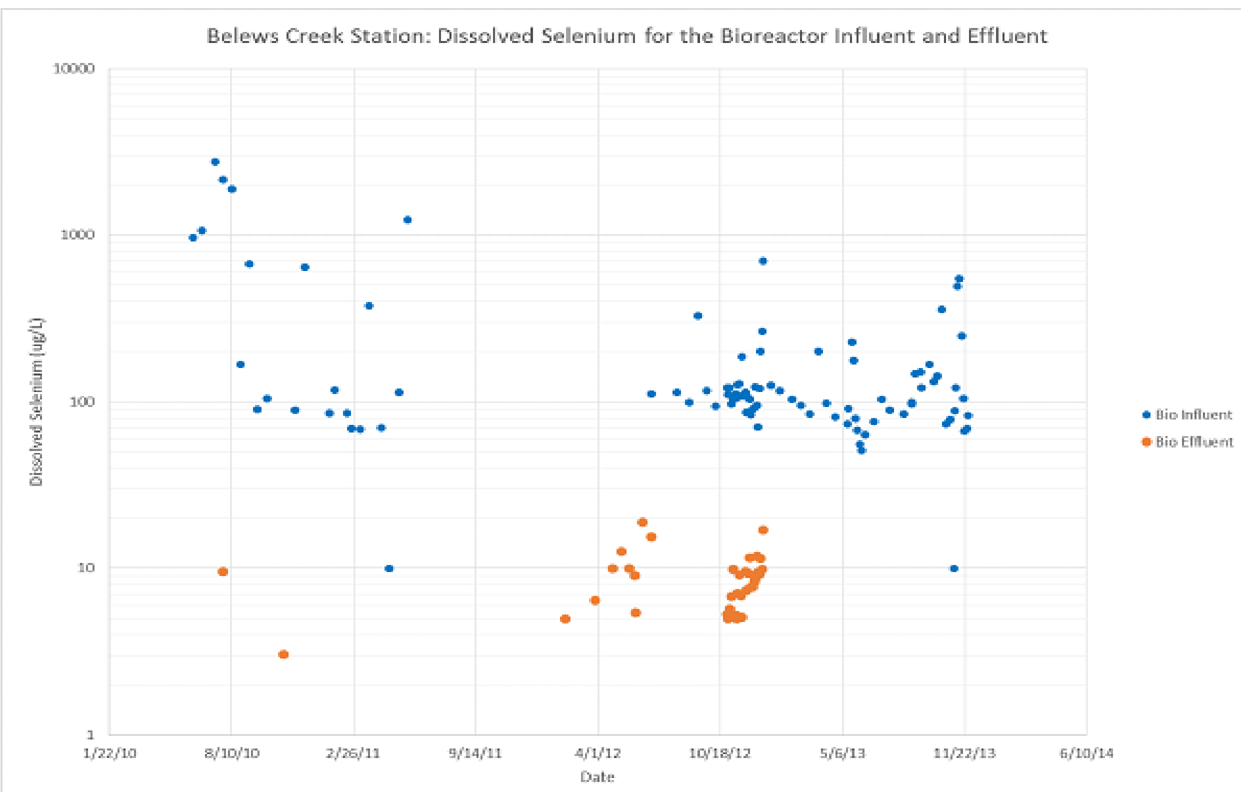


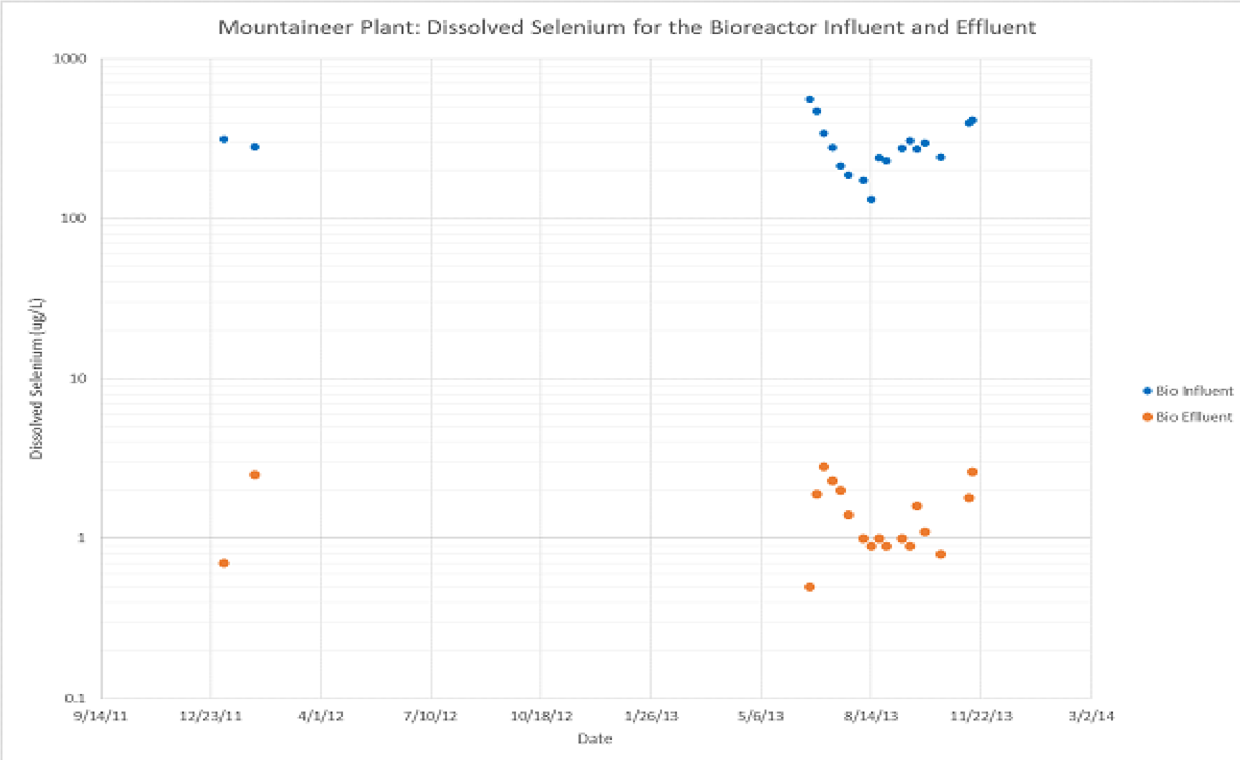
Figure 3-2
Comparison of Particulate and Dissolved Selenium in FGD Wastewater Influent
Source: EPRI, 2010a.

Comment Response:

EPA partially agrees with the commenter that dissolved selenium is "the more challenging fraction to treat." EPA agrees that the dissolved selenium is difficult to treat in a chemical precipitation system; however, EPA disagrees with the commenter that dissolved selenium is difficult to treat in the biological treatment system. EPA's record demonstrates that the biological treatment system component of the BAT basis is capable of treating both total and dissolved fractions of selenium. See the data in the plots below showing the removal of dissolved selenium across the bioreactor. These data were submitted in March 2014 by Duke Energy for Allen and Belews Creek Stations, and by AEP for the Mountaineer Plant (dissolved selenium for the bioreactor influent and effluent is shown on the plots below). See also Earthjustice's comment on the achievability of dissolved selenium treatment in DCN EPA-HQ-OW-2009-0819-4702-A7, Excerpt Number 3 in Comment Code 10.a.


Allen Station: Dissolved Selenium for the Bioreactor Influent and Effluent
Dissolved Selenium (ug/L)
10000
1000
100
10
1
5/10/10
7/10/10
9/10/10
11/10/10
1/10/11
3/10/11
5/10/11
7/10/11
9/10/11
11/10/11
1/10/12
3/10/12
5/10/12
7/10/12
9/10/12
11/10/12
1/10/13
3/10/13
5/10/13
7/10/13
9/10/13
Date
Bio Influent
Bio Effluent


Belews Creek Station: Dissolved Selenium for the Bioreactor Influent and Effluent
Dissolved Selenium (ug/L)
10000
1000
100
10
1
1/22/10
8/10/10
2/26/11
9/14/11
4/1/12
10/18/12
5/6/13
11/22/13
6/10/14
Date
Bio Influent
Bio Effluent



EPA acknowledges that the EPA's design basis for the biological treatment system is based on a projected influent selenium concentration. Plants that consistently have higher selenium concentrations in the bioreactor influent (i.e., the chemical precipitation effluent, not the FGD purge, is the selenium concentration that matters for the bioreactor design) may need a larger bioreactor capacity which could cost somewhat more than EPA estimated; however, plants with lower selenium would actually be able to install a smaller bioreactor which could cost less than EPA estimated. The data in the record shows that most plants would have lower selenium levels in the bioreactor influent than the levels used as the basis for EPA's cost estimate. In fact, the table of data presented here by the commenter shows that only 1 of the 17 plants had total selenium concentrations <u>in the FGD purge</u> higher than 8,000 mg/L, and most plants were much lower concentrations. Furthermore, a portion of the selenium (i.e., a portion of the selenite) will be removed in the chemical precipitation stage, reducing the amount of total selenium entering the bioreactor. The commenter states that the "fraction of dissolved selenium is critical, as this is the more challenging fraction to treat." The table presented by the commenter shows that the dissolved selenium is no higher than 5,000 mg/L at any of the plants, and is much less than that at nearly every plant. EPA also notes that all of the plants included in EPA's sampling program had chemical precipitation effluent concentrations that are below 4,000 ppb of total selenium (excluding the one data point from Pleasant Prairie at 14,000 ppb that was associated with start-up of the system). As such, those plants would not be expected to need larger bioreactors. The commenter provides no information to identify which plants would need larger bioreactors and, therefore, EPA did not revise its costing approach, which is reasonable based on information in the record.

Commenter Name: Jerry Purvis
Commenter Affiliation: East Kentucky Power Cooperative, Inc. (EKPC)
Document Control Number: EPA-HQ-OW-2009-0819-4455-A1
Comment Excerpt Number: 3
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

With respect to smaller coal-fired utilities, EKPC contends that EPA's finding that the preferred BAT options that would require biological treatment in addition to chemical precipitation are economically achievable is unreasonable. First, the average cost[1] that EPA estimated for a coal-fired power plant to install chemical precipitation plus biological treatment for FGD wastewaters is $12.5 million in capital, with $1.7 million per year in operating and maintenance ("O&M") costs.[2] The average FGD wastewater flow of the facilities considered by EPA in this analysis was 0.559 mgd. Similarly, in the administrative record relating to the draft Merrimack Station NPDES Permit, EPA provided an estimated capital cost of $20 million for physical/chemical treatment followed by a biological treatment unit for an FGD with a flow of approximately 0.35 mgd. For an FGD with 2.1 mgd of flow, EPA estimated capital costs for such a treatment system of $35 million.

EKPC performed preliminary engineering estimates to evaluate the cost of installing physical/chemical treatment followed by biological treatment of the pulverized coal units for the two wet FGD's at EKPC's Spurlock Station. The combined FGD wastewater flow at this station is approximately 0.475 mgd. The goal of the preliminary design was to achieve the proposed BAT effluent limits for FGD wastewater under preferred Options 3 and 4a. The estimated range of capital costs for the physical/chemical treatment unit followed by a biological treatment unit at Spurlock Station is approximately $60 to $75 million. Actual costs may vary within this range dependent upon unknown cost impacts such as separation of wastewater streams to treat streams prior to co-mingling, added cost expected to obtain commercial guarantees for effluent constituent reductions, and insufficient market capacity to supply physical/chemical plus biological treatment systems at all stations that would need to meet the preferred Options 3 and 4a requirements. This is more than four to six times higher than the average costs estimated by EPA for the industry despite the fact that the estimated FGD wastewater flows at Spurlock are lower than the average flows considered by EPA (0.475 mgd and 0.559 mgd respectively). Accordingly, on a total cost basis, it appears EPA has substantially underestimated capital costs of preferred Options 3 and 4a that would establish BAT for FGD wastewaters based upon chemical precipitation and biological treatment. Obviously, these higher capital costs indicate EPA has underestimated the plant-level economic achievability of the proposed BAT limits for FGD wastewater under Options 3 and 4a in its cost-to-revenue analysis. See "Regulatory Impact Analysis for the Proposed Effluent Limitation Guidelines and Standards for the Steam Electric Power Generating Point Source Category," EPA-821-R-13-005 (April 2013) (hereinafter "Regulatory Impact Analysis") at Pages 4-3 to 4-4.

Accordingly, for smaller coal-fired utilities, such as Spurlock Station, the proposed rule does not support the economic achievability of the most stringent of the preferred regulatory options that would require biological treatment of FGD wastewater.[3]

---

1 Average cost calculated based on the values for total industry costs and number of plants presented in Table 9-3 of the Technical Development Document for the Proposed ELGs (April 2013).

2 Many of the parameters used by EPA's model for estimating the costs for facilities covered by the proposed ELG and the results for individual stations contain Confidential Business Information ("CBI") and therefore are not included in the Docket. As a result, it is difficult to evaluate the methodology utilized by EPA for estimating capital costs, but as set forth below, EKPC's estimated capital costs for a physical/chemical precipitation unit, followed by a biological treatment unit, are over 100% higher than the estimated costs relied upon by EPA.

3 EKPC believes it was appropriate for EPA not to consider cost recovery from ratepayers in its cost-to-revenue analysis. Any argument that increased costs can simply be recovered from ratepayers to render any treatment option feasible from a cost standpoint is misplaced . Given all of the upward pressures on electric rates related to environmental programs, such as the Clean Air Act, and the difficult economic climate, any assumption that low-income ratepayers can afford substantially higher rates would ignore reality. For example, the U .S. Conference of Mayors has notified EPA that rising municipal wastewater rates due to other Clean Water Act programs are already unaffordable to many low-income ratepayers. See, *e.g.,* Attachments 1 and 2. The same is true with respect to rising electricity rates. Additionally, rising electric rates can result in industries moving operations to other states or countries or simply closing their doors.

Comment Response:

The commenter did not provide specific enough information regarding its own cost estimates associated the chemical precipitation and biological treatment system for EPA to evaluate whether any revisions to EPA's compliance cost estimates would be appropriate. However, EPA has revised costs to include contingency costs that account for the "unknown cost impacts" for implementing the BAT technology. Section 6.2 of the *Incremental Costs and Pollutant Removals for the Final Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category* (Cost & Loads Report) (DCN SE05831/SE05832) contains more information on EPA's cost estimates associated with biological treatment. Additionally, EPA's record demonstrates that the market availability of anaerobic/anoxic fixed film bioreactors is sufficient to supply steam electric power plants with the BAT technology. See section V.C. of the preamble for a discussion on the advancement of technologies.

See response to DCN EPA-HQ-OW-2009-0819-4607-A1, Excerpt Number 13 in Comment Code 10.a regarding the market availability of biological treatment systems. Also see the response to DCN EPA-HQ-OW-2009-0819-5552-A2, Excerpt Number 7.

Regarding EPA's approach with respect to consideration of cost recovery from ratepayers in the cost-to-revenue analysis, see the RIA. EPA does not agree that the ELGs are not economically achievable for small entities, nor for small-sized plants. See the preamble and the RIA for a discussion and results for EPA's economic analyses.

Commenter Name: Chris M. Hobson
Commenter Affiliation: Southern Company
Document Control Number: EPA-HQ-OW-2009-0819-4379-A1
Comment Excerpt Number: 128
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Costs of FGD Wastewater Treatment

EPA's preferred options vary as to FGD technology options. Option 3a calls for "best professional judgment" (BPJ) determinations for FGD wastewater. Options 3 and 4a are based on chemical precipitation plus biological treatment for plants with a scrubbed capacity greater than 50 MWs. And Option 3b would require chemical precipitation and biological treatment for plants with a scrubbed capacity greater than or equal to 2,000 MWs, and BPJ determinations for facilities with less than 2,000 MWs scrubbed capacity.

Comparing EPA's estimated plant-specific costs (2010$) to Southern's reveals that EPA has badly underestimated the costs of compliance for FGD wastewater treatment. For example, for options 3 and 4a, under which all coal-fired facilities generating FGD wastewater would have to meet limits that are designed on the basis of chemical precipitation plus biological treatment, Georgia Power would need to add treatment to Plants Bowen, Hammond, Scherer and Wansley. The table below compares the cost estimates generated by EPA and by Southern for chemical precipitation and biological treatment at these plants.

Comparison of EPA's and Southern's Total Capital Cost Estimates for Retrofitting Chemical Precipitation Plus Biological Treatment at Georgia Power

Plant	Nameplate MWs Scrubbed	EPA Estimate (2010), M$	Southern Estimate (2010) M$	Southern In-Service Estimate, M$
Bowen	3,160	$43	$163	$208
Hammond	800	$14	$105	$134
Scherer	3,272	$7.5	$70	$89

Wansley	1,730	$33	$140	$178

The key difference between Southern's and EPA's capital costs for FGD wastewater treatment is that several major cost elements were omitted from EPA's estimates. First, EPA did not include most of the BOP costs, such as concrete, piping, miscellaneous metals and finishes, HVAC, electrical, or instrumentation and control. Second, EPA did not include any costs for profits and overheads for contractors and subcontractors and underestimated the engineering overhead costs. And third, EPA does not include any contingency for unidentified costs even though EPA's cost estimates are screening level costs at best. The information provided in the 2013 TDD and the IC&PR regarding estimating wastewater technologies is not detailed enough to identify other differences between EPA's and Southern's estimates. However, Southern is convinced its estimates, which are based on thorough research over several years by a team of experienced engineers is much more accurate.

In fact, the capital costs to retrofit chemical precipitation plus biological treatment for all wet scrubbed Southern facilities that discharge FGD wastewater are orders of magnitude higher than what EPA estimates for the same plants. Southern estimates that its total capital costs would be up to $1.7 billion for retrofitting, in 2010 dollars, while EPA estimates only $253 million.[58] This significant difference is further compounded because EPA's total costs include treatment at Yates 1-7 and Branch 1-4, while Southern's estimates do not include these units. This omission is due to the scheduled retirement of Branch 1-4 and Yates 1-5 as well as a planned gas conversion at Yates 6-7. Even with EPA's inclusion of Yates and Branch, Southern's estimate is still almost four times EPA's estimate for the same technology.

EPA did not supply to Southern its estimates of costs for chemical precipitation alone at Southern facilities. However, we suspect that those estimates would suffer from the same deficits demonstrated above. We believe it very likely that EPA has underestimated Southern's costs and the industry's costs for application of chemical precipitation for FGD wastewater treatment across the board.

---

[58] Southern summed EPA's plant-specific costs for chemical precipitation plus biological treatment for each of its plants to arrive at a total of $253 million. Southern obtained EPA's estimates for this treatment option from its e-mail request to EPA of June 23, 2013 for certain plant-specific information in the ELG record.

Comment Response:

EPA revised its cost estimates with respect to cost factors. For changes made to the chemical precipitation cost estimates, see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 24 in Comment Code 9.b. For changes made to the biological treatment system cost estimates, see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 30. Additionally, details regarding EPA's cost methodology are described in Sections 6.1 and 6.2 of the *Incremental Costs and Pollutant Removals for the Final Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category* (Cost & Loads Report) (DCN SE05831/SE05832).

Regarding the commenter's assertion that "EPA did not include any costs for profits and overheads for contractors and subcontractors and underestimated the engineering overhead costs," EPA's cost estimates include an indirect capital cost factor equal to 43 percent of the direct capital costs. This indirect capital cost factor was developed based on information from Peters and Timmerhaus' *Plant Design and Economics for Chemical Engineers* to represent costs associated with engineering and supervision, construction expenses, contractor's fees, and contingency. EPA reasonably assumed that "costs for profits and overheads for contractors and subcontractors" were accounted for in the contractor's fees included in the indirect capital cost factor.

Commenter Name: Dennis Leonard
Commenter Affiliation: DTE Energy Company
Document Control Number: EPA-HQ-OW-2009-0819-4517-A2
Comment Excerpt Number: 8
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

EPA Should not Require Biological Treatment

The proposed ELG has not considered that many coal fired units, initially designed to burn bituminous coal, are now fuel flexing between blends that cause the FGD blowdown to have drastically different characteristics. Trying the make such biological systems work at such plants would entail much more costs than EPA has estimated. Additional chemical costs, waste water storage costs, and heating costs would be incurred. The effluent quality would still be less than predicted in the proposal, because biological systems take time to respond to changing conditions and fuel flexing causes extreme changes.

Comment Response:

EPA recognizes that changing the type or source of fuel can potentially affect the characteristics of the FGD purge, although the data in the record also demonstrates that this does not happen every time a plant changes fuel. More importantly, the data in the record show that such changes can be anticipated, monitored for and detected, and mitigated when necessary, with the result that plants will be able to meet the effluent limitations in the final ELGs. As described in preamble section VIII, for units greater than 50 MW and that are not oil-fired, the BAT basis for discharges of FGD wastewater is chemical precipitation followed by biological treatment, not biological treatment alone. Chemical precipitation systems have demonstrated the ability to handle the FGD wastewater variability prior to biological treatment. For more information, see response to DCN EPA-HQ-OW-2009-0819-4448-A1, Excerpt Number 24. For additional information on FGD wastewater variability, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107 in Comment Code 10.a, and DCN SE05846 (memorandum *Variability in Flue Gas Desulfurization Wastewater: Monitoring and Response*).

EPA's cost estimates for the ELGs include the necessary equipment, instrumentation, chemical additives, and staffing to ensure plants operating the BAT technology can meet the final limitations.

Commenter Name: Stephen M. Frank
Commenter Affiliation: NRG Energy, Inc.
Document Control Number: EPA-HQ-OW-2009-0819-4510-A2
Comment Excerpt Number: 10
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

EPA states in the 2013 TDD that the anoxic conditions in the bioreactor remove nitrates by denitrification and, if necessary, the model biological processes can be modified to include a step to nitrify and remove ammonia. Therefore, an unintended consequence of this anaerobic biological treatment process is that it creates effluent with concentrations of ammonia exceeding the aquatic life ambient water quality criteria. The economic analysis does not include the addition of an aerobic nitrifying unit.

Comment Response:

EPA does not agree that nitrification of the wastewater would be necessary to meet the final limitations. See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107, and DCN EPA-HQ-OW-2009-0819-4510-A2, Excerpt Number 9, both in Comment Code 10.a.

Commenter Name: Paul Chu
Commenter Affiliation: Electric Power Research Institute (EPRI)
Document Control Number: EPA-HQ-OW-2009-0819-4499-A1
Comment Excerpt Number: 34
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

3.2.4 *EPA underestimated the number of plants that require heat exchangers.*

EPA included the cost of heat exchangers only for plants that are located in Southern states. The cost of heat exchangers should be included when they are required for winter operation in northern climates. Heat exchangers are required to maintain biological activity in an ideal range between about 50 °F and 105 °F; outside of this range, biological activity would drop off significantly.

Comment Response:

EPA agrees that the biological treatment system operates optimally within a given temperature range, however, EPA disagrees that a plant cannot control a biological treatment system in extreme hot and cold weather events. Based on EPA's discussions with the vendor GE, biological treatment is effective for FGD wastewater with a temperature as low as 41 degrees F and as high as 105 degrees F. To accommodate FGD wastewater temperatures outside this range, EPA estimated additional costs for housing the biological treatment system in cold weather climates and for maintaining the temperature of FGD wastewater using heat exchangers in warm weather climates. Section 6.2.5.6 of the *Incremental Costs and Pollutant Removals for the Final Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category* (Cost & Loads Report) (DCN SE05831/SE05832) contains more information on EPA's revised estimates associated with biological treatment, which account for erecting buildings to house the biological reactors in cold weather conditions. There would be no need for heat exchangers to raise the temperature of the wastewater in cold climates because the FGD is already hot from contact with the combustion flue gases before it enters the treatment system. The wastewater cools somewhat as it progresses through the treatment system, but EPA understands that plants in cold climates will house the treatment system indoors (and included costs for buildings for plants to do so), which would limit the temperature drop so that the wastewater temperature remains substantially above the lower end of the temperature range for the microorganisms.

Commenter Name: Stephen M. Frank
Commenter Affiliation: NRG Energy, Inc.
Document Control Number: EPA-HQ-OW-2009-0819-4510-A2
Comment Excerpt Number: 14
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Also consider that for plants adding the proposed biological treatment system, dilution of their purge water to minimize chloride biomass toxicity may hydraulically overload other existing wastewater treatment system units increasing costs.

Comment Response:

EPA does not agree that the chloride levels in the FGD purge are higher than the microorganisms can tolerate. EPA reviewed Steam Electric Survey for all plants discharging FGD wastewater and determined that the chloride concentration of the wastewater for each of these plants is within the acceptable range for the biological treatment technology. See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107 in Comment Code 10.a.

EPA suggests that any plant that is considering diluting the FGD purge prior to treatment to carefully review the NPDES regulations, as well as the guidance contained in the preamble and TDD for this final rule regarding combined wastestreams. Depending on the specific factors involved, the permitting authority may determine it is necessary to demonstrate compliance with the effluent limitations prior to combining the FGD wastewater with another water stream.

Commenter Name: Thomas Cmar
Commenter Affiliation: Earthjustice, et al.
Document Control Number: EPA-HQ-OW-2009-0819-4684-A1
Comment Excerpt Number: 78
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

the industry-wide cost estimate is likely an overestimate because there are numerous other biological treatment technologies in development, pilot-testing, and operation that may have lower costs.[309] For example, anaerobic suspended growth reactors that target removal of selenium and other metals was commissioned at one plant in January 2012 following successful pilot testing.[310] In addition, CH2MHill has developed a system configured as a fluidized bed reactor that removes selenium from wastewater through a similar biological mechanism as ABMet, which may cost only one-third as much as an ABMet system.[311] The same company is developing "two additional configurations of biological treatment systems for selenium removal: a lined earthen basin-based FBR system; and a "biochemical reactor" process, a passive system which also employs anoxic/anaerobic reactions to reduce selenium," both of which will cost even less than the fluidized bed reactor.[312]

---

[309] *See* Synapse Report, Appendix A, at 18-20 (re: overestimation being a chronic problem). Dr. Jenkins cites to an upflow fluidized bed system developed by Envirogen Technologies, that has been demonstrated to reduce selenium levels in mining wastewater to under 5 ug/L. Jenkins FGD Report, Appendix C, at 5.

[310] *See* TDD at 7-12 ("One plant has pilot tested another type of anoxic/anaerobic biological treatment system that consists of suspended growth flow-through bioreactors instead of fixed-film bioreactors. Both designs share the fundamental processes that lead to nitrification/denitrification and reduction of metals in anoxic and anaerobic environments. Based on the results of the pilot test, in January 2012, the plant commissioned a full-scale suspended growth bioreactor system to treat FGD wastewater.")

[311] John Koon Rebuttal to the Expert Report of Thomas E. Higgins, In re: Bull Run NPDES permit, Exhibit FGD-19, at 15-16.

[312] *Id.*

Comment Response:

EPA agrees with the commenter that the market will likely generate other lower cost alternatives to meet the final effluent limitations and standards for FGD wastewater. See preamble section V for a discussion on the advancement of technologies.

Commenter Name: Stephen M. Frank
Commenter Affiliation: NRG Energy, Inc.
Document Control Number: EPA-HQ-OW-2009-0819-4510-A2
Comment Excerpt Number: 8
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

High Ammonia & Nitrate/Nitrite Influent Requires Significant Increases in Biological Treatment Size and Cost

According to EPA's data, the nitrate/nitrite influent to the FGD wastewater treatment system at Pleasant Prairie appears comparably high (four-day average of 158 mg/L). See EPA-HQ-OW-2009-0819- 0758, at 4-3. Such high levels may make the proposed selenium and nitrate/nitrite limits unachievable.

Also, at Homer City, the nitrate-nitrite influents are considerably higher (from 2004 to 2013: mean of 162 mg/L; maximum of 440 mg/L) than those at Allen (four-day average of 13.3 mg/L) and Belews Creek (four-day average of 19.8 mg/L), which will make it much more costly and possibly not feasible to treat down to 10 ppb selenium. Many other power stations across the country likely have influents that are more difficult to treat than those at Allen and Belews Creek. It is a big logical leap to extrapolate from [two] data points.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 44 and DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107 regarding the treatment of FGD wastewater with high nitrate-nitrite levels. EPA included costs in its cost estimates for both Pleasant Prairie and Homer City to install and operate denitrification systems to reduce the nitrate/nitrite concentrations in their FGD wastewater.

Commenter Name: Dennis Leonard
Commenter Affiliation: DTE Energy Company

Document Control Number: EPA-HQ-OW-2009-0819-4517-A2
Comment Excerpt Number: 7
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Costs of Biological Treatment will Increase

Given the extreme variability in character, and the absence of blowdown during one and a half day periods, biological treatment at Monroe could only occur with multi week storage of blowdown. Storage of FGD blowdown at Monroe to levelize flow, ORP and Nitrate levels could only be done at an astronomical price, because a several week period would necessitate use of outdoor ponds and the cold winter water temperature of outdoor ponds would itself degrade the efficacy of biological treatment, unless the wastewater was heated. EPA has not factored this and other costs associated with heating and insulating buildings, reactor tanks and wastewater to accommodate biological treatment in a northern climate.

Comment Response:

EPA disagrees that the biological system would not be effective for the Monroe plant. EPA also disagrees that outdoor ponds would be necessary to accommodate the flow rate of the system. EPA's design basis for the BAT FGD wastewater treatment system accounts for a 24-hour equalization tank. Additionally, with the equalization tank, and the volume of the water available in the chemical precipitation system, the flow through the system can be reduced in anticipation of periods with no blowdown. If necessary, the plant could recycle some water back through the treatment system and maintain water flow through the biological system, thereby continuing to feed the microorganisms. Another option is to suspend the biological treatment system operation during periods of little to no flow and bring the treatment system online when enough capacity is reached. Based on EPA's discussions with the vendor GE, the biomass can remain inactive for long periods of time and quickly resume metabolic function once wastewater is available. See DCN SE05846 (memorandum *Variability in Flue Gas Desulfurization Wastewater: Monitoring and Response*) for information showing that the biological treatment system can operate effectively even when a plant has frequent or extended shutdown periods. Regarding cold weather climates, GE noted that in non-FGD applications, treatment was effective at wastewater temperatures as low as 5-10 degrees C. Furthermore, EPA's cost estimate includes buildings for plants in cold climates to house the treatment system indoor.

Commenter Name: Tom DeLawrence
Commenter Affiliation: PowerSouth Energy Cooperative
Document Control Number: EPA-HQ-OW-2009-0819-4460-A1
Comment Excerpt Number: 40
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Accordingly, if forced to implement this technology at the Lowman Plant, PowerSouth may need to construct a building to enclose the associated equipment. This equipment includes: tanks, pumps, piping, HVAC, electrical and control system, foundations, sumps, curbs, trenching for exterior interconnection piping for numerous systems, an electrical power supply line, etc., meaning the building would be quite large. Additionally, operation and maintenance costs associated with such an installation would range from $400,000 to $500,000 annually at the plant. EPA seemingly ignored this potential cost, along with additional associated costs such as design, training, PowerSouth labor, and overhead costs, among others.

Comment Response:

EPA disagrees that every plant would find it appropriate to construct a building to house the BAT basis of chemical precipitation plus biological treatment. EPA found that, in some instances, extreme cold weather conditions (mean seasonal temperature below freezing) could require additional costs to house the BAT technology, in which case EPA included building costs in its cost estimates. However, the Lowman Plant is located in Alabama, and EPA determined it was unnecessary for plants in Alabama to receive building costs. See response to EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 34 for more information on additional costs considered for biological treatment in extreme weather conditions.

Commenter Name: Dennis Wene
Commenter Affiliation: Alcoa Inc.'s Warrick Operations
Document Control Number: EPA-HQ-OW-2009-0819-4765-A1
Comment Excerpt Number: 12
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

The treatment options that are presented in this proposed rule are not minor; there costs are significant. A metals precipitation plant, coupled with a biological wastewater plant will likely cost $30,000,000. This cost estimate is based on a facility Alcoa built that serves both purposes in 1990 which cost $12,000,000 and services one half the wastewater flow. The most substantial costs associated with this facility were the solids handling building and tanks -all of which will have to be scaled up. In addition, as a practical matter, the physical layout of any expanded system will be problematic due to space constraints at the facility.

Comment Response:

EPA notes that, because the primary purpose of the Alcoa Inc.'s Warrick Operations is for purposes other than electricity generation for sale, the plant is outside the applicability of the regulation. As such, EPA did not include any compliance costs for the Alcoa plant in its analyses.

Regardless, EPA agrees with the commenter that some plants subject to the ELGs would incur costs to comply with the final rule. However, the commenter did not provide enough specific information for EPA to evaluate whether the costs presented in this excerpt are generally consistent with EPA's costing approach.

Commenter Name: Chris M. Hobson
Commenter Affiliation: Southern Company
Document Control Number: EPA-HQ-OW-2009-0819-4379-A1
Comment Excerpt Number: 159
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

The chemical precipitation plus biological treatment system costs are based on Siemens' conceptual design estimate for Plant Bowen in 2010. Our design basis for the chloride level for all FGD flows was a maximum design chloride level of 20,000 ppm. The FGD treatment flow rates for each plant are based on the gross electric load generation (MWs) scrubbed, fuel heat of combustion, sulfur and chloride content in the coal (worst case), SO2 removal efficiency of the FGD system, final gypsum product moisture content, maximum 20,000 ppm chloride in FGD purge along with materials of construction considerations, and the FGD blowdown purge flow rate.

Comment Response:

This excerpts describes information used in the commenter's own estimates of costs associated with chemical precipitation plus biological treatment. See responses to other comments submitted by this commenter regarding specific issues related to costing of the chemical precipitation plus biological treatment BAT basis.

Commenter Name: Paul Chu
Commenter Affiliation: Electric Power Research Institute (EPRI)
Document Control Number: EPA-HQ-OW-2009-0819-4499-A1
Comment Excerpt Number: 31
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

3.2.1 *EPA applied only installation and engineering overhead to its biological treatment estimate. The Agency should include additional cost factors to calculate total estimated cost.*

As in its calculations of chemical precipitation costs [EPA, 2013], EPA underestimated the additional cost factors needed to calculate the total estimated cost of biological treatment. Please see Section 3.1.1 for further discussion. Table 3-6 provides a summary of cost factors EPRI applied to each facility to develop its cost estimate.

Table 3-6
Biological Treatment Cost Factors in EPRI Estimate

Additional Cost Items	Value Used (%)	Rationale for Selected Value
Site work	1	Assumes ABMet island will be co-located with physical/chemical treatment plant. Site will be made "pad ready" as required by GE.
Concrete	–	Concrete for the ABMet island is included in GE cost.
Piping	–	Piping for the ABMet island is included in GE cost. Other piping included with tie-in allowance.
Miscellaneous metals, finishes	–	GE cost curve provides miscellaneous metals costs for items within ABMet island. Items outside of ABMet island are covered by tie-in allowance.
Mechanical, heating/ventilation/air conditioning	–	GE cost curve provides building, HVAC.
Electrical	10	Applied to heat exchanger cost only, lower than typical range due to lack of motorized equipment.
Instrumentation and control	10	Applied to heat exchanger cost only.
General contractor general conditions	5	Used lower number as majority of equipment is ABMet island.
Tie-in/Integration	5	This includes items such as integrating ABMet controls into the plant DCS and SCADA; pipe interconnections; and extending power, control wires, and piping to the ABMet island.
Bonding and insurance	2	GE provides some insurance as part of its cost curve: builder's risk, commercial liability, and worker's compensation for scope of project only.
General contractor profit	12	Used lower number, as majority of equipment is ABMet island.
Miscellaneous unidentified cost	20	Contingency of 20 percent is consistent with a Class 4 estimate
Engineering (tie-ins and heat exchanger only)	20	Engineering for heat exchanger and tie-ins only provided. Other engineering provided as part of GE cost curve.

ABMet = Advanced Biological Metals Removal Process
DCS = distributed control system
GE = General Electric
HVAC = heating, ventilation, and air conditioning
SCADA = supervisory control and data acquisition

Comment Response:

In response to comments, EPA recalculated its direct and indirect capital cost factors for the final rule.

Regarding the chemical precipitation cost factors, see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 24 in Comment Code 9.b.

Regarding the biological treatment system cost factors, see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 30.

Commenter Name: Stephen M. Frank
Commenter Affiliation: NRG Energy, Inc.
Document Control Number: EPA-HQ-OW-2009-0819-4510-A2
Comment Excerpt Number: 44
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

The technology cost modules used to estimate compliance costs for FGD Wastewater did not include the installation of a nitrifying process to remove ammonia from the biological treatment unit effluent. We assume that EPA based the costs for the biological treatment systems on a reduced flow and the maximum operating chlorides concentration, this will result in undersized biological treatment units if the high chloride concentrations inhibit the process or if high nitrate/nitrites are present in the influent.

Comment Response:

Regarding the potential generation of ammonia, see responses to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107 in Comment Code 10.a and DCN EPA-HQ-OW-2009-0819-4510-A2, Excerpt Number 9 in Comment Code 10.a.

Regarding chlorides, EPA determined that the chloride concentrations for plants discharging FGD wastewater do not present a challenge for biological treatment. See response to DCN EPA-HQ-OW-2009-0819-4510-A2, Excerpt Number 14.

Regarding nitrate/nitrite concentrations, see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 44.

EPA disagrees with the commenter that "EPA based the costs for the biological treatment systems on a reduced flow." EPA based on the costs of the biological treatment system on the average FGD wastewater treatment system flow rate for each plant times the calculated capacity factor to estimate the maximum design flow rate. EPA also accounted for the backwash flow from the biological treatment system. Flow minimization is not required by the final rule and any costs-savings related to flow minimization were calculated for only three plants.

Commenter Name: Nancy A. Evans
Commenter Affiliation: PPL Services Corporation
Document Control Number: EPA-HQ-OW-2009-0819-4348-A2
Comment Excerpt Number: 8
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

The higher nitrate/nitrite levels found in the influents of most plants would require an increase in the size of the biological treatment systems or an increase in retention time within the system, with a resulting increase in nutrient feed. Some facilities would need to install a two-step biological treatment process. EPA's cost analysis did not properly evaluate the costs that would be incurred by the typical power plant and therefore has over-estimated the benefit of the treatment.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 44. EPA included costs for a denitrification step prior to the bioreactor for those plants with influent nitrate-nitrite concentrations above 100 mg/L.

Commenter Name: Mike Roddy
Commenter Affiliation: Seminole Electric Cooperative, Inc. (SECI)
Document Control Number: EPA-HQ-OW-2009-0819-4518-A2
Comment Excerpt Number: 4
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

<u>Biological Treatment</u>

SECI is in the process of analyzing its FGD wastewater treatment system in order to meet its NPDES permit limits. During this evaluation, we additionally analyzed the cost of meeting EPA's proposed rule using biological treatment as specified in options 2, 3, 4, and 4a. After extensive testing and analysis, SECI's consultant developed a projected cost of $79 million to install chemical/physical treatment followed by biological treatment.

Comment Response:

The commenter did not provide EPA with enough information to evaluate the commenter's methodology for estimating costs to install a chemical precipitation plus biological treatment system. Therefore, EPA cannot evaluate based on these comments whether revisions to EPA's cost estimates would be appropriate. Also, EPA notes that it revised the limits for the final rule as a result of public comments.

Commenter Name: Paul Chu
Commenter Affiliation: Electric Power Research Institute (EPRI)
Document Control Number: EPA-HQ-OW-2009-0819-4499-A1
Comment Excerpt Number: 33
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

3.2.3 *The mean—instead of the median—is statistically more appropriate and should be used as the capacity factor in estimation of flow rate.*

The EPRI-recommended method of using the mean capacity factor to estimate peak flow rate results in an 8 percent increase in total annualized cost of incremental biological treatment for the industry over the EPA's method of using the median capacity factor. Please see Section 3.1.3 for further discussion.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 26 in Comment Code 9.b.

Commenter Name: Michalene Reilly
Commenter Affiliation: Hoosier Energy Rural Electric Cooperative
Document Control Number: EPA-HQ-OW-2009-0819-4471-A1
Comment Excerpt Number: 12
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

In addition, the cost of biological systems are extremely high in comparison to other treatment. At the Merom station we have estimated that biological treatment alone would be $20 to $25 MM to would treat the FGD wastestream only. In addition, adding additional wastewater hold tanks and piping would add an additional $10 - $ l 5MM resulting in a total cost as high as $40 MM. And this is for a system that is subject to major upsets.

Comment Response:

The commenter did not provide EPA with enough information for EPA to evaluate the commenter's methodology for estimating the cost of wastewater treatment. Therefore EPA cannot determine based on these comments whether it would be appropriate to revise its cost estimates for the final rule. However, EPA notes that it did revise its cost estimates for implementing the BAT technology in response to comments on the proposed rule. Sections 6.1 and 6.2 of the *Incremental Costs and Pollutant Removals for the Final Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category* (Cost & Loads Report) (DCN SE05831/SE05832) contain more information on EPA's cost methodology for the BAT basis.

EPA disagrees with the commenter that the biological treatment system "is subject to major upsets." A well designed and well operated system will be able to operate and meet the effluent limitations without any upsets, as demonstrated by the performance of Belews Creek and Allen biological treatment systems.

Commenter Name: Paul Chu
Commenter Affiliation: Electric Power Research Institute (EPRI)
Document Control Number: EPA-HQ-OW-2009-0819-4499-A1
Comment Excerpt Number: 32
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

3.2.2 *EPA did not apply a contingency to its estimate. EPRI applied a 20 percent cost factor for miscellaneous unidentified costs (contingency).*

Please see Section 3.1.2 for an explanation of contingency in cost estimating. A contingency of at least 20 percent should be applied for this screening-level estimate.

Comment Response:

EPA's cost estimate for the final rule provides for contingency costs. See response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 30.

Commenter Name: Tom DeLawrence
Commenter Affiliation: PowerSouth Energy Cooperative

Document Control Number: EPA-HQ-OW-2009-0819-4460-A1
Comment Excerpt Number: 38
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Due in large part to flaws in its cost-benefit analysis, EPA has grossly misrepresented the actual costs to the industry of implementing, operating, and maintaining this technology. Collectively, these facts make it impossible for EPA to legally classify biological treatment as BAT for this waste stream.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4460-A1, Excerpt Number 37 in Comment Code 10.a. Also see the preamble for the final ELGs for an explanation of EPA's determination with respect to BAT.

Commenter Name: Bruce W. Ramme
Commenter Affiliation: We Energies
Document Control Number: EPA-HQ-OW-2009-0819-4475-A1
Comment Excerpt Number: 30
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

EPRI included contingency and additional cost factors (e.g., general contractor profit, engineering, electrical) to develop their industry-wide cost estimates.

Comment Response:

EPA's cost estimate for the final rule includes the elements specified by the commenter. See response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 30.

10.c. FGD Bio – Pollutant Loadings

Commenter Name: Elizabeth E. Aldridge, Hunton & Williams
Commenter Affiliation: UWAG
Document Control Number: EPA-HQ-OW-2009-0819-4655-A2
Comment Excerpt Number: 19
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

- Tables 10-9 and 10-10 of the TDD suggest that total pollutant loadings increase with the use of one-stage chemical precipitation, but are significantly reduced with the use of one-stage chemical precipitation with biological treatment. In contrast to the TDD Tables 10-9 and 10-10, US EPA's comparison of wastewater treatment technologies (US EPA, 2009a, pg. 4-52 to 4-55) at the Belews Creek and Roxboro facilities indicated a significant decrease in arsenic and mercury concentrations due to chemical precipitation, and a much lower decrease upon biological treatment. Table 4-12 of the US EPA's report on Steam Electric Power generating facilities (US EPA, 2009a) also showed substantial decrease in toxic weighted pound equivalent (TWPE) values due to chemical precipitation, when compared to biological treatment. Therefore, the treatment effectiveness used by US EPA in the ELG justification may not be representative. US EPA should address uncertainties that the variability in treatment technologies add to the pollutant loading calculations.

Comment Response:

EPA acknowledges how the commenter could interpret Table 10-9 and 10-10 of the proposal TDD as suggesting "that total pollutant loadings increase with the use of one-stage chemical precipitation." However, that outcome is the result of differences in the FGD wastewater characterization data for the plants used to estimate the settling pond effluent concentrations (which were used to estimate pollutant loadings for plants that operate settling pond under baseline conditions) compared to the plants used to generate the chemical precipitation effluent concentrations. See response to DCN EPA-HQ-OW-2009-0819-4655-A2, Excerpt Number 18 in Comment Code 9.c.

Regarding the representativeness of the "treatment effectiveness used by US EPA in the ELG justification," see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 95.

EPA acknowledges that there is variability in the treatment technologies that EPA evaluated and EPA notes that the plants used in the development of the effluent limitations and standards and in the pollutant loadings calculations were not required to meet the limitations and standards in the rule (and, in many cases, they are not required to meet any limitations for toxic metals) and therefore, likely aren't fully optimized. As such, EPA notes that the pollutant loadings estimates may underestimate the actual removals achieved by the industry once plants are complying with the limitations and standards. The methodology that EPA has used to characterize the performance of treatment technologies provides a reasonable estimate of the pollutant removals for the BAT technology.

Commenter Name: Cari Boyce
Commenter Affiliation: Duke Energy
Document Control Number: EPA-HQ-OW-2009-0819-4305-A3
Comment Excerpt Number: 54
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

EPA's analysis fails to adequately acknowledge the performance of the chemical precipitation system by assessing the chemical precipitation system with biological treatment as one technology system instead of as separate technologies. Duke Energy conducted a TWPE removal analysis for Allen, Belews Creek and Miami Fort Generating Stations using the data presented in EPA's database. To calculate the average concentrations from the chemical precipitation effluent for Belews Creek and Allen, Duke Energy followed the same averaging methodology and interpretation of non-detects as EPA did for Miami Fort, Keystone, and Hatsfield in calculating the average effluent concentration from chemical precipitation effluent for the industry. Since none of these facilities discharge into a settling pond prior to the chemical precipitation system, Duke Energy used the average FGD purge (i.e. "unsettled) to calculate the TWPE removed and percent reduction across each treatment system. A summary of the analysis is provided in Table 1-8 below.

Table 1-9. Duke Energy's TWPE Reduction Analysis

Station	TWPE Loading FGD Purge (unsettled)	TWPE Reduction from Surface Impoundments(1)	TWPE Reduction from Chemical Precipitation(2)	Incremental TWPE Reduction from Biological Treatment(3)
Allen	14,895	12,707	12,807	346
Belews Creek	125,927	110,806	114,148	4,096
Miami Fort	276,264	186,007	253,034	1,425(4)

(1) Estimated reduction if a settling pond was used. None of the sites utilize a settling prior to the chemical precipitation system. This estimate is based on EPA's methodology for estimating the "settled" effluent.

(2) Loading reduction = TWPE in the FGD purge minus the TWPE in the chemical precipitation effluent.

(3) Loading reduction = TWPE in the chemical precipitation effluent minus TWPE in the biological treatment effluent.

(4) Estimated removal based on Duke Energy's experience with the operating performance of biological treatment.

The analysis shows, for Allen Steam Station, a reduction of 88% in the TWPE loading across the chemical precipitation system with biological treatment, of that, approximately 86% of the reduction is attributed to the chemical precipitation system and approximately 2% is attributed to the biological system. For Belews Creek, there is an approximate 94% reduction in the TWPE loading across the chemical precipitation with biological system with chemical precipitation accounting for 91% of the reduction, whereas, only 3% is attributed to the biological system. For Miami Fort, the analysis shows that approximately 92% of the TWPE loading is removed in the chemical precipitation system. Based on the performance of Allen and Belews Creek, the addition of a biological system at Miami Fort would probably only reduce the TWPE loading by an additional 2 to 3%. The results of the complete analysis are provided in Appendix A.

Using EPA's methodology for estimating pollutant concentrations after treatment in surface impoundments, the analysis shows that surface impoundments are effective at removing significant quantities of TWPE in FGD wastewater. EPA, however, did not propose limits based on surface impoundments or conduct an analysis of the treatment performance of surface impoundments.

For a chemical precipitation with biological treatment system, this analysis clearly shows that the majority of constituents are removed in the chemical precipitation system. Biological treatment only provides a small incremental reduction in the TWPE loading. In establishing national standards, it is, therefore, only reasonable for EPA to establish BAT limits based solely on a chemical precipitation system.

Comment Response:

Regarding whether EPA should evaluate the chemical precipitation system and biological treatment systems separately, see response to DCN EPA-HQ-OW-2009-0819-4305-A3, Excerpt Number 52.

EPA selected chemical precipitation followed by biological treatment as the BAT basis for FGD wastewaters for the reasons described in preamble section VIII. Although EPA acknowledges the treatment performance of the individual components of the BAT basis, chemical precipitation is only the first step in the technology basis which also includes biological treatment. EPA did not select chemical precipitation as the basis for BAT limitations for FGD wastewater for the reasons described in preamble section VIII.

EPA acknowledges that surface impoundments are capable of removing particulates from FGD wastewater and that the removal of those particulates does have associated TWPE removals. However, EPA did not select surface impoundments as the technology basis for BAT limitations for FGD wastewater for the reasons described in preamble section VIII.

Commenter Name: Cari Boyce
Commenter Affiliation: Duke Energy
Document Control Number: EPA-HQ-OW-2009-0819-4305-A3
Comment Excerpt Number: 52
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Table 1-1. EPA's Chemical Precipitation with Biological Treatment Evaluation Artificial Removals

Pollutant	TWPE Removed	Percent Contribution to Total TWPE Removed
Boron	229,585	9%
Cadmium	358,037	14%
Cyanide	240,107	9%
Magnesium	449,793	17%
Manganese	945,888	36%
Total	**2,223,410**	**85%**

By reviewing the per-station average concentrations used for calculating the average effluent pollutant concentrations for each treatment system, the lack of removal of these constituents are clearly shown (see Appendix A for further details). Duke Energy utilized EPA's access database, followed EPA's averaging methodology and methodology for evaluating non-detects and derived the average concentration for each analyte on a per station basis for each treatment technology. To ensure the average methodology was applied correctly, the average concentration for each constituent was compared with EPA's average concentration for each treatment system provide in *Table 10-3 Average Effluent Pollutant Concentrations for FGD Surface Impoundments*, *Table 10-4 Average Effluent Pollutant Concentrations for One-Stage Chemical Precipitation System* and *Table 10-5 Average Effluent Pollutant Concentration for One-Stage Precipitation System with Biological Treatment* as included in the Technical Development Document. All derived averages were comparable to the averages presented by EPA and any differences were attributed to rounding and do not affect the analysis presented below. This comparison is provided in Appendix A, Table A-4.

Magnesium

According to EPA's calculations, magnesium attributed 449,793 TWPE industry- wide (~17% of the total TWPE removed) for FGD wastewater with a chemical precipitation system plus biological treatment (Option 4a)[9]. EPA used data collected from sampling events conducted at the seven stations to estimate the average magnesium effluent concentration for surface impoundments ("settled effluent"). However, to calculate the average magnesium effluent concentration from a one-stage chemical precipitation system plus biological treatment, EPA only used the data collected from Allen and Belews Creek. The average "settled" effluent magnesium concentrations at Allen and Belews Creek were much lower than the other stations used in EPA's analysis, as shown in Table 1-2 below. Therefore, without any removal of magnesium from the chemical precipitation plus biological treatment system at Allen and Belews Creek, there was an already low average magnesium concentration presented for a one-stage chemical precipitation system plus biological treatment system. Also, as shown in this table, there was no actual removal of magnesium by the treatment system at Allen and Belews Creek.

Furthermore, magnesium removal could only occur in the chemical precipitation system, which is evident by the reduction of magnesium in the chemical precipitation systems at Hatfields Ferry, Keystone and Miami Fort.

Table 1-2. Plant-Specific Average Magnesium Concentrations Extracted from EPA's Database

Plant Name	"Settled" Effluent (ug/L) (1)	Chemical Precipitation Effluent (ug/L) (1)	Biological Effluent (ug/L) (1)
Allen Average	472,936		675,750
Belews Creek Average	695,388		810,167
Dickerson Average	1,450,463		
Hatfields Ferry Average	5,200,300	2,775,000	
Keystone Average	2,824,978	2,025,000	
Miami Fort Average	9,050,532	5,437,500	
Pleasant Prairie Average	3,926,720		
Average(1)	**3,374,474**	**3,412,500**	**742,958**

(1) Only data EPA used in calculating the technology averages were used in calculating the plat-specific averages.

(2) The average concentrations correspond to EPA's reported average concentration for ea ch treatment technology in the Technical Development Document.

Boron

As another example, boron attributed 229,585 TWPE (~9%) to the total TWPE removed in FGD wastewater with a chemical precipitation system plus biological treatment (Option 4a). Boron, however, is not removed in a combined chemical precipitation system and biological treatment system, which is clearly evident upon reviewing the per station averages for each treatment system.

Under EPA's methodology, the boron removed is an artifact of the low boron calculated "settled effluent" concentrations at Allen and Belews Creek. As shown in Table 1-3 below, average boron concentrations were virtually the same in the "settled" effluent as in the bioreactor effluent at Allen and Belews Creek.

Table 1-3. Plant-Specific Average Boron Concentrations Extracted from EPA's Database

Plant Name	**"Settled" Effluent (ug/L) (1)**	**Chemical Precipitation Effluent (ug/L) (1)**	**Biological Effluent (ug/L) (1)**
Allen Average	72,272		81,734
Belews Creek Average	147,537		170,262
Dickerson Average	187,526		
Hatfields Ferry Average	322,485	177,250	
Keystone Average	395,005	272,500	
Miami Fort Average	758,212	387,500	
Pleasant Prairie Average	12,993		
Roxboro Average	80,244		
Average(1)	**247,034**	**279,083**	**125,998**

(1) Only data EPA used in calculating the technology averages were used in calculating the plat-specific averages.

(2) The average concentrations correspond to EPA's reported average concentration for ea ch treatment technology in the Technical Development Document.

Cadmium

Cadmium is another constituent where the calculated TWPE removed is misrepresented in EPA calculations. According to EPA's calculations, cadmium contributed 358,037 TWPE (~14%) to the total TWPE removed for FGD wastewater in a chemical precipitation system plus biological treatment (Option 4a). As shown in Table 1-4 below, the average cadmium "settled" effluent concentrations from Allen and Belews Creek were much lower than other stations. In fact, cadmium was virtually non-detect in the "settled" effluent sample from both Allen and Belews Creek. Therefore, the cadmium concentration in the bioreactor effluent was also at or below the detection level. Any actual cadmium removal attributed to biological treatment is an unsubstantiated byproduct of an erroneous artificial removal calculation.

Table 1-4. Plant-Specific Average Cadmium Concentrations Extracted from EPA's Database

Plant Name	"Settled" Effluent (ug/L) (1)	Chemical Precipitation Effluent (ug/L) (1)	Biological Effluent (ug/L) (1)
Allen Average	2		2
Belews Creek Average	2		3
Dickerson Average	23		
Hatfields Ferry Average	365	6	
Keystone Average	85	3	
Miami Fort Average	415	2	
Pleasant Prairie Average	11		
Roxboro Average	2		
Average(1)	**113**	**3.8**	**2.5**

(1) Only data EPA used in calculating the technology averages were used in calculating the plat-specific averages.

(2) The average concentrations correspond to EPA's reported average concentration for ea ch treatment technology in the Technical Development Document.

Manganese

Manganese is yet another example which accounted for approximately 36% (945,888 TWPE) of the total TWPE removed in FGD wastewater with a chemical precipitation system plus biological treatment (Option 4a) per EPA's calculations. As with the other constituents discussed above, a large percentage of the TWPE removed for manganese is an artificial removal and is primarily due to the low manganese concentrations in the "settled" effluent for Allen and Belews Creek. Also, the data clearly indicate that the manganese removed at Allen and Belews Creek is primarily removed in the chemical precipitation system and there is very little additional removal in biological treatment, as shown in Table 1-5 below. However, EPA did not use the chemical precipitation effluent data from Allen or Belews Creek.

These results clearly illustrate why EPA should evaluate the chemical precipitation separately, and incrementally, from the biological system. Evaluating both systems as one fails to recognize the performance of the chemical precipitation system and artificially inflates the pollutant removal of the biological treatment system.

Table 1-5. Plant-Specific Average Manganese Concentrations Extracted from EPA's Database

Plant Name	**"Settled" Effluent (ug/L)** (1)	**Chemical Precipitation Effluent (ug/L)** (1)	**Biological Effluent (ug/L)** (1)
Allen Average	3,382	**1,279***	1,071
Belews Creek Average	4,560	**2,702***	2,844
Dickerson Average	9,774		
Hatfields Ferry Average	85,251	4,920	
Keystone Average	450,009	35,450	
Miami Fort Average	119,990	506	
Pleasant Prairie Average	69,777		
Roxboro Average	1,690		
Average	**93,054**	**13,625**	**1,958**

(1) Only data EPA used in calculating the technology averages were used in calculating the plat-specific averages.

(2) The average concentrations correspond to EPA's reported average concentration for ea ch treatment technology in the Technical Development Document.

* Values were not used in EPA's calculation to determine the Average Effluent Pollutant Concentration for One-Stage Chemical Precipitation System.

Cyanide

The final example is for cyanide, which accounted for approximately 9% (240,107 TWPE) of the total TWPE removed in FGD wastewater with a chemical precipitation system plus biological treatment (Option 4a) in EPA's calculations. Duke Energy contends none of the cyanide results should be used in EPA's analysis. All of the 40 CRF Part 136 approved cyanide methods are subject to numerous interferences, especially in complex sample matrices, such as FGD wastewater. The methods were originally designed for use with discharges from metal plating facilities where cyanide was known to be present. Most of the interferences result in false positives, and many are caused by sulfide and other reduced sulfur compounds which may be present in FGD wastewater. Other compounds that can cause false positives under the right conditions are organosulfides, thiosulfates, nitrites, and other nitrogen compounds. Some of these compounds can actually cause cyanide to be produced during the acid distillation procedure of the method. The procedures for removing interferences provided in the methods are often not effective, and complex samples, such as FGD wastewater, may also contain unknown interferences. It is entirely possible that most, if not all, of the reported cyanide detections could be attributed to sample matrix interferences. In fact, cyanide should not be present in any FGD wastewater generated from forced oxidized scrubbers, and all the seven plants have forced oxidized scrubbers. Furthermore, the average station specific results indicate an increase in the average cyanide concentrations across the various systems, which is not plausible. EPA, therefore, should not use any of the cyanide results for calculating pollutant removals.

Even if EPA assumes the cyanide results are acceptable, EPA only used the results obtained from the chemical effluent from Miami Fort, Hatsfield Ferry and Keystone and the biological effluent from Allen and Belews Creek to calculate the pounds of cyanide removed for each technology. EPA, however, analyzed all the samples for cyanide collected of the FGD purge and chemical effluent at the other four sites. EPA assumed that the cyanide concentration in the "settled" effluent would equal the cyanide concentration in the chemical precipitation effluent, which is a completely false assumption. In addition, if EPA were to maintain this assumption, then the average cyanide concentrations at the other four sites should have been included in the analysis, especially when the elevated average cyanide concentration in the chemical precipitation effluent is due to the average concentration from Miami Fort (3,329 ug/L), which is 10 times greater than the other sites, including Allen and Belews Creek. This elevate average cyanide concentration from Miami Fort is due to the elevated results of 15,000 ug/L in Month 4 (January 14, 2011) of the CWA 308 sampling event. Upon reviewing all the data, this result is clearly either an outlier or analytical error (see Table 1-6 below). This is clear evidence that not only is EPA's assessed removal of cyanide flawed, but all the cyanide results are questionable.

Table 1-6: Cyanide Results from Miami Fort Extracted from EPA's Database

Date Collected	Units	Non-Detect Indicator	Amount	Dilution
13-Jul-10	mg/L	D	0.21	1
14-Jul-10	mg/L	ND	0.045(1)	1
14-Jul-10	mg/L	D	2.4	1
15-Jul-10	mg/L	D	0.6	1
16-Jul-10	mg/L	D	1.5	1
28-Sep-10	mg/L	ND	0.068(1)	1
02-Nov-10	mg/L	D	0.23	1
07-Dec-10	mg/L	D	0.48	1
14-Jan-11(2)	**mg/L**	**D**	**15**	**10**

(1) Estimate J-value

(2) Outlier or analytical error

By examining the average cyanide concentration for both Allen and Belews Creek, it is clearly evident that cyanide is not removed in the biological system.

Table 1-7. Plant-Specific Average Cyanide Concentrations Extracted from EPA's Database

Plant Name	"Settled" Effluent (ug/L) (1)	Chemical Precipitation Effluent (ug/L) (1)	Biological Effluent (ug/L) (1)
Allen Average	255	75	101*
Belews Creek Average	39	50	48*
Dickerson Average	950	196	
Hatfields Ferry Average	182	129*	
Keystone Average	275	98*	
Miami Fort Average	787	3,329*	
Pleasant Prairie Average	235	240	
EPA's Reported Average(1)	**1,185**	**1,185**	**74**
Revised Average	**332**	**588**	

(1) Only data EPA reported in the database was used in calculating the plat-specific averages.

(2) The average concentrations correspond to EPA's reported average concentration for each treatment technology in the Technical Development Document.

Only values EPA used to determine the Average "Settled" Effluent Cyanide Concentration, the Average Effluent Cyanide Concentration for One-Stage Chemical Precipitation System and the Average Effluent Cyanide Concentration for One-Stage Chemical Precipitation System with Biological Treatment

[9] ERG Memorandum Steam Electric Pollutant-Level Loadings and Removals for Each Wastestream and Regulatory Option, April 19, 2013.

Comment Response:

Regarding the pollutant removals estimates, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 95.

Regarding potential analytical interferences encountered with cyanide data, see response to DCN EPA-HQ-OW-2009-0819-4379-A1, Excerpt Number 69 in Comment Code 32.

EPA disagrees with the commenter that "EPA should evaluate the chemical precipitation separately, and incrementally, from the biological system." EPA's BAT basis for the treatment of FGD wastewater is chemical precipitation followed by biological treatment; therefore, EPA analyses evaluate the statutory factors associated with the BAT determination for the combined BAT system. EPA finds no reason to estimate the pollutant removals (including the estimate of TWPE) for the chemical precipitation system separately from the biological treatment system because it is the combination of the two processes that comprise the BAT basis for the effluent limitations being established by this rule. EPA has revised its pollutants loadings methodology such that the analysis does not "artificially inflates the pollutant removal of the biological treatment system."

Commenter Name: Paul Chu
Commenter Affiliation: Electric Power Research Institute (EPRI)
Document Control Number: EPA-HQ-OW-2009-0819-4499-A1
Comment Excerpt Number: 110
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

B.1.4.2 Biological Influent and Effluent

The removal via biological treatment was first calculated at both Allen and Belews Creek for each parameter. To avoid artificial removals due to the mixing of plants' data (Hatfield's Ferry, Keystone, Miami Fort, and Pleasant Prairie as influent and Allen and Belews Creek as effluent), parameters that weren't treated at Allen or Belews Creek were assessed. Four parameters (magnesium, cyanide, boron, and manganese) that had little to no removal at Allen and Belews Creek are shown in Table B-5. These parameters were then removed from the industry benefit calculation. This is consistent with EPA's methodology in past ELGs where EPA has excluded parameters with insignificant removal.

Table B-5
Biological Parameters Removed for Industry Benefit Calculation

	Allen				Belews Creek			
	Biological Influent (ug/L)	Biological Effluent (ug/L)	Removal (ug/L)	Removal (%)	Biological Influent (ug/L)	Biological Effluent (ug/L)	Removal (ug/L)	Removal (%)
Magnesium	675,500	676,000	None	None	702,500	739,000	None	None
Cyanide	88	104	None	None	33	33	0	1
Boron	94,717	78,616	16,101	17	164,431	168,000	None	None
Manganese	1,279	1,072	208	16	2,701	2,844	None	None

EPRI calculated the influent to the biological treatment system as the average of the CP effluent by coal type from Miami Fort, Keystone, Hatfield's Ferry, and Pleasant Prairie. Miami Fort and Keystone CP effluent data were averaged and used for biological treatment influent for plants that use bituminous coal as fuel. Hatfield's Ferry CP effluent data were used for biological influent for plants that use a blend of coal as fuel. Pleasant Prairie CP effluent data were used for biological influent for plants that use PRB coal as fuel.

Since Belews Creek and Allen use only bituminous coal as fuel, the effluent from the biological treatment system was calculated as the average of the biological effluent from Belews Creek and Allen and was applied to all plants regardless of coal type. The monthly, 4-day and long-term data were used to calculate average concentration for each pollutant for the biological system effluent. Incorporation of the data is described in the 'Summary of Data Used for the Benefits Evaluation" section above.

The biological treatment system removal for the bituminous coal type was calculated by taking the biological influent average of the bituminous plants (Miami Fort and Keystone) and subtracting it by the average of the biological effluent (Allen and Belews Creek). The removal for the blend coal type was calculated by taking the biological influent of Hatfield's Ferry and subtracting it by the average of the biological effluent. The removal for PRB coal type was calculated by taking the biological influent of Pleasant Prairie and subtracting it by the average of the biological effluent.

Table 6 shows the average Biological influent, effluent, and removal by coal type in ug/L for each parameter. Each of the parameters was then multiplied by the toxic weighting factor (TWF) to calculate a TWug/L.

Table B-6
Biological Influent and Effluent Concentrations and TWug/L

		CP Effluent			Biological Effluent	Biological Removal		
		CP Effluent (Bit Average)	HF CP Effluent (Blend Average)	P4 CP Effluent (PRB/Sub-bit Average)	2 Biological Effluent (AL, BC)	Biological Removal Bit	Biological Removal Blend	Biological Removal PRB/Sub-bit
Analyte	TWF	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Aluminum	0.064691216	25	107	75	25	1	82	50
Antimony	0.01225	3	9	3	0	3	8	2
Arsenic	4.041333333	4	7	7	19	0	0	0
Barium	0.001990757	176	141	66	324	0	0	0
Beryllium	1.056603774	0	0	0	2	0	0	0
Cadmium	23.1168	2	5	1	5	0	0	0
Calcium	0.000028	2,811,750	1,360,000	687,000	2,880,000	0	0	0
Chloride	0.0000243	10,202,500	6,430,000	2,310,000	6,802,085	3,400,415	0	0
Chromium	0.075696709	7	9	2	4	3	5	0
Cobalt	0.114285714	1	1	1	1	0	0	0
Copper	0.634822222	1	2	4	2	0	0	2
Hexavalent Chromium	0.516557576	4	4	1	1	3	3	0
Iron	0.0056	109	139	117	2,021	0	0	0
Lead	2.24	0	0	0	0	0	0	0
Manganese	0.07043299	17,978	4,917	11,240	1,958	16,020	2,959	9,282
Mercury	117.1180233	0	0	0	0	0	0	0
Molybdenum	0.201438849	131	386	50	13	118	373	38
Nickel	0.108914308	6	6	5	22	0	0	0
Nitrate/Nitrite	0.0032	42,455	116,800	182,000	1,342	41,113	115,458	180,658
Selenium	1.121344	343	680	2,595	9	334	671	2,586
Silver	16.47072824	0	0	0	4	0	0	0
Sodium	0.00000549	396,750	464,500	506,500	46,450	350,300	418,050	460,050
Sulfate	0.0000056	6,852,500	4,695,000	12,620,000	1,406,333	5,446,167	3,288,667	11,213,667
Thallium	1.027058824	8	9	1	0	8	9	1

		CP Effluent			Biological Effluent	Biological Removal		
		CP Effluent (Bit Average)	HF CP Effluent (Blend Average)	P4 CP Effluent (PRB/Sub-bit Average)	2 Biological Effluent (AL, BC)	Biological Removal Bit	Biological Removal Blend	Biological Removal PRB/Sub-bit
Analyte	TWF	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Tin	0.301075269	2	2	3	2	0	0	1
Titanium	0.029319372	4	1	1	8	0	0	0
Vanadium	0.035	10	24	1	1	9	22	0
Zinc	0.046886	8	6	15	6	2	0	10
Ammonia as Nitrogen	0.00111	10,613	845	5,510	4,981	5,631	0	529
Boron	0.008341667	329,750	177,500	12,965	123,308	206,442	54,192	0
Magnesium	0.000865533	3,730,000	2,775,000	3,545,000	707,500	3,022,500	2,067,500	2,837,500
Cyanide	1.116923077	1,698	129	241	69	1,630	61	172
Total								

		CP Effluent			Biological Effluent	Biological Removal		
		CP Effluent (Bit Average)	HF CP Effluent (Blend Average)	P4 CP Effluent (PRB/Sub-bit Average)	2 Biological Effluent (AL, BC)	Biological Removal Bit	Biological Removal Blend	Biological Removal PRB/Sub-bit
Analyte	TWF	TWug/L	TWug/L	TWug/L	TWug/L	TWug/L	TWug/L	TWug/L
Aluminum	0.064691216	2	7	5	2	0	5	3
Antimony	0.01225	0	0	0	0	0	0	0
Arsenic	4.041333333	14	27	27	76	0	0	0
Barium	0.001990757	0	0	0	1	0	0	0
Beryllium	1.056603774	0	0	0	3	0	0	0
Cadmium	23.1168	37	111	14	109	0	2	0
Calcium	0.000028	79	38	19	81	0	0	0
Chloride	0.0000243	248	156	56	165	83	0	0
Chromium	0.075696709	1	1	0	0	0	0	0
Cobalt	0.114285714	0	0	0	0	0	0	0

		CP Effluent			Biological Effluent	Biological Removal		
		CP Effluent (Bit Average)	HF CP Effluent (Blend Average)	P4 CP Effluent (PRB/Sub-bit Average)	2 Biological Effluent (AL, BC)	Biological Removal Bit	Biological Removal Blend	Biological Removal PRB/Sub-bit
Analyte	TWF	TWug/L	TWug/L	TWug/L	TWug/L	TWug/L	TWug/L	TWug/L
Copper	0.634822222	0	1	3	1	0	0	1
Hexavalent Chromium	0.516557576	2	2	1	0	2	2	0
Iron	0.0056	1	1	1	11	0	0	0
Lead	2.24	1	1	1	1	0	0	0
Manganese	0.07043299	1,266	346	792	138	-	-	-
Mercury	117.1180233	14	33	12	40	0	0	0
Molybdenum	0.201438849	26	78	10	3	24	75	8
Nickel	0.108914308	1	1	1	2	0	0	0
Nitrate/Nitrite	0.0032	136	374	582	4	132	369	578
Selenium	1.121344	385	762	2,910	10	375	752	2,900
Silver	16.47072824	5	5	5	69	0	0	0
Sodium	0.00000549	2	3	3	0	2	2	3
Sulfate	0.0000056	38	26	71	8	30	18	63
Thallium	1.027058824	9	9	1	0	8	9	1
Tin	0.301075269	1	1	1	1	0	0	0
Titanium	0.029319372	0	0	0	0	0	0	0
Vanadium	0.035	0	1	0	0	0	1	0
Zinc	0.046886	0	0	1	0	0	0	0
Ammonia as Nitrogen	0.00111	12	1	6	6	6	0	1
Boron	0.008341667	2,751	1,481	108	1,029	-	-	-
Magnesium	0.000865533	3,228	2,402	3,068	612	-	-	-
Cyanide	1.116923077	1,897	145	269	77	-	-	-
Total		10,157	6,012	7,967	2,449	663	1,237	3,558

HF – Hatfield's Ferry Power Station
P4 – Pleasant Prairie Power Plant
AL – Allen Steam Station
BC – Belews Creek Steam Station
Bit = bituminous
Sub-bit = sub-bituminous

Comment Response:

Regarding the "artificial removals due to the mixing of plants' data," see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 95.

Regarding the breakout of loadings by coal type, see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 48 in Comment Code 8.d.

Commenter Name: Stephen M. Frank
Commenter Affiliation: NRG Energy, Inc.
Document Control Number: EPA-HQ-OW-2009-0819-4510-A2
Comment Excerpt Number: 3

External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Discharges Directly to Surface Water from Existing Facilities - Preferred Options 3b, 3 & 4a

NRG does not support the alternatives for BAT referred to as Options 3b, 3 and 4a establishing numeric effluent limits for selenium and nitrate-nitrite in discharges of flue gas desulphurization (FGD) wastewater for the reasons outlined below. The effluent limits that are BAT modeled on anoxic/anaerobic biological treatment systems are not appropriate for all FGD wastewaters and not achievable.

As presented in Table 6-3, 10-3, 10-4 and 10-5 of the April 2013 TDD, the average pollutant concentrations (in mg/L) in untreated and treated FGD wastewater from two of the plants (Belews Creek and Allen Generating Stations) operating fixed-film anoxic/anaerobic biological treatment systems are:

Analyte	Untreated	Treated Surface Impoundment	Treated CP	Treated CP & Bio
Ammonia	6.35	NA	8.12	8.75
Nitrate/Nitrite, N	74.9	67.3	67.3	0.079
TKN	39.6	NA	27	12.1
Chloride	7,740	7,320	8,940	6,720
Sodium	275	276	420	46.1
Selenium	4.49	1.11	0.455	0.005
Arsenic	0.489	0.0068	0.0045	0.0046
Mercury	0.411	0.0056	0.00017	0.000067

After conducting an engineering review of the data, EPA determined that "both plants operate systems consistent with the one-stage chemical precipitation with biological treatment technology option." What is clear from this data is that the two plants using the model biological treatment technology:

1. Treat dilute FGD purge water, which is apparent from the substantial decrease in chlorides and sodium.
2. Discharge effluent with a greater ammonia, as nitrogen concentrations.

Data presented in the 2013 TDD are not consistent with Sampling Episode 6561 (Allen Steam Station) and Sampling Episode 6558 (Belews Creek Steam Station):

- Minimum and maximum influent concentrations of chlorides are 3,200 mg/l (Allen) and 8,000 mg/l (Belews Creek).

- Minimum and maximum influent concentrations of nitrate/nitrite are 13 mg/l (Allen) and 21 mg/l (Belews Creek). None of the data summarized above in the 2013 TDD for treatment processes used prior to biological treatment reflect these low influent nitrate/nitrite concentrations.
- Effluent contains more ammonia and TKN than the influent. Ammonia and TKN concentrations in the effluent at Allen were as great as 13 mg/l and 14 mg/l, respectively.
- Most importantly, selenium concentrations in the effluent were 0.0255 mg/l (Day 2) and 0.025 mg/l (Day 4) in two of the four samples collected at Belews Creek exceeding the proposed Monthly Average and Daily Maximum limits for Selenium of 0.010 mg/l and 0.016 mg/l, respectively.

These data demonstrate the extreme variability in meeting the proposed selenium limits, and show the dilute influent chloride and nitrate/nitrite concentrations.

Comment Response:

EPA disagrees with the commenter that "[t]he effluent limits that are BAT modeled on anoxic/anaerobic biological treatment systems are not appropriate for all FGD wastewaters and not achievable." Note the effluent limitations have been revised in some cases where the dataset used to develop the effluent limitations was supplemented with additional data following proposal. See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 84 and DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107 in Comment Code 10.a.

Regarding the potential generation of ammonia in the biological treatment system, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 107 in Comment Code 10.a.

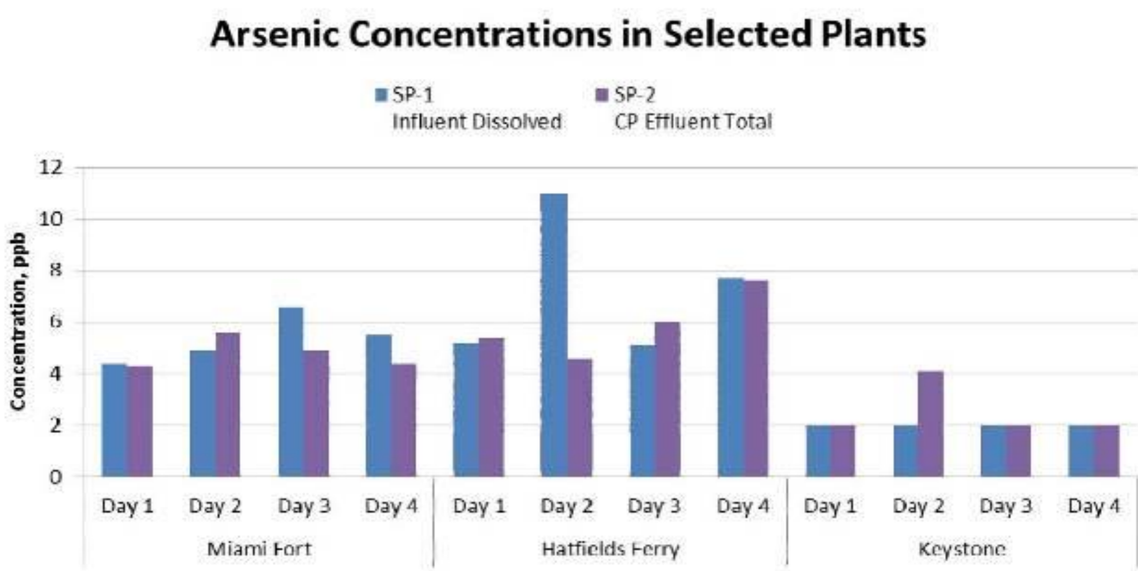
EPA notes that the "[d]ata presented in the 2013 TDD are not consistent with Sampling Episode 6561 (Allen Steam Station) and Sampling Episode 6558 (Belews Creek Steam Station)" because the sampling episode reports contain only the data collected from those sampling episodes; however, EPA also collected data from Allen and Belews Creek from the CWA 308 monitoring program, as well as self-monitoring data provided by the plant. Additionally, EPA notes that the data presented by the commenter representing the "untreated," "treated surface impoundment," and "treated CP" include additional plants other than Allen and Belews Creek.

Commenter Name: Chris M. Hobson
Commenter Affiliation: Southern Company
Document Control Number: EPA-HQ-OW-2009-0819-4379-A1
Comment Excerpt Number: 57
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Additionally, as shown in Figure 5, the influent dissolved arsenic concentrations for the proposed BAT plants (Miami Fort, Hatfield's Ferry, and Keystone) range from < 4 to11 µg/L, which in most instances are below the proposed limits of 6 µg/L monthly average and 8 µg/L daily maximum. The dissolved arsenic levels in these proposed BAT plants are not high enough to properly evaluate the effectiveness of these treatment systems. Based on EPA's criteria for identifying pollutants of concern (POCs), arsenic in FGD wastewater does not qualify as a POC. 2013 TDD, p. 6-25.

Figure 5: Arsenic Concentrations at Selected Plants – Influent (Dissolved) and Chemical Precipitation Effluent (Total)



Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 56.

Commenter Name: Elizabeth E. Aldridge, Hunton & Williams
Commenter Affiliation: UWAG
Document Control Number: EPA-HQ-OW-2009-0819-4655
Comment Excerpt Number: 95
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

2. EPA Counted TWPEs for Pollutants Not Removed by the Treatment System

Using the EPA sampling data, the TWPE reductions for boron, magnesium, manganese, cadmium, and cyanide account for 87% of the TWPEs removed by biological treatment.

But those TWPEs are simply not accurate. The apparent removal is caused entirely by EPA's "borrowing" the average concentration values from the CP effluent from three facilities, Hatfield, Keystone, and Miami Fort, and inappropriately using these values as if they were the actual "influent" concentrations into the biological treatment systems at Allen and Belews Creek.

FGD wastewater varies tremendously from plant to plant. The average concentrations for many pollutants from the three model CP facilities was simply much, much higher than was present in the actual influent to the biological systems at Allen and Belews Creek that EPA chose as its model for biological treatment. A quick examination of these biological systems shows that for most of these pollutants, there is essentially no removal when compared to the actual concentrations in the influent wastewater to these biological systems. The TWPE removals that EPA calculated for the biological systems are entirely based on the incorrect premise that the actual influent to these biological systems was a different wastewater stream from treatment plants actually located hundreds of miles away. If, by some coincidence, the concentrations of these pollutants had actually been higher in the influents to these biological systems, then it is certain that the effluent from these systems would also be just as high, since the biological system is not capable of removing them.

Table 14 shows TWPE removals for Allen and Belews Creek based on EPA's calculations in the ERG Memorandum, *Steam Electric Pollutant-Level Loadings and Removals for Each Wastestream and Regulatory Option*, (April 19, 2013), EPA-HQ-OW-2009-0819-2250. Incremental Biological TWPEs are based on the difference between Chemical Precipitation + Biological TWPEs and Chemical Precipitation TWPEs.

Table 14: EPA TWPE Removals for FGD Wastewater Preferred Options

Pollutant	Chemical Precipitation	Chem. Prec. + Biological	Incremental Biological	Percent of Total Bio TWPEs
Boron	14,229	229,585	215,356	20%
Cyanide	31,065	240,107	209,042	19%
Magnesium	73,283	449,793	376,510	35%
Manganese	808,286	945,888	137,602	13%
Cadmium	353,010	358,037	5,027	0.5%
SUM	**1,279,873**	**2,223,410**	**943,537**	**87.5%**

EPA's analysis is flawed because it did not consider what is actually being removed in the Belews Creek and Allen bioreactors. EPA's own data show very little removal, if any, of these constituents by the biological treatment system.

Table 15: Percent Removals of Boron, Magnesium, Manganese, Cyanide, and Cadmium in Belews Creek and Allen's Bioreactors Using EPA's Sampling Data

Pollutant	**Actual Belews Creek** **Percent Removal**	**Actual** **Allen** **Percent Removal**	**Percent Removal EPA Average Concentrations**
Boron	1%	6%	55%
Cyanide	1%	-17%	94%
Magnesium	-5%	0%	78%
Manganese	-5%	16%	86%
Cadmium	0%	0%	34%

The artificial TWPEs for biological treatment are due to the mixing of data sets from three different plants. The average concentrations EPA derived the average concentrations used to calculate annual TWPE removals for chemical precipitation effluent (or bioreactor influent) from Hatfield's Ferry, Keystone, and Miami Fort data. The average concentrations EPA used to calculate annual TWPE removals for chemical precipitation plus biological treatment are based on data (EPA-generated and self-monitoring data) from Belews Creek and Allen. The cyanide, boron, magnesium, and manganese concentrations are higher in the conceptual bioreactor influent at Hatfield's Ferry, Keystone, and Miami Fort than in the actual bioreactor influent at Belews Creek and Allen; therefore, EPA's TWPE removals for biological treatment are based on artificial removals. Thus, methodology for averaging concentrations from various plants creates artificial removals for biological treatment.

3. EPA Should Not Count TWPEs Removed by Biological Systems at Belews Creek and Allen when Influent and Effluent Data Show No Effective Removal

The table below contains the daily and average total boron and magnesium results from the EPA four-consecutive-day sampling events at Allen and Belews Creek. These data illustrate why apparent percent removals across treatment technologies, even when consistently observed, are not reliable and are well within the margins of sampling and analytical error.

EPA considered sample location SP-1 to be equivalent to the influent to treatment, and only grab samples were taken at that location. SP-2 and SP-3 were 24-hour composite samples, representing the effluent from chemical precipitation treatment and the effluent from biological treatment, respectively.

Boron and Magnesium Data from 4-Day FGD Sampling Events at Allen and Belews Creek

Sample and Analyte	**Day 1**	**Day 2**	**Day 3**	**Day 4**	**Average**
Results for total metals from Allen site (µg/L)					
SP-1 boron	54,000	62,000	80,000	100,000	74,000
SP-2 boron	55,000	54,000	59,000	64,000	58,000

Sample and Analyte	Day 1	Day 2	Day 3	Day 4	Average
SP-3 boron	65,000	66,000	63,000	61,000	63,800
SP-1 Mg	440,000	470,000	520,000	590,000	505,000
SP-2 Mg	420,000	400,000	420,000	420,000	415,000
SP-3 Mg	450,000	435,000	410,000	420,000	429,000
Results for total metals from Belews Creek site (µg/L)					
SP-1 boron	150,000	140,000	140,000	170,000	150,000
SP-2 boron	160,000	140,000	150,000	150,000	150,000
SP-3 boron	180,000	190,000	170,000	140,000	170,000
SP-1 Mg	830,000	760,000	670,000	710,000	743,000
SP-2 Mg	810,000	740,000	720,000	740,000	753,000
SP-3 Mg	890,000	760,000	750,000	740,000	785,000

For both Belews Creek and Allen, the average data values demonstrate that, over the four-day period of the EPA sampling, no meaningful removal of magnesium and boron occurred. Cases of *apparent* removal are related to unrepresentative grab sample influent (SP-1) concentrations and retention times within the treatment systems.

Using the average concentrations from the EPA sampling episode reports' four-successive-day sampling events to calculate percent removal, the results do not meet the criteria EPA adopted in the CWT ELG for effective removal. Even when there is a small amount of *apparent* removal, it is due to erratic influent results at the Allen site that may not be representative of the actual influent (*see* discussion below).

Percent Removals Based on EPA Data Four-Day Averages

Analyte	SP-1 to SP-2 percent removal (chem precip only)	SP-2 to SP-3 percent removal (bio treat only)	SP-1 to SP-3 percent removal (chem + bio)
Removals from Allen site			
Boron	21.6%	-9.1%	13.8%
Magnesium	17.8%	-3.3%	15.0%
Removals from Belews Creek site			
Boron	0%	-11.7%	-11.7%
Magnesium	-1.3%	-4.1%	-5.4%

Note: negative percent removals designate apparent increase of parameter across treatment.

None of the above calculated percent removals based on the four-day average data even comes close to meeting the EPA minimum criteria for effective removal as used historically in the ELG process. All the boron and magnesium removals across the biological treatment are negative for both sites.

The only apparent slight positive removals are from the Allen site, where the SP-1 FGD influent data was consistently rising from day one through day four. This apparent removal is insignificant and largely a function of the uncertainty, unrepresentativeness, and potential bias of the SP-1 sample collections (as discussed above), combined with the effects of retention time in the treatment system.

Our conclusion is that no effective removal is demonstrated by these data for magnesium or boron, for either chemical precipitation or biological treatment, and EPA should not take removal credits for these parameters when evaluating the technologies. When treatment retention times are considered, the apparent removal for boron and magnesium through chemical precipitation from the EPA data at the Allen site essentially disappears. The retention time between the FGD influent (SP-1) and chemical precipitation (SP-2) is about 44-46 hours, and the bio-treatment retention (SP-2 to SP-3) is about 19-20 hours for both the Belews Creek and Allen FGD treatment systems. These are significant retention times, and pairing data from the same day across the treatment system would be completely inappropriate. However, when the data remain steady, as they do for the four days at the Belews Creek site, then the problem is not evident in the percent removal calculations.

For Allen, however, the SP-1 concentrations for boron and magnesium shift significantly over the four days. Given the applicable retention times, it is a reasonable approximation to pair the SP-2 data from Days 3 and 4 with the SP-1 data from Days 1 and 2, respectively, and the SP-3 data from Days 2, 3, and 4 with the SP-2 data from Days 1, 2, and 3 for the Allen site to calculate percent removals.

Retention time adjusted percent removals for Allen treatment system

Pollutant	SP1 day 1 to SP2 day 3	SP1 day 2 to SP2 day 4	SP2 day 1 to SP3 day 2	SP2 day 2 to SP3 day 3	SP2 day 3 to SP3 day 4
boron in	54,000	62,000	55,000	54,000	59,000
boron out	59,000	64,000	66,000	63,000	61,000
Daily boron percent removal	-8.5%	-3.1%	-16.7%	-14.3%	-3.3%
magnesium in	440,000	470,000	420,000	400,000	420,000
magnesium out	420,000	420,000	435,000	410,000	420,000
Daily Mg percent removal	4.5%	10.6%	-3.4%	-2.4%	0%

Note: negative percent removals designate an apparent increase of parameter across treatment

Note that the apparent daily removals of boron and magnesium at the Allen site (when data from the same days are paired) are almost eliminated with the adjustments for retention time within the system. The percent recoveries have been reduced on a daily basis to an insignificant amount.

4. Self-Monitoring Data for Belews Creek and Allen Also Show Little Removal of Magnesium and Boron

UWAG's consultant URS examined a spreadsheet containing the self-monitoring data for magnesium and boron from Allen and Belews Creek.

URS first looked at the Belews Creek data. Data from all three sampling points were available only from June 2011 through June 2012 for boron and from October 2011 through June 2012 for magnesium. URS therefore selected only data from these time periods for performing the percent removal calculations. This resulted in about 57-58 data points from each sample location for boron and about 29-30 data points for each sample location for magnesium. The data were not continuous and averaged around 4-5 data points per month, but most of the time samples from the three locations were all taken on the same day.

The Belews Creek site shows much less variability in the EPA data, and this appears to hold true for the Belews Creek self-monitoring data as well. From the selected data, the ratio of the minimum-to-maximum sample concentration for all three sample locations was close to 2.5 for boron and less than 2.0 for magnesium. The apparent percent removals calculated in the table below are very low, and well within the range of incidental removal due to sampling and data uncertainty. In fact, the removal due to the biological treatment was apparently negative.

Percent Removals Based on the 2011-2012 Belews Creek Average Self-Monitoring Data

Analyte	SP-1 to SP-2 apparent percent removal (chem precip only)	SP-2 to SP-3 apparent percent removal (bio treat only)	Cumulative SP-1 to SP-3 apparent percent removal (chem + bio)
Boron	6.5%	-0.6%	5.9%
Magnesium	7.4%	-1.9%	5.9%

Based on the self-monitoring data from Belews Creek, EPA should not take credit for removal of magnesium and boron. The results demonstrate essentially zero removal of boron and magnesium and would not meet the criteria established by EPA in the CWT ELG for evaluating percent removal and cost-effectiveness.

For Allen, the self-monitoring data appear to be similar to the EPA data, in that the influent concentrations of boron and magnesium were much more variable at Allen, which caused variable boron and magnesium concentrations to be measured throughout the treatment system. Also, the sampling was not as uniform as the sampling at Belews Creek. Because of this, URS did not attempt to focus on a modified time segment of the data, but instead used all the available data, except for a single obviously erroneous boron concentration.

The ratio of the minimum to maximum concentrations, the standard deviations, and the relative standard deviations all demonstrate that the Allen data are far more variable than the Belews Creek data.

Percent Removals Based on Averages of All Allen Self-Monitoring Data

Analyte	SP-1 to SP-2 apparent percent removal (chem precip only)	SP-2 to SP-3 apparent percent removal (bio treat only)	cumulative SP-1 to apparent SP-3 percent removal (chem + bio)
Boron	8.0%	16.2%	24.2%
Magnesium	19.0%	4.7%	23.7%

Given how variable the data are, these apparent percent removals are not reliable and do not indicate effective treatment. Even on a cumulative basis, they are below the EPA CWT minimum criterion for effective treatment of 30% removal.

Also, there is no reason to expect actual boron or magnesium removal at Allen, when the same treatment technology at Belews Creek demonstrated essentially zero removal for these pollutants, and there is no chemical or biological mechanism for the removal of boron or magnesium. In addition, with the EPA data, when sample concentrations were paired based on treatment retention times, the apparent removal for the Allen site essentially disappeared. Finally, as noted above, the SP-1 sample location is not representative of the influent to treatment, which adds further uncertainty to these values.

5. There Is No Scientific Basis for Assuming Removal of Boron or Magnesium

In addition, there is no theoretical basis on which the removal of either boron or magnesium can be attributed to either the Belews Creek or Allen treatment systems. Based on URS's experience, the only case where boron removal has been observed in a wastewater treatment system has been in the porcelain enameling industry, where boron was a significant component of the particulate porcelain-enameling frit suspended in the influent wastewater. In this case, boron removal was observed when these solids settled out of the wastewater.

In contrast, based on the EPA data, essentially all the boron in FGD wastewater from the Allen and Belews Creek plants is dissolved, as is true for boron in the vast majority of wastewaters. Boron that is dissolved in water is present exclusively as a series of stable borate anions; the formation of boron cations is essentially unknown in aqueous solutions.

The most common of these anions is borate itself, or BO_3^-. More complex borate anions such as disodium octaborate tetrahydrate are similarly water soluble over wide pH ranges. Being stable anions, they do not form hydroxide or carbonate precipitates, and they are not known to form co-precipitation products with cation additives such as ferric iron.

Also, borates are not used biologically, and in fact biological treatment is shown to be ineffective by the very data from Allen and Belews Creek.

Magnesium, in addition to being a common water hardness cation that is ubiquitous in the environment, also cannot be removed by the chemical precipitation systems at these sites to levels that are lower than currently exist in the FGD influent. While magnesium hydroxide can precipitate at extremely high pH, the chemistry of magnesium includes many soluble magnesium cation complexes, so that even at high pH (>10.0), dissolved magnesium concentrations will typically still be well over 1000 mg/L. The magnesium concentration in the FGD influent (SP-1 sampling site) was only around 450 mg/L at Allen and around 800 mg/L at Belews Creek, both well below the solubility of magnesium even at high pH.

In short, there is no theoretical rationale for anything other than incidental removal of either magnesium or boron across these treatment systems. In fact, the data from the Allen and Belews Creek wastewater treatment systems demonstrate, at most, only incidental or apparent (false) removal.

Comment Response:

In response to comments, EPA revised its estimates of the effluent concentrations used in the loadings analysis for each pollutant for each treatment technology. In instances where EPA determined that no effective removal was demonstrated by the treatment technology for a given pollutant, EPA assumed that the effluent concentration would be equivalent to the effluent from the less advanced treatment system (e.g., if no treatment observed in chemical precipitation system, chemical precipitation system would be set equal to the settling pond effluent concentration). This approach ensured that no TWPE removals would be accounted for in the in cases where pollutant removals were not observed for the treatment system. Section 11 of the *Incremental Costs and Pollutant Removals for the Final Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category* (Cost & Loads Report) (DCN SE05831/SE05832) describes how EPA determined pollutant concentrations for use in calculating pollutant reductions for the BAT system components.

Regarding the calculation of percent removal, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 87.

Regarding the representativeness of the SP-1 sample location during the EPA sampling episodes, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 124 in Comment Code 4.b.

EPA disagrees with the commenter's argument that for certain pollutants the removals "would not meet the criteria established by EPA in the CWT ELG for evaluating percent removal and cost-effectiveness." EPA reviewed the CWT final rule TDD and has determined that EPA did not use a specific percent removal in its evaluating of pollutant loadings or cost-effectiveness. Rather, EPA used a percent removal threshold of 30 percent to identify pollutants for regulation. As noted in Section 7.7.1 of the CWT final rule TDD:

"After EPA eliminated pollutants of concern which were treatment chemicals, non-conventional bulk parameters, not detected at treatable levels, not treated, or volatile, EPA still had a lengthy list of pollutants which could be regulated…EPA eliminated pollutants that were removed by less than 30% with the proposed technology options for the organics subcategory and by less than 50% with the proposed technology options for the metals and oils subcategories." [Page 7-25 of the CWT final rule TDD].

Therefore, EPA concludes that the percent removal threshold was used in the CWT rulemaking as a way to identify regulated pollutant, not in the cost effectiveness analysis. Additionally, the percent removal threshold was used only because the list of pollutants meeting the criteria for the regulation was too long and EPA wanted to reduce the list of regulated pollutants to reduce the burden on the industry.

Based on EPA's revised pollutant removal analysis, EPA determined that neither the chemical precipitation nor the biological treatment system demonstrate effective removal of cyanide or magnesium in FGD wastewater. For this reason, EPA did not account for removal of these pollutants in its analyses for the final rule. However, EPA determined that the chemical precipitation system demonstrates removals of boron, cadmium, and manganese in FGD wastewater. For this reason, EPA did account for treatment of these pollutants associated with the chemical precipitation portion of the BAT technology, but EPA did not account for treatment of these pollutants associated with the biological treatment portion of the BAT technology.

Commenter Name: Elizabeth E. Aldridge, Hunton & Williams
Commenter Affiliation: UWAG
Document Control Number: EPA-HQ-OW-2009-0819-4655
Comment Excerpt Number: 98
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

c. There is No Observable Cyanide Removal from Biological Treatment

The treatment systems at the Belews Creek and Allen sites consist of chemical precipitation, followed by settling, and then biological treatment intended to remove additional mercury and selenium. These biological systems make no claim to cyanide removal, and, in fact, they do not demonstrate any cyanide removal on the wastewater at their respective facilities, as documented in the EPA SERs for these facilities. The following are the average cyanide results for all eight samples taken at the three SERs which EPA used to calculate cyanide removal for chemical precipitation treatment, and the two SERs EPA has used to calculate removals for biological treatment.

Average Cyanide Results at Treatment Stages Taken from EPA SERs (all mg/L, all 8 samples)

Site of WWTP	Average Influent to CP Treatment	Average Effluent from CP treatment (also influent to bio treatment at Allen and BC only)	Average Effluent from Biological Treatment	Percent removal of cyanide from Biological Treatment (from CP effluent)
Allen	0.26	0.094	0.11	no removal (-17%)

Site of WWTP	Average Influent to CP Treatment	Average Effluent from CP treatment (also influent to bio treatment at Allen and BC only)	Average Effluent from Biological Treatment	Percent removal of cyanide from Biological Treatment (from CP effluent)
Belews Creek	0.031	0.025	0.034	no removal (-36%)
Hatfield	0.525	0.141	No bio treatment	NA
Keystone	0.319	0.092	No bio treatment	NA
Miami Fort	3.15	2.4	No bio treatment	NA

All five SER facilities apparently had moderate removal of the reported cyanide results from the influent to chemical precipitation treatment to the effluent from chemical precipitation. For Allen and Belews Creek, where the chemical precipitation effluents went on to biological treatment, the apparent cyanide concentration remained essentially the same or even possibly increased. We say "apparent" because, as already noted, there is definite reason to believe that most, if not all, of the cyanide detections are forms of positive interference. There are two pieces of evidence that indicate that the last three chemical precipitation treatment-only sites have more interference than do Belews Creek and Allen.

1. The total dissolved solids (TDS) present in the three chemical precipitation-only sites are generally significantly higher than the TDS in the Belews Creek and Allen sites, and the TDS for Miami Fort is very much higher. Plant operators can, to a certain extent, control the TDS in the FGD scrubber water by increasing or decreasing the rate of blowdown. Decreased blowdown results in higher TDS. Before the advent of biological FGD treatment, a major operating issue was controlling the level of chlorides (corrosive) in order to protect the scrubber equipment. But biological processes are sensitive to TDS content, not just chloride content. Operators at these plants might also further reduce TDS to prevent biological treatment upsets. Whether this is a conscious decision or not, the TDS on average is much higher in the chemical precipitation-only wastewater, and consequently there is a much higher likelihood of interferences to the cyanide test.
2. There is another important difference at the chemical precipitation-only sites. For these sites, the effluent from the chemical precipitation treatment is essentially the final FGD discharge. All three of these sites – Hatfield, Keystone, and Miami Fort – were selected by EPA as chemical precipitation technology for the rule in part because these sites added organosulfide chemicals during the chemical precipitation process to enhance mercury removal. Allen and Belews Creek do not use these chemicals, because their chemical precipitation effluent will proceed to further treatment in a biological system that should provide the additional mercury removal. The problem is that these excess remaining organosulfide compounds form sulfide gas in the analytical testing procedure during the strong acid cyanide distillation process. This sulfide gas will distill over and get trapped in the alkaline sparger solution. The sulfides and organics will discolor the distillate and sometimes cause a milky precipitation. These conditions would result in a positive

interference to the colorimetric cyanide test. The use of these chemicals is another likely reason why the overall average cyanide concentration is greater in the chemical precipitation-only sites than for the sites that also have biological treatment.

Facility	Biological Treatment? Y/N	Average TDS Concentration in CP Effluent (8 samples)	Are Organo-sulfide Chemicals Added? Y/N
Allen	Y	8,956	No
Belews Creek	Y	16,887	No
Hatfield	N	15,813	Y
Keystone	N	25,688	Y
Miami Fort	N	29,563	Y

Comment Response:

Regarding the pollutant removals estimates for cyanide, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 95.

Regarding potential analytical interferences encountered with cyanide data, see response to DCN EPA-HQ-OW-2009-0819-4379-A1, Excerpt Number 69 in Comment Code 32 .

Commenter Name: Paul Chu
Commenter Affiliation: Electric Power Research Institute (EPRI)
Document Control Number: EPA-HQ-OW-2009-0819-4499-A1
Comment Excerpt Number: 50
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

4.3 Pollutant removals calculated by EPA for biological treatment are greater than those calculated by EPRI. EPA's estimate includes manganese, cyanide, magnesium, and boron removal, which is likely an artifact of using mismatched influent and effluent data sets rather than actual removal.

Using influent data from one group of power plants and effluent data from another group of power plants may create the false impression that the biological treatment system is removing constituents when, in fact, it is not. Since EPA had used this methodology, and EPRI has followed EPA's lead, it is important to examine possible removal artifacts.

Figure 4-3 shows calculated removal of constituents when the influent to the biological system represents the average of data from four plants using CP treatment (Hatfield's Ferry, Keystone, Miami Fort, Pleasant Prairie) and the effluent represents the average of data from two different plants using biological treatment (Allen and Belews Creek). EPA did not include Pleasant Prairie data in the present calculations. Because Pleasant Prairie's FGD wastewater treatment system meets the definition of BAT and its use had a minimal impact on CP effluent (Figure 4-1), EPRI recommends that the Pleasant Prairie data be included.

Because the four plants providing influent data have higher concentrations of manganese, cyanide, boron, and magnesium than the two plants (Allen and Belews Creek) providing effluent data, it falsely appears that removal of these constituents is occurring. It is important to evaluate the removal of these constituents at each individual plant using its own influent and effluent streams (as is done in Table 4-5). Figure 4-3 shows much lower biological removal at Allen and Belews Creek when this procedure is followed.

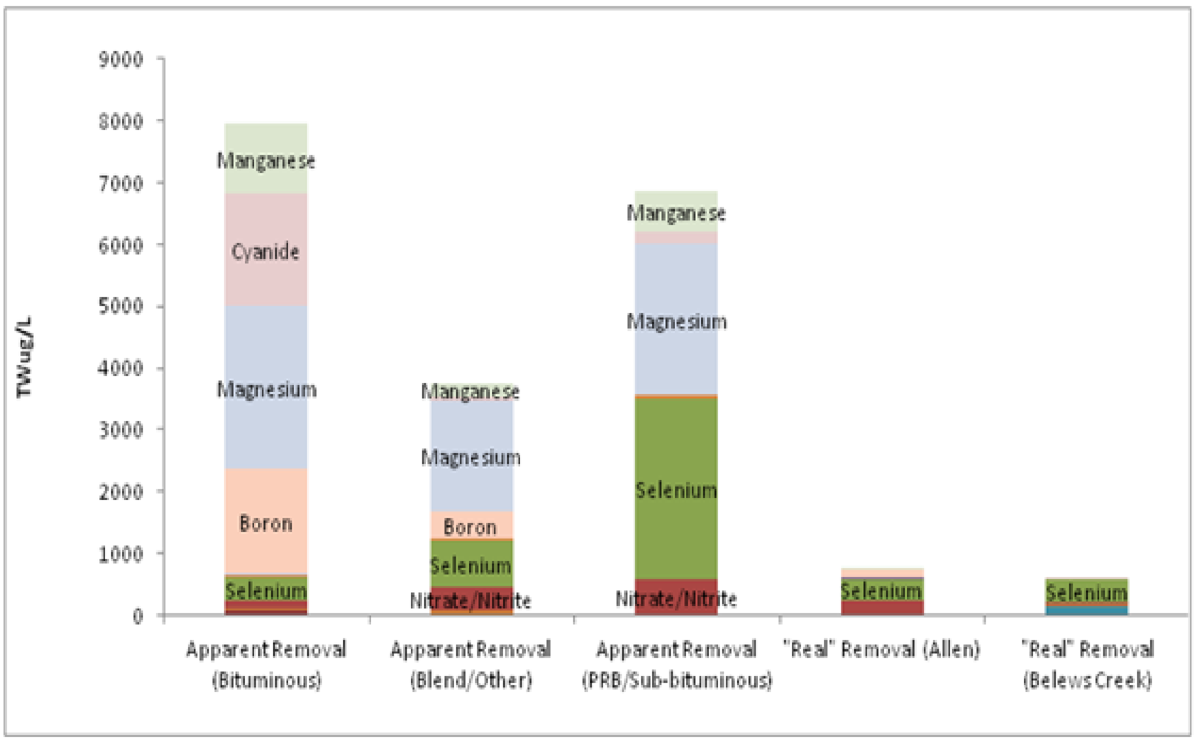


Figure 4-3
Estimates of Constituent Removal Using Biological Treatment
Source: ERG, 2011a–f

The ABMet anaerobic bioreactor, designed to remove selenium, also removes some nitrate/nitrite. It is not anticipated that biological treatment systems will remove manganese, cyanide, magnesium, or boron; there is no known mechanism to support the anoxic/anaerobic biological removal of these constituents. Removal of soluble manganese and cyanide requires oxidation processes. Magnesium is commonly removed by high-pH softening, which is incompatible with the anoxic/anaerobic process. Ettrengite precipitation, also a high-pH process, has been used to remove boron.

The average concentrations of manganese, cyanide, magnesium, and boron in influent and effluent streams of biological treatment are shown in Table 4-5. Little to no removal of these constituents occurs at Allen and Belews Creek. Figure 4-4 shows how CP Effluent (which is the same as Biological Influent) differs between the four plants used for CP evaluation by coal type and the two plants used for Biological Effluent. As illustrated in Figure 4-4, the four plants used for CP evaluation have much higher average concentrations of manganese, cyanide, magnesium, and boron than the two plants used for Biological Effluent. This leads to the false appearance of constituent removal, as described above.

Table 4-5
Evaluation of True Biological Removal of Four "Artifact" Constituents at Allen and Belews Creek

	Allen			Belews Creek		
	Biological Influent (µg/L)	Biological Effluent (µg/L)	Removal (%)	Biologial Influent (µg/L)	Biological Effluent (µg/L)	Removal (%)
Magnesium	675,500	676,000	–	702,500	739,000	–
Cyanide	88	104	–	33.4	33.0	1
Manganese	1,279	1,072	16	2,701	2,844	–
Boron	94,717	78,616	17	164,431	168,000	–

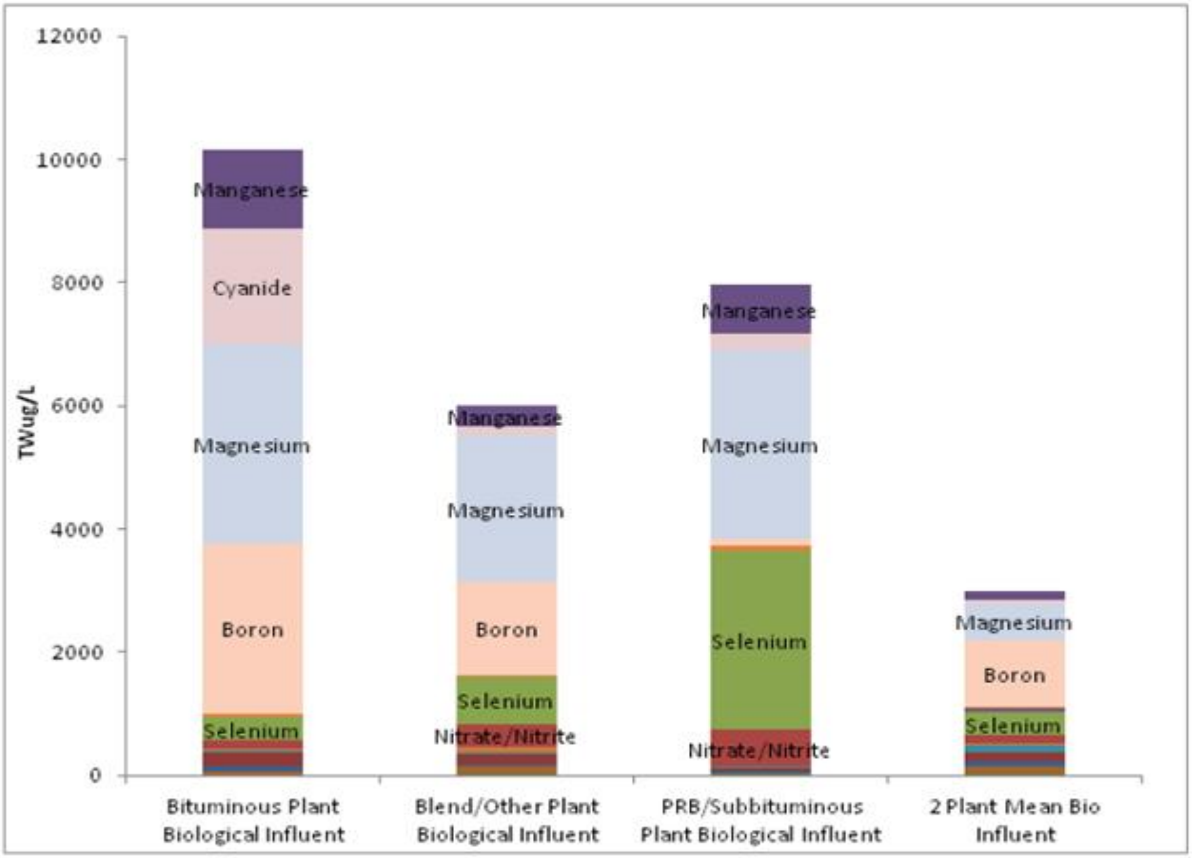


Figure 4-4
Comparison of Biological Influent for Plants Used in Treatment Evaluation
Source: ERG, 2011a–f

Comment Response:

Regarding the pollutant removal estimates for biological treatment, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 95.

Regarding the inclusion of Pleasant Prairie data in EPA's analyses, see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 53 in Comment Code 9.a.

Commenter Name: Chris M. Hobson
Commenter Affiliation: Southern Company
Document Control Number: EPA-HQ-OW-2009-0819-4379-A1
Comment Excerpt Number: 70
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

EPA counted TWPEs for Pollutants Not Removed by the Treatment System

Using the EPA sampling data, the TWPE reductions for boron, magnesium, manganese, cadmium, and cyanide account for 87% of the TWPEs removed by biological treatment. But those TWPEs are simply not accurate. Table 11 shows TWPE removals for Allen and Belews Creek based on EPA's calculations in the ERG Memorandum, *Steam Electric Pollutant-Level Loadings and Removals for Each Wastestream and Regulatory Option* (April 19, 2013), EPA-HQ-OW-2009-0819-2250. Incremental Bilogical TWPEs are based on the difference between Chemical Precipitation + Biological TWPEs and Chemical Precipitation TWPEs.

Table 11: EPA TWPE Removals for FGD Wastewater Preferred Options

Pollutant	Chemical Precipitation	Chem. Prec. + Biological	Incremental Biological	Percent of Total Bio TWPEs
Boron	14,229	229,585	215,356	20%
Cyanide	31,065	240,107	209,042	19%
Magnesium	73,283	449,793	376,510	35%
Manganese	808,286	945,888	137,602	13%
Cadmium	353,010	358,037	5,027	0.5%
SUM	**1,279,873**	**2,223,410**	**943,537**	**87.5%**

EPA's analysis is flawed because it did not consider what is actually being removed in the Belews Creek's and Allen's bioreactors. EPA's own data show very little removal, if any, of these constituents by the biological treatment system. Table 12 provides percent removals for boron, cyanide, magnesium, manganese, and cadmium using actual plant-specific data for both Belews Creek and Allen.

Table 12: Percent Removals of Boron, Magnesium, Manganese, and Cyanide in Belews Creek and Allen's Bioreactors Using EPA's Sampling Data

Pollutant	Actual Belews Creek Percent Removal	Actual Allen Percent Removal	Percent Removal EPA Average Concentrations
Boron	1%	6%	55%
Cyanide	1%	-17%	94%
Magnesium	-5%	0%	78%
Manganese	-5%	16%	86%
Cadmium	0%	0%	34%

The artificial TWPEs for biological treatment are due to the mixing of data sets from three different plants. The average concentrations EPA used to calculate annual TWPE removals for chemical precipitation are based on data from Hatfield's Ferry, Keystone, and Miami Fort. The average concentrations EPA used to calculate annual TWPE removals for chemical precipitation plus biological treatment are based on data from Belews Creek and Allen. The cyanide, boron, magnesium, and manganese concentrations are higher in the bioreactor influent at Hatfield's

Ferry, Keystone, and Miami Fort than in the bioreactor influent at Belews Creek and Allen; therefore, EPA's TWPE removals for biological treatment are based on artificial removals. This methodology for averaging concentrations from various plants creates artificial removals for biological treatment.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 95.

Commenter Name: Pamela F. Faggert
Commenter Affiliation: Dominion Resources, Inc.
Document Control Number: EPA-HQ-OW-2009-0819-4631-A1
Comment Excerpt Number: 38
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

We believe there are errors in the analysis of biological treatment pollutant removals and costs which significantly alter the economics considered by EPA in the proposal. As mentioned above the proposed biological treatment limitations assume influent data from Allen and Belews Creek is representative of average influents at other facilities. Yet, the nitrate/nitrite levels in the Allen and Belews Creek influents contain distinctly lower levels of nitrate/nitrite in relation to other facilities. Furthermore , it appears that Allen and Belews Creek did not collect nitrate/nitrite data after completing the start-up modes of their treatment systems. We believe that reliance on these two stations overestimates the effectiveness and the capabilities of biological treatment technologies. As a consequence of overestimating technological effectiveness, the cost effectiveness analysis in the proposed rule is likewise in error.

The proposal also indicates that biological treatment removes significant amounts of boron, manganese , magnesium, and cyanide. According to the sampling data, boron, manganese, magnesium, and cyanide account for 87% of all the pounds of pollutants removed by biological treatment. Biological treatment systems data from Belews Creek and Allen, however, showed less than 10% and less than 25% removal of these pollutants respectively. Overall, this indicates that biological systems remove little boron, manganese, magnesium, and cyanide resulting in an overestimation in the number of pounds of pollutants removed by biological treatment systems. As above, the overestimation of pollutants removed results in an erroneous estimation in the cost effectiveness of biological treatment as cost-effectiveness changes in inverse proportion to the number of pounds of pollutants removed .

Comment Response:

Regarding influent concentration of nitrate/nitrite, see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 44 in Comment Code 10.b.

Regarding boron, manganese, magnesium, and cyanide, see response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 95.

Commenter Name: Tom DeLawrence
Commenter Affiliation: Public Service Company of New Hampshire(PSNH)
Document Control Number: EPA-HQ-OW-2009-0819-4633-A1
Comment Excerpt Number: 25
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

In evaluating biological treatment as a viable technological option, EPA collected and ultimately utilized too small a data set that is also too homogeneous and not representative of the variant FGD waste water discharges throughout the industry. UWAG discusses at length the fatal shortcomings of EPA's data set for FGD waste water and PSNH incorporates those comments by reference as if set out fully herein. See UWAG Comments at Section VI, B-F. The following are the most notable deficiencies in the agency's data set.

EPA considered essentially only one biological treatment system in its analysis, the system employed by Duke Energy at its Belews Creek and Allen facilities. The systems at those two plants are virtually identical, as they utilize the same design provided by the same vendor and involve substantially the same operating conditions due to those plants burning similar fuel mixes, which gives the plants' FGD influents similar properties and concentrations of metals, nutrients, and other waste water constituents. EPA's evaluation does not take into consideration any of the facilities burning petroleum coke, Powder River Basin, or lignite fuels. See TDD at 6-5 (noting that 1-5 plants burn petroleum coke and 1-5 plants burn lignite). EPA's conclusion that biological treatment is a viable control technology is based upon a limited evaluation of a single set of circumstances and therefore does not suffice to justify requiring an otherwise unproven technology as a control option to the rest of the industry.

Comment Response:

See responses to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Numbers 84 and 99 in Comment Code 10.a, and 124 in Comment Code 4.b.

Commenter Name: Elizabeth E. Aldridge, Hunton & Williams
Commenter Affiliation: UWAG
Document Control Number: EPA-HQ-OW-2009-0819-4655
Comment Excerpt Number: 83
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Having sampled at only three facilities with chemical precipitation and biological treatment for FGD wastewater, as already noted, EPA decided not to use the effluent results for Dickerson.[33] As a result, EPA's assessment of biological treatment is based on only two plants, Allen and Belews Creek. Those two facilities burn the same coal and have FGD wastewater treatment plants. Duke Energy completed the Belews Creek wastewater treatment system in 2008, and it used experience gained from the design and operation of Belews Creek to build the same type of treatment system (with some improvements) at Allen as well.

There are similarities between the Belews Creek and Allen plants. For instance, they burn a similar mix of coals, and both plants' influent to the FGD treatment system is low in TSS, total dissolved solids (TDS), and chlorides and therefore relatively easy to treat. Other plants with influents higher in TSS, TDS, and chlorides will present more challenges for the treatment system.

---

[33] In addition to not using *any* FGD data from Widows Creek, Homer City, Big Bend, and Mitchell, even though EPA sampled each of those facilities, EPA also decided not to use the 2008 monitoring effluent data from Duke's Roxboro facility, which it analyzed in some depth for the Detailed Study. *See* Detailed Study at 4-51 to 4-55.

Comment Response:

The chemical precipitation stage of the BAT technology is designed, and system operating conditions are adjusted on an ongoing basis, to account for variations in the FGD wastewater. As demonstrated in the plants that operate a chemical precipitation system with hydroxide and sulfide addition, these chemical precipitation systems are proven to manage the variability of FGD wastewater prior to biological treatment. See response to DCN EPA-HQ-OW-2009-0819-4448-A1, Excerpt Number 24 in Comment Code 9.a. Higher influent concentrations of TSS will be appropriately handled in the chemical precipitation portion of the BAT system. EPA reviewed Steam Electric Survey data for each plant discharging FGD wastewater and determined that the concentrations of TDS and chlorides at these plants are within the acceptable range for the microorganisms within the bioreactor. Additionally, EPA notes that the commenter has provided no additional data to support its assertion that conflicts with EPA's analysis. Also see responses to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Numbers 84 and 99 in Comment Code 10.a, and 124 in Comment Code 4.b.

The commenter states that "EPA also decided not to use the 2008 monitoring effluent data from Duke's Roxboro facility." EPA used the Roxboro data in its calculation of the FGD purge average concentrations and the calculation of the settling pond effluent concentrations. Regarding data from the biological treatment effluent from Roxboro, EPA did not use these data because the Roxboro plant does not operate an upstream chemical precipitation system and, therefore, does not represent the BAT option.

Regarding EPA's decision not to use the Widows Creek, Homer City, Big Bend, and Mitchell monitoring data, see response to DCN EPA-HQ-OW-2009-0819-4499-A1, Excerpt Number 48 in Comment Code 8.d.

Commenter Name: Kim Mireles
Commenter Affiliation: Luminant
Document Control Number: EPA-HQ-OW-2009-0819-4614-A1
Comment Excerpt Number: 17
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

EPA inappropriately includes TWPEs for constituents that are not removable by biological treatment.

For biological treatment of FGD wastewater in particular, EPA's calculated benefits (that is, the number of TWPEs removed) are overestimated.[7] Most of the TWPEs removed are associated with constituents that are *not* removed by biological treatment. The pollutant reductions EPA counted for boron, magnesium, manganese, and cyanide are not removed in the bioreactors at Belews Creek and Allen. These reductions are an artifact of the methodology used to calculate TWPE removals. Luminant believes EPA should have eliminated TWPEs for constituents with less than 25% removal due to many issues associated with the data collected (sampling location, unpaired sampling, mixing data from different plants, and other problems).

---

[7]Most of the TWPEs removed are associated with constituents that are *not* removed by biological treatment. EPA counted pollutant reductions for boron, magnesium, manganese, and cyanide at Belews Creek and Allen, two plants significantly different influent characteristics than other sampled plants. These pollutants are not removed in the bioreactors. These reductions are an artifact of the methodology used to calculate TWPE removals.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 95.

Commenter Name: Bruce W. Ramme
Commenter Affiliation: We Energies
Document Control Number: EPA-HQ-OW-2009-0819-4475-A1
Comment Excerpt Number: 31

External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

For development of pollutant removal estimates, EPRI removed the values associated with manganese, cyanide, magnesium, and boron as these parameters are *not* removed by the biological treatment system. EPA used the CP Effluent from three plants (Duke Energy's Miami Fort Station ["Miami Fort"], RRI Energy's Keystone Generating Station ["Keystone"], and Allegheny Energy's Hatfield's Ferry Power Station ["Hatfield's Ferry"]) as the bioreactor influent and the BIO effluent from two plants (Duke Energy Carolina's Belews Creek Steam Station ["Belews Creek"] and Allen Steam Station ["Allen"]) to calculate the pollutant removal estimates. EPRI evaluated the pollutant removal estimates at each individual plant using its own influent and effluent streams. The data shows that little to no removal of manganese, cyanide, magnesium, and boron occurs at Allen and Belews Creek. Thus, EPA's pollutant removals for biological treatment are based on artificial removals associated with a misapplication of a mixed dataset.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 95.

Commenter Name: Cari Boyce
Commenter Affiliation: Duke Energy
Document Control Number: EPA-HQ-OW-2009-0819-4305-A3
Comment Excerpt Number: 51
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

This flawed methodology is evident upon examination of the TWPE removal estimate for a combined chemical precipitation and biological treatment system. Based on the industry-level pollutant-specific removals achieved under Regulatory Option 4a (chemical precipitation plus biological for FGD wastewater), EPA calculated 2,615,337 TWPE removed[7] annually from FGD wastewater[8]. Upon examination of the pollutant-specific removal and Duke Energy's extensive expertise with biological treatment, approximately 85% of this total TWPE removed is attributed to pollutants that are not removed in a biological system (see Table 1-1 below), but are actually "artificial removals".

[7] ERG Memorandum Steam Electric Pollutant-Level Loadings and Removals for Each Wastestream and Regulatory Option, April 19, 2013. [DCN SE03970].

[8] These same amounts were included for Options 2, 3 and 4 as well as a proportionate amount for Option 3b for facilities with scrubbed capacity over 2000MWs.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 95.

Commenter Name: Pamela F. Faggert
Commenter Affiliation: Dominion Resources, Inc.
Document Control Number: EPA-HQ-OW-2009-0819-4631-A1
Comment Excerpt Number: 32
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

For chemical precipitation plus biological treatment, EPA used biological treatment data from onl y two facilities. Both facilities, Belews Creek and Allen, are owned and operated by the same utility, Duke Energy. These two facilities bum the same type of fuel and have very similar influents with low TSS, Total Dissolved Solids (TDS), and nitrate/nitrite levels that are distinctly different from influents at many other facilities. We believe reliance on these two facilities lacks the diversity of representation and does not recognize any variability in the application of the technology that will necessarily arise at facilities that use different fuels, have different influent and environmental characteristics, and have divergent operational needs.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4655-A2, Excerpt Number 20 and DCN EPA-HQ-OW-2009-0819-4655, Excerpt Numbers 84 and 99 in Comment Code 10.a, and 124 in Comment Code 4.b regarding EPA's use of available data to evaluate the performance of the BAT technology.

See response to DCN EPA-HQ-OW-2009-0819-4448-A1, Excerpt Number 24 in Comment Code 9.a regarding the treatment effectiveness of the chemical precipitation component of the BAT technology that reduces the variability in the wastewater prior to entering biological treatment.

Commenter Name: Paul Chu
Commenter Affiliation: Electric Power Research Institute (EPRI)
Document Control Number: EPA-HQ-OW-2009-0819-4499-A1
Comment Excerpt Number: 49

External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

4.2The incremental pollutant removal of biological treatment should be evaluated in assessing the pollutant removal of this technology. This is important because most constituents are removed by the CP system, which makes it impossible to evaluate the cost-effectiveness of a biological treatment system in addition to CP.

EPA presents the pollutant removal of FGD wastewater treatment as the combined pollutant removal of CP + biological treatment. However, only about 15% of EPRI's calculated CP + biological pollutant removal is attributed to biological treatment. About 85% of the TWPE is removed via CP (Table 4-4).

Table 4-4
Comparison of EPA and EPRI Calculated Industry Pollutant Removal of Treating FGD Wastewater

	EPA[a] (TWPE per year)	EPRI (TWPE per year)
Incremental Biological	1,087,000[b]	136,000
CP + Biological	2,620,000	987,000

[a] Source: EPA, 2013, page 10-25
[b] The Incremental Biological treatment pollutanat removal was not directly provided by EPA. This was calculated by subtracting the CP pollutant removal estimate from the CP + Biological pollutant removal estimate.
TWPE = toxic-weighted pounds equivalent

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4305-A3, Excerpt Number 52 and 54.

Commenter Name: Chris M. Hobson
Commenter Affiliation: Southern Company
Document Control Number: EPA-HQ-OW-2009-0819-4379-A1
Comment Excerpt Number: 65
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

EPA's TWPE analysis for FGD wastewater has two major flaws. First, EPA merged the benefits of chemical precipitation and biological benefits together, showing the TWPEs removed for the combination of both of these two treatment systems. This is not valid, because most of the TWPEs removed are removed by the chemical precipitation system. The two treatments should be evaluated independently.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4305-A3, Excerpt Number 52 and 54.

Commenter Name: Chris M. Hobson
Commenter Affiliation: Southern Company
Document Control Number: EPA-HQ-OW-2009-0819-4379-A1
Comment Excerpt Number: 61
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

To estimate post-compliance loadings for the chemical precipitation plus biological treatment option, EPA used its average concentrations for chemical precipitation plus biological treatment systems, as summarized in Table 10-5 of the 2013 TDD at 10-13. EPA developed the average concentrations using only data from the two FGD wastewater treatment systems at Belews Creek and Allen.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4655-A2, Excerpt Number 20 and DCN EPA-HQ-OW-2009-0819-4655, Excerpt Numbers 84 and 99 in Comment Code 10.a, and 124 in Comment Code 4.b regarding EPA's use of available data to evaluate the performance of the BAT technology.

See response to DCN EPA-HQ-OW-2009-0819-4448-A1, Excerpt Number 24 in Comment Code 9.a regarding the treatment effectiveness of the chemical precipitation component of the BAT technology that reduces the variability in the wastewater prior to entering biological treatment.

Commenter Name: Elizabeth E. Aldridge, Hunton & Williams
Commenter Affiliation: UWAG
Document Control Number: EPA-HQ-OW-2009-0819-4655

Comment Excerpt Number: 90
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

To estimate post-compliance loadings for the chemical precipitation plus biological treatment option, EPA used its average concentrations for chemical precipitation plus biological treatment systems, as summarized in Table 10-5 of the 2013 TDD at 10-13. EPA developed the average concentrations using only data from the FGD wastewater treatment systems at Belews Creek and Allen.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4655-A2, Excerpt Number 20 and DCN EPA-HQ-OW-2009-0819-4655, Excerpt Numbers 84 and 99 in Comment Code 10.a, and 124 in Comment Code 4.b regarding EPA's use of available data to evaluate the performance of the BAT technology.

See response to DCN EPA-HQ-OW-2009-0819-4448-A1, Excerpt Number 24 in Comment Code 9.a regarding the treatment effectiveness of the chemical precipitation component of the BAT technology that reduces the variability in the wastewater prior to entering biological treatment.

Commenter Name: Cari Boyce
Commenter Affiliation: Duke Energy
Document Control Number: EPA-HQ-OW-2009-0819-4305-A3
Comment Excerpt Number: 50
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

The methodology evaluates the chemical precipitation with biological treatment as one technology, when in fact, it is two separate technologies. By evaluating these two technologies as one system, EPA has failed to give credit to the performance and, thus, pollutant removal of a chemical precipitation system.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4305-A3, Excerpt Number 52 and 54.

Commenter Name: Chris M. Hobson
Commenter Affiliation: Southern Company
Document Control Number: EPA-HQ-OW-2009-0819-4379-A1
Comment Excerpt Number: 67
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Third, EPA counted TWPE removals for pollutants – such as boron, magnesium, manganese, and cyanide – that are *not removed* by biological treatment. This makes a significant difference in the estimated TWPEs removed for biological treatment.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 95.

Commenter Name: Cari Boyce
Commenter Affiliation: Duke Energy
Document Control Number: EPA-HQ-OW-2009-0819-4305-A3
Comment Excerpt Number: 35
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

Duke Energy further contends that EPA's annual TWPE removal analysis is flawed and overestimates the TWPE removed by a biological treatment system while underestimating the TWPE removed in a chemical precipitation system.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 95.

Commenter Name: Paul Chu
Commenter Affiliation: Electric Power Research Institute (EPRI)
Document Control Number: EPA-HQ-OW-2009-0819-4499-A1
Comment Excerpt Number: 4
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

EPA's pollutant removal estimate for biological treatment includes manganese, cyanide, magnesium, and boron removal, which appears to be an artifact of using mismatched influent and effluent data sets.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 95.

Commenter Name: Barbara A. Walz
Commenter Affiliation: Tri-State Generation and Transmission Association, Inc.
Document Control Number: EPA-HQ-OW-2009-0819-4465-A1
Comment Excerpt Number: 2
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

The FGD wastewater benefits were also incorrectly calculated, reflecting an artifact of mismatched influent and effluent data rather than actual biological treatment technology reductions.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 95.

Commenter Name: Kim Mireles
Commenter Affiliation: Luminant
Document Control Number: EPA-HQ-OW-2009-0819-4614-A1
Comment Excerpt Number: 6
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

- EPA inappropriately includes constituents that are not removable by biological treatment.

Comment Response:

See response to DCN EPA-HQ-OW-2009-0819-4655, Excerpt Number 95.

10.d. FGD Bio – NWQI

Commenter Name: Thomas Cmar
Commenter Affiliation: Earthjustice, et al.
Document Control Number: EPA-HQ-OW-2009-0819-4684-A1
Comment Excerpt Number: 81
External Review Flag: No External Review
External Review Incorporated into Response: No

Comment Excerpt:

The minimal non-water quality impacts of chemical precipitation plus biological treatment do not weigh against their selection as BAT. EPA has estimated that the "energy increases associated with Regulatory Option 3 will be less than eight thousandths of a percent (0.008%) of the total electricity generated by all electric power plants."[322] Although the chemical precipitation and biological treatment backwash will create additional solid waste, EPA estimates that the "increases associated with Regulatory Option 3 will be less than 0.001 percent of the total solid waste generated by all electric power plants."[323] EPA also found that recycling water at five high-flow FGD treatment systems, already economical because it reduces the size of the needed biological treatment system, would reduce freshwater intake by 7.7 million gallons per day.[324] These water savings are likely an underestimate, as they do not account for the reuse of post-treatment FGD wastewater in other plant processes, so long as the FGD wastewater meets the effluent limits before it is mixed with any other waters. Thus, EPA's record fully supports a conclusion that the non-water environmental quality impacts support a determination that biological treatment is BAT for FGD wastewater.

---

[322] EPA-HQ-OW-2009-0819-2133, at 6. Because Option 3 includes biological treatment for FGD wastewater, but not dry handling for bottom ash, the estimated incremental energy usage for this option is a better approximation of the impacts associated with biological treatment.

[323] *Id.* at 13.

[324] *Id.* at 15.

Comment Response:

EPA agrees with the commenter that the final BAT effluent limitations, which include FGD limitations based on chemical precipitation followed by biological treatment for existing generating units that are not oil-fired and that have a nameplate capacity of more than 50 MW, have acceptable non-water quality environmental impacts. See preamble sections VIII and XII for additional information.

As described in Section 12.4 of the TDD, EPA estimated a reduction in intake water withdrawal from plants operating "high flow" FGD systems that could reuse untreated FGD wastewater by increasing the rate of recycle within the FGD system. EPA acknowledges the commenter's assessment that the estimated intake withdrawal reduction associated with the rule is likely an underestimate because EPA did not estimate water reductions associated with other, non-"high flow" FGD systems. Other plants may choose to increase the rate of recycle in their FGD systems or recycle treated FGD wastewater effluent; however, EPA did not receive sufficient information to quantify a similar reduction in intake water usage from these plants.