NOTE

Subject: EPA Comments on Dynegy Midwest Generation Inc. – Baldwin Power Station, Baldwin, IL
Round 10 Draft Assessment Report

To: File

Date: May 25, 2012

1. Please make a global change of "inspection" to "assessment" in relation to the contractor's activities.
2. Please include copies of stability analyses reports.
3. Appendix A, Limitations, is written for "Alliant" and "Wisconsin" not "Dynegy" and "Illinois" Please correct.
4. It appears from the subsection in section 1.2, that the only units that have instrumentation are SFAP and SP, if this is correct, please add a statement in the descriptions for the other units that no instrumentation exists at those units.
5. In the last sentence of section 2.1.10, remove the first "no"
6. Please correct the grammar in the first sentence of section 2.1.13: "The crest of the Secondary Dike generally had an access road that was generally grassy be appeared to have been graveled in the past."
7. Please include the recommendation for development of an Emergency Action Plan in section 3 of the report.
8. It is requested that either in Appendix C- the checklist, or in section 1.2 there be a specific statement made to address the following question: “Is any part of the impoundment built over wet ash, slag, or other unsuitable materials (like TVA)?” Please correct for each impoundment.

Comments on Draft Report
Dynegy Midwest Generation – Baldwin Energy Complex
By Paul Mauer, Jr., P.E.
Senior Engineer
Illinois Dam Safety Program

In general, it is important that the report correctly reflect the regulation of structures in Illinois. All man-made structures intended to impound or divert water, or other fluids, are regulated by the Illinois Department of Natural Resources' Dam Safety Program. All the structures covered in the report are subject to those regulations. The NPDES permit program in Illinois is administered by the Illinois Environmental Protection Agency.

Executive Summary

Assessments

PFAP –

5. The structure has sufficient freeboard to store the PMP event without discharge. Hydraulic / hydrologic analysis is not justified.

6. Storm loading events are short term conditions that seldom change the stability profile of an engineered embankment. Without specific concerns regarding short term stability, storm condition analysis is not justified.

7. It is not documented that no stability analysis was performed for the design of the Intermediate Embankment. That it is currently not available from the owner does not effect the condition of the PFAP.

Based upon items 3 and 4, I concur with the condition assessment of Poor.

SFAP-

3. The slide described is a typical surface failure in fine grained soil. This event is not a threat to the dam if it is repaired quickly. The report indicates this was the case. As such, it is an observation of a typical maintenance item.

Based upon the observations the condition of the SFAP should be Fair. The analyses recommended in 4 and 5 should be completed as secondary studies.

Secondary Pond –

1 & 2. The referenced studies are not available, if completed for design. The structure shows no signs of hydraulic or stability deficiencies. The evidence of potential seepage issues is related to the SFAP, but seepage analysis is not indicated for that structure. The lack of seepage evidence at the complex indicates the original design and construction properly addressed seepage. Lacking historic or visual evidence of need for these analyses, they are secondary studies at best.

Based upon the observations the condition of the Secondary Pond should be Satisfactory.

Intermediate Pond –

3. & 6. The inspection report indicates the concrete is “along the overflow spillway”. The overflow spillway is located over the rockfill section of the spillway. Placement of the concrete appears to bring into question either the gradation of the original rockfill or of the roadway gravel layer placed over the rockfill, relative to surface flow. In either case, it does not indicate an erosion issue at the surface of the fine material in the embankment and the gravel layer placed between it and the rockfill. The inspection documentation does not raise the issue of erosion at that level. The observation is indicative of the misunderstanding of maintenance personnel regarding the effective use of grout. The inspectation observation does indicate that the rockfill has trapped fine CCW to the point that the lowest portion no longer is open to flow. This does not appear to be the case for the Final Pond spillway section.

4. The inspection report and the interviews appear to raise only the cement grout as evidence of insufficient spillway capacity. There is no indication of an issue in the structure immediately downstream, which has the same design capacity. While additional investigation is appropriate, there is nothing which suggests that additional hydraulic/hydrologic analysis is critical.

5. This office has not been provided a copy of the URS analysis, thus I cannot comment on the apparent use of improper or inconsistent values. GZA’s general comment is based, in part, or a concern over the lack of consideration for a storm event loading analysis of embankment stability. The Illinois Dam Safety Office does not agree with this concern. Typical upstream depth variation for the condition noted does not result in a significant change in load. The duration of the referenced event is insufficient to materially change the phreatic surface in fine grained soils that are the norm in Illinois. The comment may have some applicability to the rockfill spillways in the Intermediate and Final ponds, however the primary question would be the potential for internal erosion by the design flow through the rock fill, not the potential for a slope failure. For the embankments composed of fine grain soil materials, the analyses appear to be sufficient.

With regard to seismic capacity, the failure to demonstrate a F.S. of 1.0 for the 2% chance in 50 years event is typical in the southern half of Illinois. Because the pseudo-static analysis is not typical of the expected failure mechanism, a result less than 1.0 simply indicates an incomplete analysis of seismic capacity. The analysis is completed by a determination of the vertical deformation during the design seismic event. With the exception of SFAP, there is sufficient freeboard on the embankments to meet the seismic performance requirements.

Based upon the observations, the condition of the Intermediate Pond should be Fair. The additional Hydraulic/Hydrologic analysis is a secondary study.

Final Pond –

4. & 5. Comments are the same as in Intermediate Pond above.

Based upon the observations, the condition of the Final Pond should be Fair. The additional Hydraulic/Hydrologic analysis is a secondary study.

3.3 Recurrent Operation & Maintenance Recommendations

1. Increased mowing of the grasses on the embankments to facilitate inspections and reduce the risk of burrowing animals.

The inspection reports and photos show a vigorous stand of grass. This office would be overjoyed to have this vegetative cover at every dam in the state. It appears unfortunate that the inspectors and the owner did not schedule the inspection for a time when the embankments were recently mowed. Given the time required, it may have been virtually impossible to facilitate a concurrent inspection under that condition. With regard to animal activity, the purpose of dense vegetative cover is to protect the embankment from erosion, both by rainfall and overtopping by storms that exceed design. There are other ways to control animal activity. Increased mowing is not called for at these structures. The owner should be urged to provide this vegetative in areas now covered with trees, brush and weeds.

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O'Fallon, IL 62269
618.206.5905

DYNEGY

Via Overnight Delivery

July 2, 2012

United States Environmental Protection Agency
Two Potomac Yard
2733 South Crystal Drive
5th Floor, N-5237
Arlington, Virginia 22202-2733

Attn: Mr. Stephen Hoffman

RE: DMG Comments on Draft Assessment of Dam Safety of Coal Combustion Surface Impoundments at the Baldwin Energy Complex, dated March 15, 2012

Mr. Hoffman:

Dynegy Midwest Generation, LLC (DMG), by its agent Dynegy Operating Company, appreciates the opportunity to review and comment upon the March 15, 2012 draft dam assessment report of the Baldwin Energy Complex ash pond systems, written by GZA GeoEnvironmental, Inc. ***We are enclosing a marked-up copy of selected pages of the draft report, which includes our consolidated comments.*** These attached revisions are minor and are provided for clarification purposes.

With respect to the draft report recommendations and while we have had initial consultations with our independent, 3rd party, geotechnical engineering consultant - URS Corporation (URS) - DMG and URS will review the recommendations in greater detail.

General Comments

DMG offers the following general comments:

1. To avoid confusion and for consistency with formal documents that already exist in the public domain, such as permit applications, groundwater report submittals, etc., DMG recommends that the ash pond designations on the attached figure, labeled as the Baldwin Energy Complex Ash Pond Systems, be used in the assessment report and associated figures.

2. The northwestern portion of the overall ash pond system is a significant cut/incision area, and, therefore, a berm system is not installed. Also, a berm system of a considerable length does not extend along the northern perimeter of the ash pond system. Furthermore, the eastern and southeastern portions of the perimeter embankments do not impound standing water. In summary, significant areas of the surface impoundment perimeter do not impound any water at all. This should be taken into consideration as part of the overall assessment and rating.

3. The Illinois Environmental Protection Agency (IEPA) generally regulates surface impoundment systems in their entirety and does not separately regulate the individual, internal cells within a larger surface impoundment system. Therefore, the assessment report should follow this approach and provide an assessment on the surface impoundment as a whole, as opposed to assessing the various internal cells of the overall ash pond system.

4. The northern dike, secondary dike, ash pond dike, and intermediate embankment, as designated on Figure 2 of the draft assessment report, are interior partition berms and do not serve as perimeter berms. Notably, a dam safety permit from the Illinois Department of Natural Resources (IDNR) or a construction permit from the IEPA would not be required for the construction of an internal/partition berm. Therefore, an assessment of these four interior berms is outside the scope of the assessment and should be removed from the assessment report.

5. Referring the attached figure, labeled as the Baldwin Energy Complex Ash Pond Systems, the inactive fly ash pond and the primary fly ash pond are essentially inactive and do not impound surface water. DMG also understands that the scope of the assessment, as stated by the USEPA, includes "the assessment of closed units that no longer receive coal combustion residues or by-products but still contain free liquids". GZA has apparently assumed that these two inactive surface impoundments contain free liquids, without performing a paint filter (free liquid) test. DMG recommends that a paint filter (free liquid) test be conducted, to determine the presence of free liquids, before the report is finalized.

6. With respect to the recommendations for the secondary, intermediate, and final ponds, DMG initiated a significant restoration project to increase the efficiencies of these three lower surface impoundments in November 2011. The project is ongoing and includes the following scope:
    - Drain and mechanically dredge the secondary, intermediate, and final surface impoundments;
    - Remove the secondary dike and, thereby, remove the intermediate pond;
    - Re-establish the normal pond water elevations on both the secondary pond and final pond, from 398' to 393' mean sea level;

- Reduce the width of the secondary pond;
- Replace and significantly extend the discharge pipe from the primary fly ash pond impoundment to the secondary pond;
- Replace/install overflow standpipe and support/access structures on both the secondary and final ponds; and
- Install flow measuring weir on the final pond overflow pipe.

The final assessment report should be updated to include this project. As a result of this ongoing project, DMG recommends that the following recommendations be removed from the final assessment report:

- Repair the discharge pipe from the PFAP northern decant;
- Complete a seepage and/or stability analysis of the secondary dike; and
- Complete a hydraulic/hydrologic analysis of the intermediate pond.

7. With respect to the scarp present on the downstream slope of the northern embankment, identified as a secondary fly ash pond deficiency item, those repairs were implemented in June 2012. Therefore, this deficiency item has been addressed and the final report should reflect that.

8. With respect to the recommendation for tree clearing from the slopes and crests of the embankments, DMG is concerned that tree clearing could cause damage, as opposed to leaving the trees undisturbed. Also, the mature tree growth of approximately 45 years does provide erosion protection.

<u>Specific Comments</u>

DMG, after initial consultations with URS, offers the following, more-detailed, comments on specific recommendations and statements in the draft assessment report. For ease of review, the USEPA/GZA recommendation/statement is italicized; and, the respective DMG/URS comment is provided immediately afterwards.

1. *"Pending the results of the complete seepage and stability analysis for each impoundment, modify the design or operation of the impoundments to provide conditions that result in embankments that meet generally accepted factors of safety."* (Executive Summary, "Repair Recommendations", #4, page iv).

   The values for "generally accepted factors of safety" are dependent upon the reference used to identify the factors of safety. DMG/URS recommends using a modified version of the factors of safety utilized by the Illinois Department of Natural Resources (IDNR) for the permitting of new dams.

Because the IDNR Guidelines address the permitting of new dams and the Baldwin Energy Complex impoundment is an existing impoundment system, the factors of safety proposed by the IDNR should not apply. As an alternative, DMG/URS recommends using the modified minimum factors of safety listed in Table 1 as criteria for the impoundments at the Baldwin Energy Complex.

Table 1 – Proposed Minimum Factor of Safety Criteria for DMG's Baldwin Impoundments

Loading Condition	Analysis Type	Minimum Factor of Safety without Seismic Forces	Minimum Factor of Safety with Seismic Forces
Normal Operating Level (Steady Seepage)	Drained (Steady-State Seepage)	1.5	1.0
100-yr, 24 Hour Storm Water Level	Drained and Undrained	1.4[1]	N/A
Rapid (Sudden) Drawdown	Drained/Undrained[2]	1.2	N/A

[1]Recommended factor of safety for this type of analysis by the US Army Corps of Engineers.
[2]Rapid drawdown analyses will use a multi-stage approach as recommended by the US Army Corps of Engineers.

DMG requests USEPA/GZA's concurrence on the use of these proposed minimum factor of safety criteria for the Baldwin Energy Complex impoundments.

2. *"…establish a complete seepage and stability analysis for each impoundment."* (Executive Summary, #2 of the recommended studies and analysis, page iii).

   The secondary and intermediate ponds are cross-valley impoundments with the ponds in series. Water levels within these ponds are maintained at similar elevations, so the seepage gradient would essentially be 0.
   This is a moot point because, as previously discussed, the secondary dike was removed in November 2011, eliminating the intermediate pond.

3. *"However, GZA observed several instances where the values used in the URS analysis did not correlate to the values reported in the Woodward Clyde Failure Analysis. In addition, there were soil types (eg. riprap, sand and gravel filter) that were not part of the Woodward Clyde Failure Analysis and no justification was provided in the URS analysis for the soil parameters used in the analysis."* (Section 2.6.2, #1, page 21).

   The difference in soil properties for clay from the 1995 analyses to the 2011 analyses is that the clay was assumed to be fully softened in the 2011 analyses. The concept of fully softened clay was not used in practice in 1995. URS updated the properties to account for newer procedures. Items such as rip rap were not part of the section analyzed in the 1995 analyses. When the 2011 analyses were performed, engineering judgment was used to select appropriate parameters for these new materials.

4. *"The analysis of the ash pond dike did not provide justification that the Section used represented the critical section of the embankment."* (Section 2.6.2, #3, page 21).

   The dikes used to create the Intermediate and Final Ponds are approximately 900 and 680 feet long. The critical section was considered to be the section with the tallest berm height and was therefore selected for analysis. Without geotechnical investigation and specific data that indicated a non-homogenous condition, we believed this was a reasonable approach.

5. *"The analysis for section F-F' through the overflow section of the Settling Pond Dike assumes a water surface that follows the base of the rockfill in the section and exits at the downstream slope near the toe. Based on the conditions observed during GZA's inspection, water exits the downstream slope within several feet of the crest of the impoundment. The analysis also assumed the tail-water elevation to be at the ground surface. However, there appeared to be several feet of water on the downstream toe at the time of our inspection. Therefore, the assumed water table within the embankment and along the downstream toe does not match the observed conditions. An analysis with a modeled water table that more closely matches the observed conditions may result in a low FOS."* (Section 2.6.2, #4, page 21).

   USEPA/GZA stated that water conditions observed at the final pond during their site visit were different than that included in URS' analysis. One item raised was the absence of water at the downstream toe in the analysis. URS believes the toe water conditions for the settling pond dike analysis were conservative. Including standing water at the toe of the embankment, as recommended by USEPA/GZA, would effectively buttress the embankment and increase the slope stability factor of safety.

   Since water at the toe may not exist during dry conditions (USEPA/GZA visited in plant in May 2011, typically a wet portion of the year), it would be unconservative to rely on the ponded water.

   In addition, USEPA/GZA observed seepage "within several feet of the crest of the impoundment". URS inspections have observed seepage lower on the exterior slope of the final pond, but higher than used in the 2011 analysis. URS reran the cross section having water exiting the exterior slope at the same elevation as the flat contact between the earthfill and rockfill. The factor of safety was calculated to be 1.3 using these parameters.

6. *"After the failure of the western portion of the southern embankment the normal pool level in the SFAP area was lowered to an elevation of approximately 430 feet (MSL). Subsequently, the Intermediate Embankment was constructed to relieve the stresses on the failed portion of the southern embankment."* (Section 1.2.4, page 5, 5th paragraph).

   This statement is not completely accurate. The portion of the embankment that failed was over an old stream channel. The dike was degraded in the area of movement to relieve the stress. In addition, the water level within the pond was lowered. The construction of the splitter dike was to maintain the use of the eastern portion of the pond with water at a higher elevation.

* * * * *

In conclusion, as discussed above, DMG/URS has identified numerous technical issues with the draft assessment report. DMG requests a phone conference with USEPA/GZA to discuss and/or clarify these issues.

If you have any questions regarding our comments on the draft report, please contact Mr. Phil Morris, P.E.,a member of my staff, directly at (618) 206-5934.

Sincerely,
Dynegy Midwest Generation, LLC
by its agent Dynegy Operating Company

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Enclosures

FROM THE PFAP, THE EFFLUENT IS DIRECTED TO THE SECONDARY POND, VIA A DISCHARGE PIPE EXTENDING FROM THE PFAP TO THE NORTHERN SECTION OF THE SECONDARY POND.

EXECUTIVE SUMMARY

This Inspection Report presents the results of a visual inspection of the Dynegy Midwest Generation, Inc. (Dynegy) – Baldwin Energy Complex (BEC) Coal Combustion Waste (CCW) Impoundments located at 10901 Baldwin Road, Baldwin, Illinois. These inspections were performed on May 24 and 25, 2011 by representatives of GZA GeoEnvironmental, Inc (GZA), accompanied by representatives of Dynegy.

The BEC is a three-unit coal-fired power plant, with a maximum generating capacity of approximately 1800 Megawatts. Commercial operation of the facility began in the 1970's. Unlined earthen embankment CCW Impoundments (Primary Fly Ash Pond, Intermediate Pond, and Final Pond) were constructed in conjunction with the BEC facility for the purpose of storing and disposing non-recyclable CCW from the BEC facility and clarification of water prior to discharge. The Primary Fly Ash Pond (PFAP) was expanded in 1981 to the south and west and included the area that was later split into the Secondary Fly Ash Pond (SFAP). The PFAP was originally constructed with 35 foot embankments and was expanded vertically in 1989 with a 20 foot 'raise'. In response to a failure of the southern embankment of the PFAP in February 1995, an Intermediate Embankment was constructed and resulted in the separation of the SFAP from the PFAP. A berm (Secondary Dike) was constructed upstream of the Intermediate Pond in approximately 1998 and resulted in the construction of the Secondary Pond.

ACCUMULATED RAINWATER IS DIRECTED FROM THE SFAP TO THE SECONDARY POND, VIA A GRAVITY FLOW DISCHARGE PIPE.

Water and CCW is discharged into the PFAP where the CCW is allowed to settle. ~~and water is discharged into the SFAP and the Secondary Pond. Solids are further settled in the SFAP prior to water discharge to the Secondary Pond.~~ Water flows sequentially through the Secondary, Intermediate and Final Ponds for further clarification prior to discharge of the water near the southwest corner of the property. *

For the purposes of this EPA-mandated inspection, the sizes of the impoundments were based on U. S. Army Corps of Engineers (COE) criteria. Based on the maximum crest height of 55 feet and a storage volume of approximately 10,000 acre-feet, the PFAP is classified as an **Intermediate** sized structure. Based on the maximum crest height of 55 feet and a current storage volume of 1,650 acre-feet, the SFAP Impoundment is classified as an **Intermediate** sized structure. Based on the maximum crest height of 12 feet and a storage volume of approximately 190 acre-feet, the Secondary Pond is classified as a **Small** sized structure. Based on the maximum crest height of 20 feet and a storage volume of approximately 40 acre-feet, the Intermediate Pond is classified as a **Small** sized structure. Based on the maximum crest height of 32 feet and a storage volume of approximately 72 acre-feet, the Final Pond is classified as a **Small** sized structure.

According to guidelines established by the COE, dams with a storage volume less than 1,000 acre-feet and/or a height less than 40 feet are classified as Small sized structures and dams with a storage volume between 1,000 acre-feet and 50,000 acre-feet and/or a height between 40 feet and 100 feet are classified as Intermediate sized structures.

Under the EPA classification system, as presented on page 2 of the EPA check list (**Appendix C**) and Definitions section (**Appendix B**), it is GZA's opinion that the PFAP, SFAP and the Final Pond would be considered as having a **Significant** hazard potential. The hazard potential rating is

CONDITIONED FLY ASH IS HAULED, OVER LAND, TO THE SFAP. THE FLY ASH PORTION OF THE PFAP IS FULL AND INACTIVE.
RAINFALL ACCUMULATION IS DIRECTED FROM THE PFAP TO THE SFAP, VIA SEVERAL OUTLET PIPES INSTALLED IN THE INTERMEDIATE BERM.

1.2 Description of Project

1.2.1 Location

The BEC is located about ¾ -miles north of Baldwin in Randolph County, Illinois and the entrance to the Site is on Baldwin Road. The BEC CCW impoundments are located about ½ mile southwest of the power plant, at approximately latitude 38° 11' 33" North and longitude 89° 52' 05" West. A Site locus of the impoundments and surrounding area is shown in **Figure 1**. An aerial photograph of the impoundments and surrounding area is provided as **Figure 2**. The impoundments can be accessed by vehicles from an earthen access road from the BEC.

1.2.2 Owner/Caretaker

The CCW impoundments are owned by Dynegy Midwest Generation, ~~Inc~~ LLC. and operated by the BEC.

	Dam Owner/Caretaker
Name	Dynegy Midwest Generation, ~~Inc~~ LLC, Baldwin Energy Complex
Mailing Address	10901 Baldwin Road
City, State, Zip	Baldwin, Illinois 62217
Contact	~~Charles Nerone~~ RANDY SHORT
Title	~~Operations Manager~~ MANAGING DIRECTOR
E-Mail	~~charles.nerone~~ RANDY.SHORT@dynegy.com
Daytime Phone	618-785-3244
Emergency Phone	911

1.2.3 Purpose of the Impoundments

The BEC is a three-unit coal-fired power plant, with a maximum generating capacity of approximately 1,800 Megawatts. Commercial operation of the facility began in the 1970's. Unlined earthen embankment CCW Impoundments (Primary Fly Ash Pond, Intermediate Pond, and Final Pond) were constructed in conjunction with the BEC facility for the purpose of storing and disposing non-recyclable CCW from the BEC facility and clarification of water prior to discharge. The Primary Fly Ash Pond (PFAP) was expanded in 1981 to the south and west and included the area that was later split into the Secondary Fly Ash Pond (SFAP). The PFAP was originally constructed with 35 foot embankments and was expanded vertically in 1989 with a 20 foot 'raise'. In response to a failure of the southern embankment of the PFAP in February 1995, an Intermediate Embankment was constructed and resulted in the separation of the SFAP from the PFAP. A berm (Secondary Dike) was constructed upstream of the Intermediate Pond in approximately 1998 and resulted in the construction of the Secondary Pond.

Process water and sluiced CCW IS DISCHARGED are discharged into the PFAP, where the CCW is allowed to settle and water is discharged (decanted) into ~~the SFAP and~~ the Secondary Pond. RAINWATER ACCUMULATION ~~Solids are further settled~~ in the SFAP ~~prior to water discharge~~ to the adjoining Secondary Pond (refer to Figure 2). Water flows sequentially through the Secondary, Intermediate and Final

THE FLY ASH PORTION OF THE PFAP IS FULL AND INACTIVE. CONDITIONED FLY ASH IS HAULED, OVER LAND, TO THE SFAP.

Ponds for further clarification prior to discharge via the decant structure located near the southwest corner of the property.

1.2.4 Description of the Primary Fly Ash Pond and Appurtenances

The original embankments of the PFAP, which were constructed in 1969, were designed by Sargent & Lundy. The 1981 expansion and 1989 vertical expansion were designed by Illinois Power Company. Following the failure of a portion of the southern embankment in 1995, a failure analysis was conducted by Woodward Clyde Consultants (Failure Analysis).[2] Although it was not one of the remedial options presented by Woodward Clyde, an Intermediate Embankment was designed by Illinois Power Company and was constructed within the PFAP in response to the 1995 failure. The following description of the impoundment is based on information provided in the Failure Analysis, Sargent & Lundy Design Drawings,[3] Illinois Power Company Drawings,[4] other information received from BEC, and observations made by GZA during our Site visit.

The PFAP Impoundment is located southwest of the BEC. The PFAP functions as a sedimentation basin for bottom ash, fly ash ~~and scrubber solids~~ which are discharged into two distinct areas of the impoundment for ease of recycling and disposal. The impoundment receives bottom ash and ~~other scrubber solid slurry~~ in the northern portion of the impoundment through a series of 10-inch diameter steel pipes. Water used to sluice bottom ash and other scrubber solids is discharged to the Secondary Pond through a decant structure which is located along the western embankment of the impoundment. The location of the discharge pipes and decant structure is shown in **Figure 3**. *

THE FLY ASH PORTION OF THE PFAP IS FULL AND INACTIVE.

CONDITIONED AND HAULED, OVER LAND, TO THE SFAP.

Fly ash is ~~sluiced into the southern portion of the PFAP for storage and disposal of the fly ash through a 12-inch diameter steel pipe. Fly ash is allowed to settle and water~~ ACCUMULATED RAINWATER is discharged from the southern portion of the PFAP through five 12-inch diameter decant pipes which are located along the Intermediate Embankment. The location of the decant structures and discharge pipes is shown in **Figure 3**. *

The PFAP Impoundment consists of an earthen embankment with a crest length of approximately 3.2 miles and a general height (from the lowest downstream toe elevation to the crest of the impoundment) of approximately 15 feet along the northern embankments and approximately 55 feet along the southern embankments. The following description of the PFAP embankments was provided in the Failure Analysis:

"2.1 ORIGINAL DIKE DESIGN AND CONSTRUCTION

The original dike was constructed during November 1969 using "earthfill" and "impervious fill" material as shown in the drawings. We presume both types of material were actually low plastic clay fill obtained on-site within the present pond area. The original embankment section had a 15-ft wide crest and 3H:1V side slopes between Station 46+66 and 58+77. (Dike stationing refers to stationing for the original dike construction as shown on construction drawings.

[2] "Geotechnical Investigation, Baldwin Power Station: Fly Ash Pond South Dike, Balwin, Illinois" by Woodward-Clyde Consultants, dated September 7, 1995. (Failure Analysis).
[3] Several Sargent & Lundy drawings from the original impoundment design were available. A complete list of the drawings reviewed is provided in Appendix F.
[4] The 1981 expansion, 1989 Vertical raise and the intermediate embankment were designed by Illinois Power Company Engineers.

water elevation. The water from the PFAP that enters the northern decant structure discharges upstream of and flows into the Secondary Pond.

1.2.5 Description of the Secondary Fly Ash Pond Impoundment and Appurtenances

The SFAP was separated from the PFAP after construction of the Intermediate Embankment in 1996. Therefore, the design history for the SFAP follows that described in Section 1.2.4 for the PFAP. The following description of the impoundment is based on information provided in the Failure Analysis,[5] Sargent & Lundy Design Drawings,[6] Illinois Power Company Drawings,[7] other information received from BEC, and observations made by GZA during our Site visit.

CURRENTLY, CONDITIONED FLY ASH IS HAULED OVER LAND TO THE SFAP.

HAD HISTORICALLY RECEIVED

~~The~~ SFAP is located southwest of the BEC and west of the PFAP. The impoundment was constructed in 1969 and serves as a settling pond and final disposal location for CCW generated by the BEC. The SFAP ~~receives~~ water and unsettled solids from the fly ash portion of the PFAP through a series of five decant pipes which extend through the Intermediate Embankment. Water is discharged from the SFAP to the Secondary Pond through a decant structure which is located near the northwest embankment of the SFAP. The location of the discharge pipes from the PFAP and the decant structure are shown in **Figure 8**. *

The SFAP consists of an earthfill embankment with a crest length of approximately 1.3 miles and a general height (from the lowest toe elevation to the crest of impoundment) of approximately 30 feet along the northern embankment and approximately 55 feet along the southern portion. The design of the exterior embankments and the Intermediate Embankment that makes up the SFAP are as described in Section 1.2.4 for the PFAP. Please refer to Section 1.2.4 for details of the design.

Instrumentation at the impoundment includes one well, nine vibrating wire piezometers, and four inclinometers in the area of the 1995 failure. The instrument locations are shown on **Figure 9**.

1.2.6 Description of the Secondary Pond Impoundment and Appurtenances

The Secondary Pond is a cross-valley impoundment that was created when the Secondary Dike was constructed upstream of the Ash Pond Dike in the Intermediate Pond. The Secondary Dike was designed by Illinois Power Company. The following description of the impoundment is based on information provided in the Illinois Power Company Drawings,[8] other information received from BEC, and observations made by GZA during our Site visit.

The Secondary Pond is located southwest of the BEC and west of the PFAP and SFAP. The impoundment was separated from the Intermediate Pond by the Secondary Dike and serves as a settling pond for solids that may not have settled in the PFAP and the SFAP.

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[5] "Geotechnical Investigation, Baldwin Power Station: Fly Ash Pond South Dike, Baldwin, Illinois" by Woodward-Clyde Consultants, dated September 7, 1995. (Failure Analysis).

[6] Several Sargent & Lundy drawings from the original impoundment design were available. A complete list of the drawings reviewed is provided in Appendix F.

[7] The 1981 expansion, 1989 Vertical raise and the intermediate embankment were designed by Illinois Power Company Engineers.

[8] The 1981 expansion, 1989 Vertical raise and the intermediate embankment were designed by Illinois Power Company Engineers.

The Secondary Pond receives water and unsettled solids from the PFAP through a discharge pipe which is located northeast of the Secondary Dike. Water and solids enter the Secondary Pond from the SFAP through a decant structure and discharge pipe which is located along the southern slope of the valley. Water is discharged from the Secondary Pond into the Intermediate Pond through a series of six (6) 18 inch steel decant pipes that extend through the Secondary Dike. The location of the discharge pipes from the PFAP and SFAP and the decant pipes through the Secondary Dike are shown in **Figure 10**.

The Secondary Pond is formed by a cross valley embankment (Secondary Dike) with a crest length of approximately 700 feet and a general height (from the lowest toe elevation to the crest of impoundment) of approximately 12 feet. Based on the information provided in the Illinois Power Company Drawings, the Secondary Dike was constructed by placing bottom ash on the existing ground surface in the pond area to create a working pad above the partially dewatered pond. Fill of an unknown nature was placed on the bottom ash to form the embankment. The embankments were constructed with 4H:1V upstream and 2H:1V downstream slopes and the crest was 15 feet wide. The embankments were designed with 18-inches of riprap on the upstream and downstream embankments and a 15-foot wide gravel access road on the crest. A 50-foot wide, open channel spillway was designed and constructed along the embankment with an elevation of 400 feet MSL. Typical design cross sections of the Secondary Dike and details of the decant pipes are shown on **Figure 11.**

Instrumentation at the impoundment includes a flow meter located on one of the decant pipes as shown in **Figure 11.**

1.2.7 Description of the Intermediate Pond Impoundment and Appurtenances

The Intermediate Pond is a cross-valley impoundment that was designed by Sargent & Lundy. During design and construction, the embankment that forms the Intermediate Pond was referred to as the Ash Pond Dike[9]. The following description of the impoundment is based on the Sargent & Lundy Design Drawings,[10] information received from BEC, and observations made by GZA during our Site visit.

BOTTOM ASH

The Intermediate Pond is located southwest of the BEC, west of the PFAP, and is adjacent to and downstream of the Secondary Pond as shown in **Figure 2**. The impoundment was constructed in 1969 and serves as a settling pond and final settling and disposal location for ~~CCW~~ generated by the BEC. The Intermediate Pond originally extended upward into the valley several hundred feet but was modified into the current configuration with the construction of the Secondary Dike. The Intermediate Pond receives water and unsettled solids from the Secondary Pond through the Secondary Pond decant pipes. Water is discharged from the Intermediate Pond into the Final Pond through a decant structure which is located along the Ash Pond Dike. The approximate location of the discharge pipes from the Secondary Pond and the decant structure are shown in **Figure 12**. Design details of the decant structure design are shown in **Figure 14.**

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[9] The term "Ash Pond Dike" was used in the Sargent & Lundy Design Drawings and will be used herein for convenience and consistency.

[10] Several Sargent & Lundy drawings from the original impoundment design were available. A complete list of the drawings reviewed is provided in Appendix F.

The Ash Pond Dike consists of an earthfill embankment with a crest length of approximately 900 feet and a general height (from the lowest downstream toe elevation to the crest of impoundment) of approximately 20 feet at the decant structure.

Based on the information provided in the Sargent & Lundy Design Drawings, the Ash Pond Dike was designed using an "impervious fill" core and "earthfill" shell. Based on information contained in the Failure Analysis, the impervious fill likely consisted of lean clay and the earthfill likely consists of loess deposits as both materials were generally available on the Site. The embankment was designed with 3H:1V upstream slopes and 3.5H:1V downstream slopes. The upstream and downstream slopes were designed with a one (1) foot thick layer of sand and gravel over the earthfill. A one (1) foot, 1.5 feet, and 2 feet thick layer of riprap was designed over the sand and gravel on the upstream, crest and downstream slopes, respectively. Gravel was used to fill in the voids of the riprap at the crest to create an access road. The crest elevation at the decant structure was designed to be approximately elevation 398.33 feet (MSL). The design and typical sections through the Ash Pond Dike are provided on **Figures 13 and 14**.

The overflow spillway was designed for the Ash Pond Dike by 'cutting' a V-shaped spillway into the embankment northwest of the decant structure. The spillway was 14.5 feet wide at the base and 100 feet wide at the top with a designed bottom elevation of 385 feet MSL, which is eight (8) feet below the current inlet elevation (elevation 394 feet MSL) of the decant structure. Therefore, it appears that the overflow spillway has a key role in discharging water from the impoundment. The elevation of the spillway results in continuous flow of water through the overflow spillway. The spillway was filled with "rockfill" and the crest access road was constructed over the spillway. The downstream slope portion of the spillway design included a 12 feet 'thick' (measured parallel to a level surface, not perpendicular to the slope) layer of 'rockfill' that extended to the toe. The typical section for the overflow spillway is shown on **Figure 14**.

1.2.8 Description of the Final Pond Impoundment and Appurtenances

The Final Pond is a cross-valley impoundment that was designed by Sargent & Lundy. During design and construction, the embankment that forms the Intermediate Pond was referred to as the Settling Pond Dike[11]. The following description of the impoundment is based on the Sargent & Lundy Design Drawings,[12] information received from BEC, and observations made by GZA during our Site visit.

The Final Pond is located southwest of the BEC, west of the PFAP, and adjacent to and downstream of the Intermediate Pond as shown in **Figures 2 and 12**. The impoundment was constructed in 1969 and serves as a settling pond and final settling and disposal location for BOTTOM ASH ~~CCW~~ generated by the BEC. The Final Pond receives water and unsettled solids from the Intermediate Pond through the Intermediate Pond decant structure and associated discharge pipe. * Water is discharged from the Final Pond to a drainage ditch that is adjacent to the southern portion of the utility property through a decant structure which is located near the southwest edge of the Final Pond. The approximate location of the discharge pipes from the Intermediate

[11] The term "Settling Pond Dike" was used in the Sargent & Lundy Design Drawings and will be used herein for convenience and consistency

[12] Several Sargent & Lundy drawings from the original impoundment design were available. A complete list of the drawings reviewed is provided in Appendix F.

Pond and the decant structure are shown in **Figure 12**. Details of the decant structure design are shown in **Figure 14.**

The Settling Pond Dike consists of an earthfill embankment with a crest length of approximately 680 feet and a general height (from the lowest downstream toe elevation to the crest of the impoundment) of approximately 32 feet at the decant structure.

Based on the information provided in the Sargent & Lundy Design Drawings, the Settling Pond Dike was designed using an "impervious fill" core and "earthfill" shell. Based on information contained in the Failure Analysis, the impervious fill likely consisted of lean clay and the earthfill likely consists of loess deposits as both materials were generally available on the Site. The embankment was designed with 3H:1V upstream and downstream slopes. The upstream slope was armored with a one (1) foot thick layer of sand and gravel over the earthfill, followed by a one (1) foot thick layer of riprap from the toe to an elevation of 385 feet MSL. Above elevation 385 feet MSL, the upstream slope was armored with a 6-inch thick layer of gravel fill. The downstream slope was armored with a one (1) foot thick layer of sand and gravel over the earthfill. A two (2) foot thick layer of riprap was placed over the sand from the toe to an elevation of approximately 377 feet MSL. Above elevation 377 feet MSL, the downstream slope was armored with a 6-inch thick layer of gravel fill. The Settling Pond Dike included a 2-feet thick, sand and gravel drainage blanket that varied in elevation from 377 feet to 384 feet MSL. The crest elevation was designed to be at approximately elevation 400 feet. The design and typical sections through the Settling Pond Dike are provided on **Figure 13 and 14**.

The overflow spillway designed for the Settling Pond Dike was similar to that designed for the Ash Pond Dike. The difference between the overflow spillway for the Settling Pond Dike was in the details of the downstream toe construction as shown on **Figure 14**.

1.2.9 Operations and Maintenance

The impoundments are operated and maintained by BEC personnel. Operation of the PFAP Impoundment includes periodic movement of the ash discharge pipelines. Operation of the SFAP, Secondary Pond, Intermediate Pond and Final Pond includes periodic adjustment of the decant elevations.

~~Operation and maintenance~~ DISCHARGES of the BEC facility, ~~including the impoundments, is~~ ARE regulated by the ILLINOIS EPA under the National Pollutant Discharge Elimination System (NPDES) Permit No. IL0000043. The BEC personnel perform visual inspections of the impoundments on a weekly basis and the inspection results are documented in a field log book. Starting in 2009, the impoundments were inspected by professional engineers on an annual basis.

1.2.10 Size Classification

For the purposes of this EPA-mandated inspection, the sizes of the impoundments were based on U. S. Army Corps of Engineers (COE) criteria. Based on the maximum crest height of 55 feet and a storage volume of approximately 10,000 acre-feet, the PFAP is classified as an **Intermediate** sized structure. Based on the maximum crest height of 55 feet and a current storage volume of 1,650 acre-feet, the SFAP Impoundment is classified as an **Intermediate** sized structure. Based on the maximum crest height of 12 feet and a storage volume of

2.1.8 SFAP Crest of Impoundment (Photos 36, 37, 39, 47 and 48)

The crest of the SFAP Impoundment was generally covered by a gravel access road. The crest of the impoundment had occasional pot holes along its entire length; particularly along the eastern and southern embankments of the impoundment. With the exception of the area of the 1995 Failure, the alignment of the crest appeared generally level, with no large depressions or irregularities observed. Based on information provided by BEC personnel, the crest elevation outside the 1995 Failure area is approximately elevation 455 feet MSL.

The crest was lowered 21 feet to an elevation of 434 feet MSL along a portion of the southern embankment in response to the 1995 Failure as shown in Photo 47. No significant settlement or evidence of continued movement was observed at the time of our inspection. There was approximately 4 feet of free board at the time of our inspection.

2.1.9 SFAP Downstream Slope (Photos 32, 33, 34, 35, 40 through 46, and 49)

The condition of the downstream slope of the SFAP impoundment was obscured along much of the southern embankment due to thick vegetation including trees up to 16 inches in diameter. Grass that had not been recently mowed was present on the remaining portions of the downstream slope.

A scarp was observed near the crest of the downstream slope of the northwestern embankment at the approximate location shown on **Figure 8**. The scarp was approximately 100 feet wide along the slope and extended approximately 30 feet to 40 feet down the slope. The vertical face at the head of the scarp was approximately 2 feet high. The scarp had reportedly developed 2 weeks prior to our inspection and repair of the scarp has been completed since our visit according to BEC personnel. Moist surface conditions that may have been an indicator of seepage were observed along the toe of the southern embankment. However, we were not able to confirm the nature or extent of moist conditions due to the thick vegetation.

2.1.10 SFAP Ash Discharge Pipes (Photos 52 through 54)

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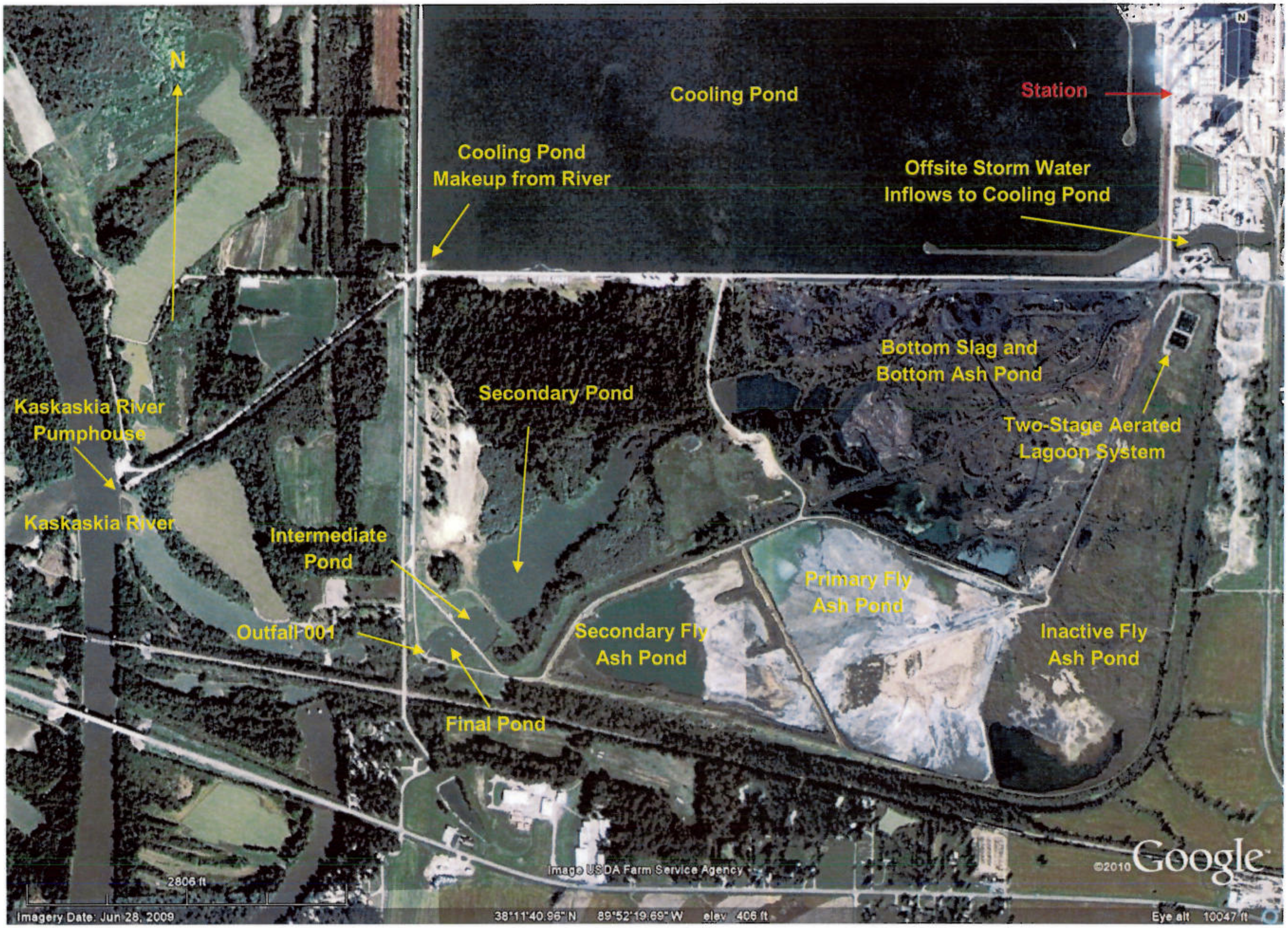
Water ~~and CCW enter~~ the SFAP from the southern portion of the PFAP through a series of five (5) steel decant pipes that appeared to be in good condition at the time of our inspection. Water is removed from the SFAP through the decant structure which is located along the northwestern embankment and discharges along the valley slope above the Secondary Pond. The decant structure and discharge pipe appeared to be in good operating condition with no defects or damage observed. The riprap present at the discharge location and down the slope appeared to be in good condition and no there were no visible signs of erosion.

2.1.11 Secondary Pond General Findings

In general, the BEC Secondary Pond was found to be in **POOR** condition. In GZA's professional opinion, the embankment(s) visually appear to be sound and no immediate remedial action appears to be necessary. However, based on EPA's inspection criteria, the impoundment has been given a POOR Condition Rating, because complete hydrologic/hydraulic and geotechnical computations were not provided/available for GZA's for review. Thus the hydrologic/hydraulic adequacy of the impoundment as well as the stability of the embankment(s) could not be independently verified.



Baldwin Energy Complex Ash Pond System