UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

June 27, 2011

OFFICE OF
SOLID WASTE AND
EMERGENCY RESPONSE

VIA E-MAIL AND FEDERAL EXPRESS

Mr. John Voyles, Jr.
Vice President,
Transmission and Generation Services
EON US
220 West Main Street
PO Box 32020
Louisville, Kentucky 40232

Dear Mr. Voyles,

On August 16, 2010 the United States Environmental Protection Agency ("EPA") and its engineering contractors conducted a coal combustion residual (CCR) site assessment at the Green River facility. The purpose of this visit was to assess the structural stability of the impoundments or other similar management units that contain “wet” handled CCRs. We thank you and your staff for your cooperation during the site visit. Subsequent to the site visit, EPA sent you a copy of the draft report evaluating the structural stability of the units at the Green River facility and requested that you submit comments on the factual accuracy of the draft report to EPA. Your comments were considered in the preparation of the final report.

The final report for the Green River facility is enclosed. This report includes a specific condition rating for each CCR management unit and recommendations and actions that our engineering contractors believe should be undertaken to ensure the stability of the CCR impoundment(s) located at the Green River facility. These recommendations are listed in Enclosure 2.

Since these recommendations relate to actions which could affect the structural stability of the CCR management units and, therefore, protection of human health and the environment, EPA believes their implementation should receive the highest priority. Therefore, we request that you inform us on how you intend to address each of the recommendations found in the final report. Your response should include specific plans and schedules for implementing each of the recommendations. If you will not implement a recommendation, please explain why. Please provide a response to this request by July 27, 2011. Please send your response to:

Mr. Stephen Hoffman
U.S. Environmental Protection Agency (5304P)
1200 Pennsylvania Avenue, NW
Washington, DC 20460

If you are using overnight of hand delivery mail, please use the following address:

Mr. Stephen Hoffman
U.S. Environmental Protection Agency
Two Potomac Yard
2733 S. Crystal Drive
5th Floor, N-5838
Arlington, VA 22202-2733

You may also provide a response by e-mail to hoffman.stephen@epa.gov

You may assert a business confidentiality claim covering all or part of the information requested, in the manner described by 40 C. F. R. Part 2, Subpart B. Information covered by such a claim will be disclosed by EPA only to the extent and only by means of the procedures set forth in 40 C.F.R. Part 2, Subpart B. If no such claim accompanies the information when EPA receives it, the information may be made available to the public by EPA without further notice to you. If you wish EPA to treat any of your response as "confidential" you must so advise EPA when you submit your response.

EPA will be closely monitoring your progress in implementing the recommendations from these reports and could decide to take additional action if the circumstances warrant.

You should be aware that EPA will be posting the report for this facility on the Agency website shortly.

Given that the site visit related solely to structural stability of the management units, this report and its conclusions in no way relate to compliance with RCRA, CWA, or any other environmental law and are not intended to convey any position related to statutory or regulatory compliance.

Please be advised that providing false, fictitious, or fraudulent statements of representation may subject you to criminal penalties under 18 U.S.C. § 1001.

If you have any questions concerning this matter, please contact Mr. Hoffman in the Office of Resource Conservation and Recovery at (703) 308-8413. Thank you for your continued efforts to ensure protection of human health and the environment.

Sincerely,
/Suzanne Rudzinski/, Director
Office of Resource Conservation and Recovery

Enclosures

4.2 Ash Treatment Basin #1 or Main Pond

4.2.1 Hydrologic and Hydraulic Recommendations

September 2010 Draft Report

An August 2010 report by MACTEC Engineering and Consulting, Inc. titled *Assessment of Spillway Hydrologic Adequacy for the Coal Pile Pond, Ash Treatment Basin No. 2, and Scrubber Pond at Green River Generating Station* provides a hydrologic analysis that is specific to Ash Treatment Basin #1. Design storm events of various returns periods and of various durations, including 6 hours, 24 hours and 48 hours, were used in the analyses. Additionally, MACTEC‟s report was unclear if the present ash material located in the pond profile was included in their analysis. MACTEC noted in their report that while Ash Treatment Basin #1 is not a structure subject to investigation, analysis of Ash Treatment Basin #1 was required for their analysis and it was found to have a minimum freeboard of 1.54 ft for the DNREP-DOW Class A freeboard design hydrograph (FDH) and a freeboard of 2.11 ft for the 100-year, 48-hour design storm event.

AMEC recommends that an appropriately conservative design storm rainfall and freeboard depth in accordance with MSHA guidelines be applied to the impoundment„s watershed to assure that the dam and decant system can safely store, control, and discharge the design flow. Based on the large size and significant rating for Ash Treatment Basin #1, the MSHA design storm would be the PMF. Hydraulic calculations should also be completed to determine the rate at which the discharge structure and associated piping could pass the design storm, if necessary, or draw down elevated water surfaces following such an event. The study should consider all critical stages over the life of the pond including pond full conditions. MSHA guidelines recommend a minimum freeboard of 3 feet. Since Ash Treatment Basin #1 discharges into Ash Treatment Basin #2, MSHA‟s guidelines for impoundments in series should be utilized.

Final Report

In comments included in the January 26, 2011 response to the draft report by Kentucky Utilities and comments from Kentucky Department of Water to EPA dated January 31, 2011 both parties take exception to the use of MSHA guidelines to evaluate CCW impoundments. AMEC followed the guidelines presented in our scope of work for assessment of CCW impoundments which was provided by EPA.

AMEC acknowledges the hydraulic studies for Ash Treatment Basin #1 indicate the impoundment meets KDOW requirements. However, based on past and recent surface slope failures on the south embankment, the wet area noted in inspection reports at piezometer P5 (toe of south embankment), consistent elevated water readings in piezometers P5 and the layout of the impoundments at the site (i.e. structures in series configuration), AMEC recommends Kentucky Utilities evaluate the need to (1) temporarily lower the normal operating level of Ash Treatment Basin #1 until the recent slope repair and wet area below the repair have been assessed and (2) permanently increase the available freeboard to provide adequate safety based on sound engineering judgment for the operation of all the impoundments particularly in light of the “structures in series” configuration of the impoundments.

4.2.2 Geotechnical and Stability Recommendations

September 2010 Draft Report

In the opinion of the assessing professional engineer, the criteria for minimum safety factors should be in accordance with USACE EM 1110-2-1902 with a minimum seismic safety factor of 1.2 as recommended by 2007 *MSHA Coal Mine Impoundment Inspection and Plan Review Handbook*, page 88. Likewise, if the dam does not meet the above seismic factor of safety, then the stability of the embankment should be analyzed and the amount of embankment deformation or settlement that may occur should be evaluated to assure that sufficient section of the crest will remain intact to prevent a release from the impoundment.

A July 2010 report by Associated Engineers, Inc. titled *Final Geotechnical Report Main Ash Pond Slope Stability Analysis and Repair*, for the Green River Station presents two stability analyses for Ash Treatment Basin #1 including a slope failure located on the downstream slope

of the south embankment north of the outlet structure, and a global stability (also referred to as critical slope). Based on the results and recommendations in this report, the slope failure was repaired during May and June of 2010.

The repair stability adjusts the friction and phi angle for the material above the ground surface from elevation 385 feet to 393 feet. However, the report notes the slide extending down to approximate elevation 400 feet. From elevation 393 feet to 402 feet a fly ash and clay material was encountered. On the boring log for P-1, this material within the embankment is described as wet. The report also notes that the water levels observed in the piezometer installed in Boring P-5 below the toe of the slide were up to two feet above the pipe and stated there must be a connection between the fly ash in the embankment and fly ash below the slope. It is assumed that the lowering of the parameters in the layer above the bedrock by "backing in" to a safety factor of less than 1 and then designing a repair with a safety factor over 1.5 will compensate for the failure and that the repair will provide adequate stability. This area should be regularly and closely monitored for any changes in piezometers readings or surficial movement.

The global stability was reviewed for the maximum section at B-B‟. The dam at cross section BB‟was noted to have a maximum height (from crest to downstream toe), and to contain close to a maximum thickness of fill material (measured from the top of the dam vertically downward). The results of the stability analyses provided factors of safety of 1.6 for long-term and 1.3 for seismic conditions. A review of the slopes used for the downstream embankment indicated about a 2.7H:1V was used in the analyses. The design slope for the downstream embankment is 2.5H:1V. During the site visit, this area was noted for possible uneven and over-steepened slopes. A survey should be performed at the cross-section to determine the actual configuration of the existing slope. In addition, the minimum depth of slice used in the program was 10 feet. The analysis should be performed with a 5 feet minimum depth of slice to identify shallow failure surfaces.

The analysis should consider all critical stages over the life of the pond including pond full conditions. These conditions would need to be determined in conjunction with the hydraulic recommendations above. The hydraulic analysis should provide a phreatic surface through the embankment. A rapid-drawdown should be performed for the A-A‟ section in case the pond would need to be lowered in response to a problem. The friction angle value used for the CCW in the analysis appears high for ash material. Typical ash friction values are 28 degrees for compacted, 24 degrees for loosely compacted, and 11 degrees for uncompacted material. Consideration should be given for lowering strength values to account for inconsistencies within the fill or foundation materials. Consideration should also be given to allow water levels in the piezometers to develop and stabilize. The analyses presented appear limited to a circular surface; different types of failure surfaces should be analyzed and optimized.

In the opinion of the assessing professional engineer, the analyses should be revised in accordance with these recommendations. The analysis should consider all critical stages over the life of the pond including pond full conditions. These conditions would need to be determined in conjunction with the hydrologic and hydraulic recommendations above. The hydrologic and hydraulic analysis will provide maximum water levels in the pond and a phreatic surface through the embankment.

Final Report

In comments included in the January 26, 2011 response to the draft report by Kentucky Utilities and comments from Kentucky Department of Water to EPA dated January 31, 2011 both parties take exception to the use of MSHA guidelines to evaluate CCW impoundments. AMEC followed the guidelines presented in our scope of work for assessment of CCW impoundments which was provided by EPA.

AMEC acknowledges the stability studies performed for Ash Treatment Basin #1 indicate the impoundment meets KDOW requirements. However, based on past and recent surface slope failures on the south embankment, the wet area noted in inspection reports at piezometer P5 (toe of south embankment below recent repair), consistent elevated water readings in piezometers P5 and the layout of the impoundments at the site (i.e. structures in series configuration), AMEC recommends Kentucky Utilities evaluate the need to (1) temporarily lower the normal operating level of Ash Treatment Basin #1 until the recent slope repair and wet area

have been assessed and (2) permanently increase the available freeboard to provide adequate safety based on sound engineering judgment for the operation of all the impoundments particularly in light of the “structures in series” configuration of the impoundments.

4.2.3 Monitoring and Instrumentation Recommendations

September 2010 Draft Report

Twelve piezometers, of which 10 are remaining, were installed in 2010 (July and August) to support the recent stability analyses. It would be prudent for the Green River Power Station to maintain and protect these instruments, and document monitoring frequently until base line phreatic readings are apparent. After that time, a regular frequency should be maintained and the results evaluated by an engineer. Monitoring should include pond and river levels and should include additional readings and evaluation in response to elevated pond levels or specific rainfall events. AMEC recommends additional instrumentation, especially at the crest and toe of critical slopes, be installed as budgets or development of any future problems allow.

Final Report

Kentucky Utilities continues to monitor the piezometers at Ash Treatment Basin #1 as evidenced by the two additional sets of readings provided in *Addendum A* to the stability report (submitted with KU‟s comments to the Draft report). AMEC reiterates the recommendations made in our Draft report especially the inclusion of pond and river levels data. Elevated water levels in P-5 and the wet area in this same area should be continuously monitored and evaluated.

4.2.4 Inspection Recommendations

September 2010 Draft Report

AMEC has reviewed provided information and inspection records for the Green River Ash Ponds: Ash Treatment Basin #1, Ash Treatment Basin #2, Scrubber Pond and Coal Runoff Pond and determined that Kentucky Utilities has begun adequate inspection practices. Finishing Pond #3 was removed from service in 2010, therefore, no inspection services have been provided for this pond. AMEC recommends that the current inspection program by the plant be expanded to include at least monthly instrumentation monitoring and pond and river levels. AMEC has reviewed the 2009 inspection reports and determined Kentucky Utilities has adequate annual inspections by a Profession Engineer. In addition to the inspections by facility personnel, we recommend this type of annual inspection program and report by a Professional Engineer be continued at least yearly basis. Due to the recent slide repair on the south dike of Ash Treatment Basin #1 and the Coal Runoff Pond, the recent surficial slide repair at the southwest corner of the Scrubber Pond and recent repair of the east dike of Ash Treatment Basin #2, AMEC recommends additional inspections be performed by Professional Engineer should any problems, such as seepage, scarps, etc., be encountered with the repairs or if new similar problems develop.

Final Report

The January 2011 inspection by ATC for Ash Treatment Basin #1 generally identified normal maintenance type items. KU‟s response to the Draft report stated they are *developing plans to address the priority maintenance items in 2011. AMEC recommends KU personnel perform frequent inspections of the embankments with special attention to the wet area identified at piezometer P5.*

4.3 Ash Treatment Basin #2

4.3.1 Hydrologic and Hydraulic Recommendations

September 2010 Draft Report

An August 2010 report by MACTEC Engineering and Consulting, Inc. titled *Assessment of Spillway Hydrologic Adequacy for the Coal Pile Pond, Ash Treatment Basin No. 2, and Scrubber Pond at Green River Generating Station* provides a hydrologic analysis that is specific to Ash Treatment Basin 2. Design storm events of various returns periods and of various durations, including 6 hours, 24 hours and 48 hours, were used in the analyses. The analyses for Ash Treatment Basin #2 indicated a minimum freeboard of -0.73 ft for the DNREP-DOW Class A freeboard design hydrograph (FDH) and a freeboard of -0.33 ft for the 100-year, 48-hour design storm event.

AMEC recommends that an appropriately conservative design storm rainfall and freeboard depth in accordance with MSHA guidelines be applied to the impoundment„s watershed to

assure that the dam and decant system can safely store, control, and discharge the design flow. Based on the small size and significant rating for Ash Treatment Basin #2, the MSHA design storm would be the ½ PMF. Hydraulic calculations should also be completed to determine the rate at which the discharge structure and associated piping could pass the design storm, if necessary, or draw down elevated water surfaces following such an event. The study should consider all critical stages over the life of the pond including pond full conditions. MSHA guidelines recommend a minimum freeboard of 3 feet. In addition, Ash Treatment Basin #2 will be required to utilize MSHA‟s guidelines for impoundments in series.

Final Report

In comments included in the January 26, 2011 response to the Draft report by Kentucky Utilities and comments from Kentucky Department of Water to EPA dated January 31, 2011 both parties take exception to the use of MSHA guidelines to evaluate CCW impoundments. AMEC followed the guidelines presented in our scope of work for assessment of CCW impoundments which was provided by EPA.

In AMEC‟s opinion, as supported by a normal action item included in ATC‟s October 2009 Assessment of Ash Treatment Basin #2, KDOW should investigate this impoundment, based on its size, for inclusion in the Kentucky Inventory of Dams. At 345 acre-feet, the impoundment far exceeds the KDOW minimum size criteria for dams. Additionally, this impoundment is located downstream of (series configuration), and receives flow from the larger Ash Treatment Basin #1. The location and series operating conditions should be taken into account by KDOW in any rating assigned to Ash Treatment Basin #2.

MACTEC‟s *Addendum A* (January 25, 2011) to their August 12, 2010 report entitled *Assessment of Spillway Hydrologic Adequacy for the Coal Pile Pond, Ash Treatment Basin No. 2, and Scrubber Pond at Green River Generating Station* details possible modifications to Ash Treatment Basin #2 to eliminate overtopping of the existing crest by the KY Class A Freeboard Design Hydrograph 100-year 24-hour storm event, as shown through hydraulic modeling. Use of storms larger than the 100-year 6-hour is a step in the right direction, but in AMEC‟s opinion, identification of a remaining “freeboard” of 0.04 feet (Alternative 1) is not acceptable. MSHA, along with other acceptable hydrologic and hydraulic design guidelines, indicate minimum “freeboard” depths of three feet as adequate. Further, freeboard is understood to be the vertical distance above the design storm water surface elevation and the crest of an impoundment. In order to obtain a more reasonable “freeboard” in Ash Treatment Basin No. 2, AMEC recommends modeling, at minimum, the 100-year 24-hour design storm in the KDOW Freeboard Design Hydrograph to obtain a resulting water surface elevation. Once the resulting water surface elevation is determined from the routed Freeboard Design Hydrograph, a minimum of at least two feet should separate that design storm water surface elevation and the crest of the impoundment. MSHA guidelines (rare or extreme hydrologic conditions) would not be met, but the level of protection for the river, as well as the retention capacity of the impoundment, would be greatly improved over existing conditions.

A hydrologic and hydraulic report should be produced for Ash Treatment Basin No. 2 that clearly identifies all factors, flows, calculations, and results, including available freeboard, for the impoundment.

4.3.2 Geotechnical and Stability Recommendations

September 2010 Draft Report

In the opinion of the assessing professional engineer, the criteria for minimum safety factors should be in accordance with USACE EM 1110-2-1902 with a minimum seismic safety factor of 1.2 as recommended by 2007 *MSHA Coal Mine Impoundment Inspection and Plan Review Handbook*, page 88. Likewise, if the dam does not meet the above seismic factor of safety, then the stability of the embankment should be analyzed and the amount of embankment deformation or settlement that may occur should be evaluated to assure that sufficient section of the crest will remain intact to prevent a release from the impoundment.

A September 2010 report by MACTEC Engineering and Consulting, Inc. titled *Geotechnical Exploration and Slope Stability Analyses Data Package*, for the Green River Power Station presents stability analyses for Ash Treatment Basin #2 and the Scrubber Pond. Five sections were chosen for analyses on each structure. Section 1 is located on the south embankment of the Coal Runoff Pond. Sections 2 through 5 are located at Ash Treatment Basin #2 on the

south embankment (2), southeast corner (3) and east embankment (4 and 5). Sections 6 through 10 are located at the Scrubber Pond on the west embankment (6), south embankment (7 and 8), southeast corner (9) and east embankment (10). For this preliminary report, results for sections 4 and 7 were presented.

Section 4 is located on the east embankment of Ash Treatment Basin #2. AMEC is concerned with the configuration and soil strength parameters used in the analyses. The 2009 ATC inspection report noted erosion in the outfall channel which had eroded the eastern toe of this slope. During AMEC"s site visit in August 2010, the downstream embankment on the east dike was observed to be recently repaired with a rip-rap surface and the outfall channel had been relocated to the east of the toe. AMEC also observed wet/saturated areas along the eastern toe of this slope, this area was discussed with the personnel listed in Table 1 of this report. We were informed while onsite the wet/saturated soils were due to improper grading (i.e., water standing from a recent rain event); however, AMEC recommends this section be reviewed for existing conditions and parameters adjusted to reflect softer conditions at the toe. The wet areas may also reflect seepage from the pond; and therefore, higher water levels would need to be utilized in the pond and embankment analyses. In addition, soft layers of clay and ash were shown in the Section 2 borings, other sections yet to be analyzed may be more critical.

Consideration should also be given to the extension of the south embankment and construction of the east embankment (estimated to be performed in the early 1970s). Construction documents and construction details are very limited from this era. As evidenced by the ash encountered in the Section 2 borings, it is suspected that portions of the extension and formation of Ash Treatment Basin #2 were constructed over and possibly with the CCW material. Consequently, embankments constructed over ash would be susceptible to piping and slope failures.

The analysis should consider all critical stages over the life of the pond including pond full conditions. These conditions would need to be determined in conjunction with the hydraulic recommendations above. The hydraulic analysis should provide a phreatic surface through the embankment. A rapid-drawdown should be performed for upstream embankment in case the pond would need to be lowered in response to a problem, and the downstream embankment in relation to flooding of Green River. The friction angle value used for the CCW in the analysis appears high for ash material. Typical ash friction values are 28 degrees for compacted, 24 degrees for loosely compacted, and 11 degrees for uncompacted material. Consideration should be given for lowering strength values to account for inconsistencies within the fill or foundation materials. Consideration should also be given to allowing some time for water levels in the piezometers to develop and stabilize. The analyses presented appear limited to a circular surface; different types of failure surfaces should be analyzed and optimized.

In the opinion of the assessing professional engineer, the analyses should be revised in accordance with these recommendations. The analysis should consider all critical stages over the life of the pond including pond full conditions. These conditions would need to be determined in conjunction with the hydrologic and hydraulic recommendations above. The hydrologic and hydraulic analysis will provide maximum water levels in the pond and a phreatic surface through the embankment.

Final Report

In comments included in the January 26, 2011 response to the Draft report by Kentucky Utilities and comments from Kentucky Department of Water to EPA dated January 31, 2011 both parties take exception to the use of MSHA guidelines to evaluate CCW impoundments. AMEC followed the guidelines presented in our scope of work for assessment of CCW impoundments which was provided by EPA.

AMEC acknowledges the stability studies performed for Ash Treatment Basin #2 indicate the impoundment meets KDOW requirements. AMEC recommends the seep identified at boring B-1.75T be monitored frequently until the time of, and, following repairs. AMEC recommends Kentucky Utilities evaluate the need to revise the stability analyses for Ash Treatment Basin #2 resulting from any changes made to improve the hydraulics of the facility as described in the previous section.

4.3.3 Monitoring and Instrumentation Recommendations

September 2010 Draft Report

Twelve piezometers, of which 10 are remaining, were installed in 2010 (July and August) to support the recent stability analyses. It would be prudent for the Green River Power Station to maintain and protect these instruments, and document monitoring frequently until base line phreatic readings are apparent. After that time, a regular frequency should be maintained and the results evaluated by an engineer. Monitoring should include pond and river levels and should include additional readings and evaluation in response to elevated pond levels or specific rainfall events. AMEC recommends additional instrumentation, especially at the crest and toe of critical slopes, be installed as budgets or development of any future problems allow.

Final Report

AMEC reiterates our recommendations noted in the Draft report, especially to include pond and river levels with the readings. Additional piezometer readings provided by KU in their comments to the draft report indicate rising and falling water levels in B-2C and relatively static water levels in B-3C and B-4C. Without pond and river levels, no further evaluations can be made.

4.3.4 Inspection Recommendations

September 2010 Draft Report

AMEC has reviewed provided information and inspection records for the Green River Ash Ponds: Ash Treatment Basin #1, Ash Treatment Basin #2, Scrubber Pond and Coal Runoff Pond and determined that Kentucky Utilities has begun adequate inspection practices. Finishing Pond #3 was removed from service in 2010, and therefore, no inspection services have been provided for this pond. AMEC recommends that the current inspection program by the plant be expanded to include at least monthly instrumentation monitoring and pond and river levels. AMEC has reviewed the 2009 inspection reports and determined Kentucky Utilities has adequate annual inspections by a Profession Engineer. We recommend this type of annual inspection program and report by a Professional Engineer be continued at least yearly, in addition to the inspections by facility personnel. Due to the recent slide repair on the south dike of Ash Treatment Basin #1 and the Coal Runoff Pond, the recent surficial slide repair at the southwest corner of the Scrubber Pond and recent repair of the east dike of Ash Treatment Basin #2, AMEC recommends additional inspections be performed by Professional Engineer should any problems, such as seepage, scarps, etc., be encountered with the repairs or if new similar problems develop.

Final Report

The January 2011 inspection by ATC for Ash Treatment Basin #2 generally identified normal maintenance type items. KU‟s response to the Draft report stated they are developing plans to address the priority maintenance items in 2011. AMEC recommends KU perform frequent inspections of the south embankment with special attention to the seep area identified at B-1.75T.

4.4 Scrubber Pond

4.4.1 Hydrologic and Hydraulic Recommendations

September 2010 Draft Report

An August 2010 report by MACTEC Engineering and Consulting, Inc. titled *Assessment of Spillway Hydrologic Adequacy for the Coal Pile Pond, Ash Treatment Basin No. 2, and Scrubber Pond at Green River Generating Station* provides a hydrologic analysis that is specific to Ash Treatment Basin 2. Design storm events of various returns periods and of various durations, including 6 hours, 24 hours and 48 hours, were used in the analyses. The analyses for the Scrubber Pond indicated a minimum freeboard of 0.22 feet for the DNREP-DOW Class A freeboard design hydrograph (FDH) and a freeboard of 0.60 feet for the 100-year, 48-hour design storm event.

AMEC recommends that an appropriately conservative design storm rainfall and freeboard depth in accordance with MSHA guidelines be applied to the impoundment„s watershed to assure that the dam and decant system can safely store, control, and discharge the design flow. Based on the small size and significant rating for the Scrubber Pond, the MSHA design storm would be the ½ PMF. Hydraulic calculations should also be completed to determine the rate at which the discharge structure and associated piping could pass the design storm, if necessary, or draw down elevated water surfaces following such an event. The study should consider all

critical stages over the life of the pond including pond full conditions. MSHA guidelines recommend a minimum freeboard of 3 feet.

Final Report

In comments included in the January 26, 2011 response to the Draft report by Kentucky Utilities and comments from Kentucky Department of Water to EPA dated January 31, 2011 both parties take exception to the use of MSHA guidelines to evaluate CCW impoundments. AMEC followed the guidelines presented in our scope of work for assessment of CCW impoundments which was provided by EPA.

MACTEC‟s *Addendum A* (January 25, 2011) to their August 12, 2010 report entitled *Assessment of Spillway Hydrologic Adequacy for the Coal Pile Pond, Ash Treatment Basin No. 2, and Scrubber Pond at Green River Generating Station* details modifications and improvements made to the Scrubber Pond pumping capacity in addition to the introduction of automation. AMEC acknowledges the hydraulic studies for the Scrubber Pond indicate the impoundment meets KDOW requirements. MSHA guidelines (rare or extreme hydrologic conditions) are not met, but the level of protection for the river, as well as the retention capacity of the impoundment, are greatly improved over previous conditions.

4.4.2 Geotechnical and Stability Recommendations

September 2010 Draft Report

In the opinion of the assessing professional engineer, the criteria for minimum safety factors should be in accordance with USACE EM 1110-2-1902 with a minimum seismic safety factor of 1.2 as recommended by 2007 *MSHA Coal Mine Impoundment Inspection and Plan Review Handbook*, page 88. Likewise, if the dam does not meet the above seismic factor of safety, then the stability of the embankment should be analyzed and the amount of embankment deformation or settlement that may occur should be evaluated to assure that sufficient section of the crest will remain intact to prevent a release from the impoundment.

A September 2010 report by MACTEC Engineering and Consulting, Inc. titled *Geotechnical Exploration and Slope Stability Analyses Data Package*, for the Green River Power Station presents stability analyses for Ash Treatment Basin #2 and the Scrubber Pond. Five sections were chosen for analyses on each structure. Section 1 is located on the south embankment of the Coal Runoff Pond. Sections 2 through 5 are located at Ash Treatment Basin #2 on the south embankment (2), southeast corner (3) and east embankment (4 and 5). Sections 6 through 10 are located at the Scrubber Pond on the west embankment (6), south embankment (7 and 8), southeast corner (9) and east embankment (10). For this preliminary report, results for sections 4 and 7 were presented.

Section 7 is located on the west end of the south embankment of the Scrubber Pond. This section is near a recently repaired surface area on the downstream embankment (located to the west). On first glance of the section reported, it appears from the plan sheet that Section 8 would have a steeper downstream slope and would be more critical. During the site visit, wet conditions were noted below the toe of the south embankment. Given this section may not represent the critical section, further review will not be performed at this time but rather at the completion of the study when recommendations herein have been incorporated into the analyses. Recommendations mentioned in the previous sections such as the configuration of the slope and adjustment of soil strength parameters and a detailed discussion of the methods and parameters should be included in the final report.

The analysis should consider all critical stages over the life of the pond including pond full conditions. These conditions would need to be determined in conjunction with the hydraulic recommendations above. The hydraulic analysis should provide a phreatic surface through the embankment. A rapid-drawdown should be performed for upstream embankment in case the pond would need to be lowered in response to a problem, and the downstream embankment in relation to flooding of Green River. The friction angle value used for the CCW in the analysis appears high for ash material. Typical ash friction values are 28 degrees for compacted, 24 degrees for loosely compacted, and 11 degrees for uncompacted material. Consideration should be given for lowering strength values to account for inconsistencies within the fill or foundation materials. Consideration should also be given to allowing some time for water levels in the piezometers to develop and stabilize. The analyses presented appear limited to a circular surface; different types of failure surfaces should be analyzed and optimized.

In the opinion of the assessing professional engineer, the analyses should be revised in accordance with these recommendations. The analysis should consider all critical stages over the life of the pond including pond full conditions. These conditions would need to be determined in conjunction with the hydrologic and hydraulic recommendations above. The hydrologic and hydraulic analysis will provide maximum water levels in the pond and a phreatic surface through the embankment.

Final Report

In comments included in the January 26, 2011 response to the Draft report by Kentucky Utilities and comments from Kentucky Department of Water to EPA dated January 31, 2011 both parties take exception to the use of MSHA guidelines to evaluate CCW impoundments. AMEC followed the guidelines presented in our scope of work for assessment of CCW impoundments which was provided by EPA.

AMEC acknowledges the stability studies performed for the Scrubber Pond indicate the impoundment meets KDOW requirements. AMEC recommends restoration of the interior slopes and crest, and frequent monitoring of the relatively steep downstream slopes and wet area below the south embankment for any signs of distress.

4.4.3 Monitoring and Instrumentation Recommendations

September 2010 Draft Report

Twelve piezometers, of which 10 are remaining, were installed in 2010 (July and August) to support the recent stability analyses. It would be prudent for the Green River Power Station to maintain and protect these instruments, and document monitoring frequently until base line phreatic readings are apparent. After that time, a regular frequency should be maintained and the results evaluated by an engineer. Monitoring should include pond and river levels and should include additional readings and evaluation in response to elevated pond levels or specific rainfall events. AMEC recommends additional instrumentation, especially at the crest and toe of critical slopes, be installed as budgets or development of any future problems allow.

Final Report

AMEC reiterates our recommendations noted in the Draft report, especially to include pond and river levels with the readings. Additional piezometer readings provided by KU in their comments to the draft report indicate relatively static water levels in B-6C, rising to static levels in B-8C and rising levels in B-10C. Without pond and river levels, no further evaluations can be made. AMEC recommends KU evaluate the need to install piezometer(s) below the south embankment.

4.4.4 Inspection Recommendations

September 2010 Draft Report

AMEC has reviewed provided information and inspection records for the Green River Ash Ponds: Ash Treatment Basin #1, Ash Treatment Basin #2, Scrubber Pond and Coal Runoff Pond and determined that Kentucky Utilities has begun adequate inspection practices. Finishing Pond #3 was removed from service in 2010, and therefore, no inspection services have been provided for this pond. AMEC recommends that the current inspection program by the plant be expanded to include at least monthly instrumentation monitoring and pond and river levels. AMEC has reviewed the 2009 inspection reports and determined KENTUCKY UTILITIES has adequate annual inspections by a Profession Engineer. We recommend this type of annual inspection program and report by a Professional Engineer be continued at least yearly, in addition to the inspections by facility personnel. Due to the recent slide repair on the south dike of Ash Treatment Basin #1 and the Coal Runoff Pond, the recent surficial slide repair at the southwest corner of the Scrubber Pond and recent repair of the east dike of Ash Treatment Basin #2, AMEC recommends additional inspections be performed by Professional Engineer should any problems, such as seepage, scarps, etc., be encountered with the repairs or if new similar problems develop.

Final Report

The January 2011 inspection by ATC for the Scrubber Pond generally identified normal maintenance type items. KU‟s response to the Draft report stated they are developing plans to address the priority maintenance items in 2011. AMEC recommend KU perform frequent inspections of the embankments and wet area below the south embankment.

4.5 Former Ash Pond or Coal Runoff Pond

4.5.1 Hydrologic and Hydraulic Recommendations

September 2010 Draft Report

An August 2010 report by MACTEC Engineering and Consulting, Inc. titled *Assessment of Spillway Hydrologic Adequacy for the Coal Pile Pond, Ash Treatment Basin No. 2, and Scrubber Pond at Green River Generating Station* provides a hydrologic analysis that is specific to Ash Treatment Basin 2. Design storm events of various returns periods and of various durations, including 6 hours, 24 hours and 48 hours, were used in the analyses. The analyses for the Coal Runoff Pond indicated a minimum freeboard of 1.74 feet for the DNREP-DOW Class A freeboard design hydrograph (FDH) and a freeboard of 2.17 feet for the 100-year, 48-hour design storm event.

AMEC recommends that an appropriately conservative design storm rainfall and freeboard depth in accordance with MSHA guidelines be applied to the impoundment„s watershed to assure that the dam and decant system can safely store, control, and discharge the design flow. Based on the small size and significant rating for the Scrubber Pond, the MSHA design storm would be the ½ PMF. Hydraulic calculations should also be completed to determine the rate at which the discharge structure and associated piping could pass the design storm, if necessary, or draw down elevated water surfaces following such an event. The study should consider all critical stages over the life of the pond including pond full conditions. MSHA guidelines recommend a minimum freeboard of 3 feet.

Final Report

In comments included in the January 26, 2011 response to the Draft report by Kentucky Utilities and comments from Kentucky Department of Water to EPA dated January 31, 2011 both parties take exception to the use of MSHA guidelines to evaluate CCW impoundments. AMEC followed the guidelines presented in our scope of work for assessment of CCW impoundments which was provided by EPA.

MACTEC‟s Addendum A (January 25, 2011) to their August 12, 2010 report entitled Assessment of Spillway Hydrologic Adequacy for the Coal Pile Pond, Ash Treatment Basin No. 2, and Scrubber Pond at Green River Generating Station details an increase of the dam crest of the Coal Pile Runoff Pond by 0.5 feet to elevation 405.5 ft NAVD88. MSHA guidelines (rare or extreme hydrologic conditions) are not met, but the level of protection for the river, as well as the retention capacity of the impoundment, are greatly improved over previous conditions.

4.5.2 Geotechnical and Stability Recommendations

September 2010 Draft Report

In the opinion of the assessing professional engineer, the criteria for minimum safety factors should be in accordance with USACE EM 1110-2-1902 with a minimum seismic safety factor of 1.2 as recommended by 2007 *MSHA Coal Mine Impoundment Inspection and Plan Review Handbook*, page 88. Likewise, if the dam does not meet the above seismic factor of safety, then the stability of the embankment should be analyzed and the amount of embankment deformation or settlement that may occur should be evaluated to assure that sufficient section of the crest will remain intact to prevent a release from the impoundment.

A September 2010 report by MACTEC Engineering and Consulting, Inc. titled *Geotechnical Exploration and Slope Stability Analyses Data Package*, for the Green River Power Station presents stability analyses for Ash Treatment Basin #2 and the Scrubber Pond. Five sections were chosen for analyses on each structure. Section 1 is located on the south embankment of the Coal Runoff Pond. Sections 2 through 5 are located at Ash Treatment Basin #2 on the south embankment (2), southeast corner (3) and east embankment (4 and 5). Sections 6 through 10 are located at the Scrubber Pond on the west embankment (6), south embankment (7 and 8), southeast corner (9) and east embankment (10). For this preliminary report, results for sections 4 and 7 were presented.

Section 1 is located on the south embankment of the Coal Runoff Pond. The 2009 ATC inspection report mentions needed repairs for a surface failure on the downstream slope in this area. During our site visit, the toe and the area below the downstream slope had been recently repaired. Details of the repair were not provided. The analysis for this section was not provided in the preliminary report. The results of the analyses should be reviewed when the final report is completed

The analysis should consider all critical stages over the life of the pond including pond full conditions. These conditions would need to be determined in conjunction with the hydraulic recommendations above. The hydraulic analysis should provide a phreatic surface through the embankment. A rapid-drawdown should be performed for upstream embankment in case the pond would need to be lowered in response to a problem, and the downstream embankment in relation to flooding of Green River. The friction angle value used for the CCW in the analysis appears high for ash material. Typical ash friction values are 28 degrees for compacted, 24 degrees for loosely compacted, and 11 degrees for uncompacted material. Consideration should be given for lowering strength values to account for inconsistencies within the fill or foundation materials. Consideration should also be given to allowing some time for water levels in the piezometers to develop and stabilize. The analyses presented appear limited to a circular surface; different types of failure surfaces should be analyzed and optimized.
In the opinion of the assessing professional engineer, the analyses should be performed in accordance with these recommendations. The analysis should consider all critical stages over the life of the pond including pond full conditions. These conditions would need to be determined in conjunction with the hydrologic and hydraulic recommendations above. The hydrologic and hydraulic analysis will provide maximum water levels in the pond and a phreatic surface through the embankment.

Final Report

In comments included in the January 26, 2011 response to the Draft report by Kentucky Utilities and comments from Kentucky Department of Water to EPA dated January 31, 2011 both parties take exception to the use of MSHA guidelines to evaluate CCW impoundments. AMEC followed the guidelines presented in our scope of work for assessment of CCW impoundments which was provided by EPA.
The results of stability studies performed for the Coal Runoff Pond indicate the downstream embankment does not meet applicable requirements for the long term/maximum surcharge pool and long term/maximum surcharge pool/maximum solids (pond full) conditions. The January Final Stability Report and Addendum A to this report note “methods are available for improving the minimum factor of safety such as installation of a rock buttress on the downstream slope to provide more sliding resistance along the predicted slip circle”. In their comments to the draft report KU states they are “currently evaluating the results and plan to study options to improve the section if necessary to increase the factor of safety above KY DEP recommended values”. AMEC recommends KU continue their ongoing evaluation and develop plans to improve the stability of the south embankment to meet applicable minimum safety requirements.

4.5.3 Monitoring and Instrumentation Recommendations

September 2010 Draft Report

Twelve piezometers, of which 10 are remaining, were installed in 2010 (July and August) to support the recent stability analyses. It would be prudent for the Green River Power Station to maintain and protect these instruments, and document monitoring frequently until base line phreatic readings are apparent. After that time, a regular frequency should be maintained and the results evaluated by an engineer. Monitoring should include pond and river levels and should include additional readings and evaluation in response to elevated pond levels or specific rainfall events. AMEC recommends additional instrumentation, especially at the crest and toe of critical slopes, be installed as budgets or development of any future problems allow.

Final Report

AMEC reiterates our recommendations noted in the Draft report, especially to include pond and river levels with the readings. Additional piezometer readings provided by KU in their comments to the Draft report indicate rising and falling water levels in B-2C located to the east of the pond. A recent surface slope repair was reported on the south embankment and inspection reports note a seep at Boring B-1.75T located to the east of the coal Pile Runoff Pond. AMEC recommends KU evaluate the need to install peizometer(s) at the crest and below the south embankment of the Coal Pile Runoff Pond.

4.5.4 Inspection Recommendations

September 2010 Draft Report

AMEC has reviewed provided information and inspection records for the Green River Ash Ponds: Ash Treatment Basin #1, Ash Treatment Basin #2, Scrubber Pond and Coal Runoff

Pond and determined that Kentucky Utilities has begun adequate inspection practices. Finishing Pond #3 was removed from service in 2010, and therefore, no inspection services have been provided for this pond. AMEC recommends that the current inspection program by the plant be expanded to include at least monthly instrumentation monitoring and pond and river levels. AMEC has reviewed the 2009 inspection reports and determined KU has adequate annual inspections by a Profession Engineer. We recommend this type of annual inspection program and report by a Professional Engineer be continued at least yearly, in addition to the inspections by facility personnel. Due to the recent slide repair on the south dike of Ash Treatment Basin #1 and the Coal Runoff Pond, the recent surficial slide repair at the southwest corner of the Scrubber Pond and recent repair of the east dike of Ash Treatment Basin #2, AMEC recommends additional inspections be performed by Professional Engineer should any problems, such as seepage, scarps, etc., be encountered with the repairs or if new similar problems develop.

Final Report

The January 2011 inspection by ATC for the Coal Pile Runoff Pond generally identified normal maintenance type items. KU‟s response to the draft report stated they are developing plans to address the priority maintenance items in 2011. AMEC recommends KU perform frequent inspections of the south embankment