Tennessee Valley Authority
Regulatory Submittal for Kingston Fossil Plant

Documents submitted:
Addendum to Construction of Lateral Expansion Facilities- Phase 1
Implementation of Phases 1& 2 Ash Processing Dredge Cell/ Settling Area
Date Submitted:
12/03/2009

Submitted to whom
Leo Francendese

Concurrence

Received	Not Applicable	TVA
☒	☐	Mike Scott
☐	☒	Steve McCracken
☒	☐	Kathryn Nash KGN
☒	☐	Dennis Yankee DHY
☒	☐	Michelle Cagley
☒	☐	Tom Spurlock
☐	☐	______

Received	Not Applicable	Jacobs
☐	☒	John Moebes
☒	☐	Julie Pfeffer
☒	☐	Jack Howard
☒	☐	Randy Denton
☒	☐	______
☐	☐	______

Approvals

TVA Michael T Scott Date 12/3/09

EPA Leo Fr[illegible] Date 12/4/09

Consulted w/ TDEC

WORK PLAN

ADDENDUM TO
<u>CONSTRUCTION OF LATERAL EXPANSION FACILITIES-PHASE 1</u>

<u>Implementation of Phases 1 & 2 Ash Processing Dredge Cell/Settling Area</u>

1.0 Purpose of Work

This plan is to describe the work required to construct the facilities necessary to use the lateral expansion for wet ash storage to an elevation of 763. The lateral expansion is a partially completed dredge cell located "within" the ash pond, west of the divider dike and adjacent to and east of Dike D. The expansion is partially filled with ash to an elevation of 760+\-. The dike is constructed to an elevation of 765+\-. Phase 1 readies the lateral expansion for use to an elevation of 762 by providing piping from the ash pond to the expansion area, an intake and discharge structure plus additional stabilization for the south east dike and D dike on the south east face. Phase 2 provides for construction of a berm on the crest of the lateral expansion dike to create a uniform crest elevation of 765, plus adjustment to the discharge structure thereby readying the expansion for use to an elevation of 763. These modifications are required for operations and to correct stability issues identified by Stantec. This plan includes impounding the pool to an elevation of 763, creating a settling pond to receive dredged ash slurry, and discharging the effluent into the ash pond. However, no ash will be dredged into the facility prior to the review and approval of design and quality documentation authored by the "Engineer of Record", Stantec Consulting Services Inc. A future phase will provide facilities to create a "rim ditch system" configuration.

2.0 Design Components

The over flow from the lateral expansion discharges into a shallow channel along the base of Dike D and flows south westward into the ash pond, which discharges into the stilling pond. The discharge of the lateral expansion is to be relocated to about 250'+\- south of dike D and restructured into a broad crested weir to create a low velocity rate and act as a skimmer. The weir, located in the west dike, is to be constructed with ash and capped with stone underlain with a geogrid. It is to be approximately 20' long with an initial top elevation of 761.8 feet. The top elevation of the weir will be raised incrementally to a final elevation of 763 provided the monitors for the dike continue to indicate satisfactory conditions.

The intake into the lateral expansion will be located near the north east corner to maximize the the detention time and will be directed into a riprap check dam to dissipate the energy and prevent scouring. The pipe will be held in place by covering with two feet of ash for approximately 25'. Note attached Sketch # SK-100 for the facilities noted above as well as the pipe routing from the ash pond to the lateral expansion

The modifications to the expansion dike consists of creating a bench (decreasing the slope) on the south east side of the south east dike, building the expansion dike crest to a uniform elevation of 765, and filling in an area at the north corner of the expansion where it intersects Dike D. Note attached letters/reports by Stantec, dated 11-19-09 & 11-30-09, "Evaluation of Proposed Lateral Expansion Area Dredge Cell/Settling Pond", and e-mail clarification from Dan McQuinn referencing lateral expansion dated 12-2-09. The work will be carried out and documented in accord with the referenced reports. Quality assurance will be by the "Engineer of Record."

3.0 Construction Management

The construction will be accomplished by conventional methods utilizing excavators, trucks, and other associated equipment.

4.0 Schedule

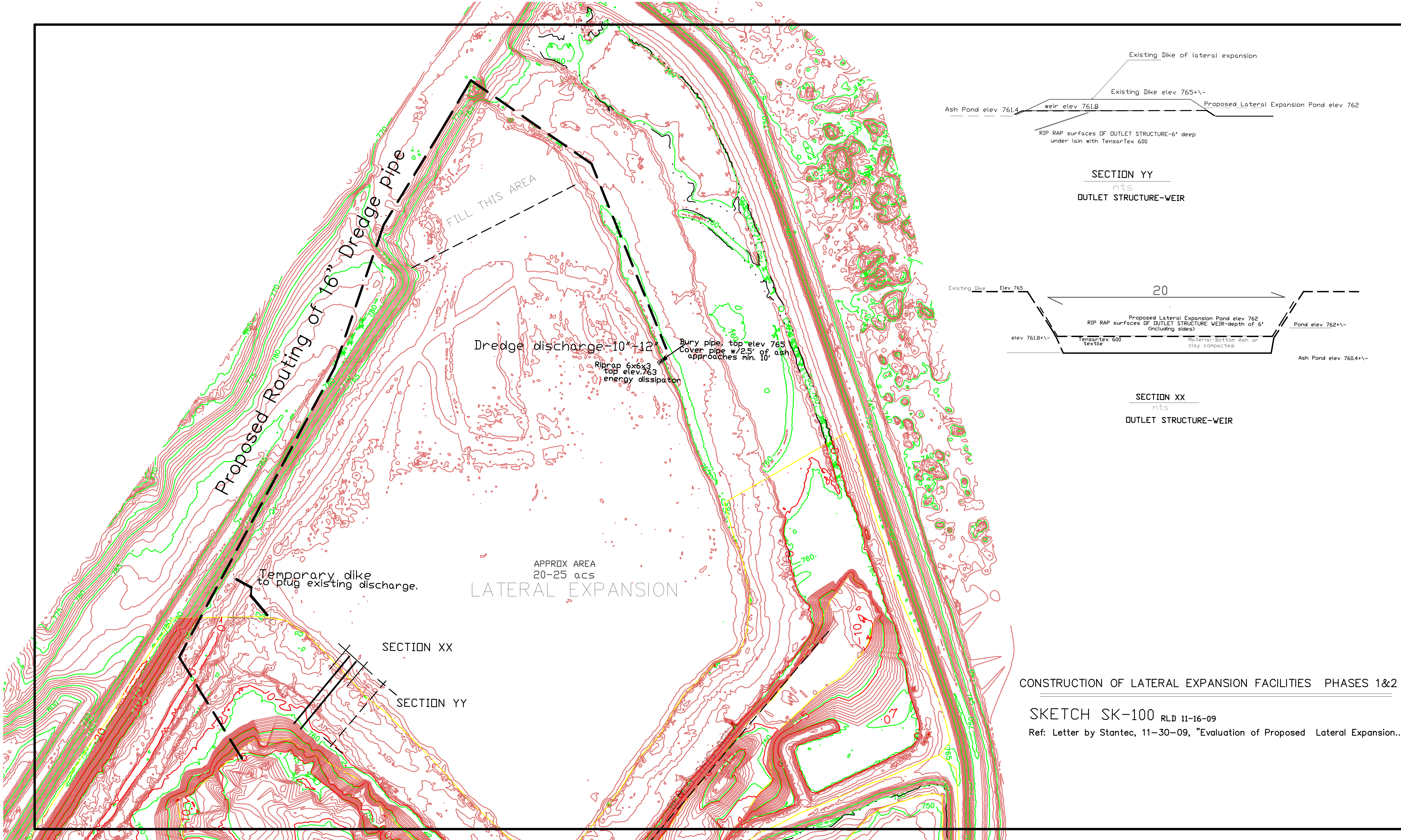
The work outlined above will be started by 12-4-09 and completed by 12-12-09.

5.0 Waste Management

No waste other than miscellaneous construction debris will be created.

6.0 Health and Safety

All construction activities will be done in accordance with site wide Health and Safety Plan. Work in close proximity of the Pond areas will be specifically addressed in the Job Safety Plan and will incorporate recommendations noted by Stantec in the referenced letter/report.



CONSTRUCTION OF LATERAL EXPANSION FACILITIES PHASES 1&2

SKETCH SK-100 RLD 11-16-09

Ref: Letter by Stantec, 11-30-09, "Evaluation of Proposed Lateral Expansion.."

Stantec

Stantec Consulting Services Inc.
1409 North Forbes Road
Lexington KY 40511-2050
Tel: (859) 422-3000
Fax: (859) 422-3100

November 30, 2009 let_005_kif_171468117

Mr. Randy Denton
Tennessee Valley Authority
TVA Kingston Fossil Ash Recovery Operations
1134 Swan Pond Road, Trailer Park
KFP 1A-KST
Harriman, Tennessee 37748

Re: Evaluation of Proposed Lateral Expansion Area Dredge Cell/Settling Pond
Kingston Fossil Plant
Harriman, Roane County, Tennessee

Dear Mr. Denton:

This is further to our letter of November 19, 2009 in which Stantec evaluated the proposed lateral expansion ash processing dredge cell/settling area with respect to raising the dike and pond level. The primary purpose of that evaluation was to determine the impact that these changes will have on the stability of Dike C and the existing internal working platform dike associated with the lateral expansion. As a consequence of this evaluation additional concerns were identified. Two primary concerns were:

1) The stability of the east lateral expansion dike; and,

2) the possibility of tension cracks parallel and perpendicular to the axis of Dike D that may constitute a preferred flow path which could result in soil piping conditions, particularly in the event of an upset in the ash pond conditions, which creates a surge in pool level and/or seepage pressures.

In our previous letter Stantec proposed to improve the stability of the east dike by placing a rock blanket over the present slope, and to address seepage concerns at Dike D by placing a sheet pile cutoff wall. These solutions were not favorable to TVA and other methods were explored. This letter details proposed alternatives.

Eastern Segment - Lateral Expansion Dike Stability

In discussions with TVA we were requested to determine a relationship between slope angle and factor of safety for the east dike of the lateral expansion. This was completed and reported by email on November 23 as follows:

Slope Gradient	Factor of Safety (Optimized Results)
Existing Slope (April 09)	1.01
2.5H:1V	1.05
3.0H:1V	1.24
3.5H:1V	1.36
4.0H:1V	1.48

The factors of safety against slope failure were computed considering an upper pond water level of el. 763 and a lower level of el 760, based on dike slope geometry measured in April 2009

Subsequently we were provided with two recent bathymetric surveys of the channel between the east lateral expansion dike and the divider dike. These surveys conducted on October 8, and November 12, 2009 showed a significant rise in the floor of the channel between the lateral expansion and the divider dike, above the survey that we had. (Unless it has already been done we recommend that the recent surveys should be confirmed with hand soundings since electronic soundings have been known to give false high readings in sediment laden water).

The new survey information implies that the channel is not scouring at the present channel flow rate and sedimentation is probably related to the high sediment loading of the ash pond. However, the additional material on the floor of the channel would be essentially a heavy liquid made up of the finest ash particles with little positive value for slope stability.

We recalculated slope stability at Section B-B' with the new bathymetry and the results are reported on Table 2. Geotechnical properties for this slope model were as per our letter report of November 19, 2009 with the addition of recent sediments as follows:

Table 1. East Lateral Expansion Dike Stability Analyses Parameters

Material	Unit Weight γ_{sat} (pcf)	Drained, Effective Stress Strength Parameters φ' (deg.)	c' (psf)
Recent Sediments	80	20	0
Constructed Ash	93	30	0
Compacted Ash	100	34	0
Hydraulically Placed Ash	96	25	0
Sensitive Silt/Clay	127	28	0
Lean Clay Foundation Soil	129	30	0
Sandy Silt to Silty Sand	109	27	0

The above drained effective stress design parameters were used to model the existing slope geometry including the raised dike to be constructed on the working platform to elevation 265 feet. However, it should be recognized that if a segment of the dike fails locally, then the retained soils could undergo a rapid failure and undrained soil conditions would apply. Based on site observations where the saturated ash flowed from breached areas on December 22, 2008, the very loose, saturated ash would revert to undrained conditions resulting in significantly lower internal strength parameters.

Stability Analysis Results East Lateral Expansion Dike

Two-dimensional, limit equilibrium stability calculations were completed using Spencer's method and Slope/W software. Results of the slope stability analyses are summarized in Table 2. The model includes an optimization process that utilizes a deformed slip surface. The calculated factors of safety are compared to design criteria requiring a factor of safety of 1.3 or greater for slope stability during construction. This criteria, as used by the US Army Corps of Engineers (USACE EM 1110-2-1902), was adopted by TVA for the Kingston project.

Table 2. Summary of Results from Stability Analyses (Recent Channel Bathymetry)

Section	Factor of Safety
Cross Section B-B' at Lateral Expansion Area Working Platform Dike	
Section B1 - Existing Conditions East Lat. Exp. Dike (Recent Bathymetry)	1.2
Section B2 - East Lateral Expansion Dike Raised to el. 765 feet (Recent Bathymetry)	1.1
Section B3 - East Lateral Expansion Dike Raised to el.765 with benched crest	1.5

The analyses were carried out assuming drained effective stress parameters under static loading conditions without equipment operating along the top of the dike.

The results of the slope stability analyses indicate that:

1. The factor of safety against slope failure for the working platform dike within the lateral expansion area at cross section B-B' is below the minimum value of 1.3 adopted by TVA for this project and is unacceptable for even a temporary condition. By raising the expansion dike, the factor of safety reduces to 1.1 which is marginally stable and would likely result in a slope movement/failure.

2. By cutting a 5-foot thick bench from the crest of the east slope of the expansion dike, the minimum factor of safety against lateral expansion dike slope failure at cross section B-B' along the Ash Pond/Stilling Pond Divider Dike can be increased to 1.5.

Recommendations East Lateral Expansion Dike

The existing east slope of the east dike of the lateral expansion area adjacent to the divider dike between the Ash Pond and Stilling Pond has a factor of safety less than 1.3 and it will be necessary to stabilize this slope. Considering that a rock blanket would not be viable at this time and that scour does not appear to be occurring under the present conditions we have evaluated methods to cut back the slope for stabilization. With the present slope geometry the factor of safety can be improved to greater than 1.3 by benching the slope crest. Pursuing this concept we make the following recommendations:

1. Excavate a bench in the east crest of the east expansion dike slope to the dimensions and elevations shown on the attached section schematics designated Figures 1 and 2.

2. Use long boom excavators operating no closer than 30 feet from the existing crest of the slope. Do not operate equipment or heavy vehicles closer than 30 feet from the crest of the slope.

3. Use the bottom ash that is excavated from the bench to construct the additional height proposed for the lateral expansion dike. The raised portion of the dike has been established previously to be 12 feet wide with side slopes of 3 horizontal to 1 vertical to a maximum elevation of 765 feet.

4. Construct the raised dike on a biaxial geogrid for added stability and resistance to traffic. Geogrid should nominally consist of the standard material used on the project for this purpose.

5. Material should be placed in maximum 12 inch lifts and compacted statically without vibration. Development of compaction specifications and field density monitoring will be performed by the Engineer.

6. Implement strict monitoring of the excavation process including soundings to ensure that the slope is cut to the specified lines and that fills are not placed above the specified lines.

7. Monitor the channel bathymetry to ensure that the grades remain the same.

Dike D Tension Cracks

During the Dredge Cell failure on December 22, 2008, deformation in the form of visible tension stress cracks developed along Dike D. The cracks were oriented both parallel and perpendicular to the axis of Dike D and may constitute a preferred flow path that could result in soil piping conditions, particularly in the event of an upset in the ash pond conditions, which creates a surge in pool level and/or seepage pressures. In our letter of November 19, Stantec recommended installing a wall of interlocking steel sheet piles near the intersection of Dike C and Dike D to seal potential flow paths and mitigate this condition. This method was not favorable to TVA and alternate methods were considered as outlined herein.

As an alternative mitigation Stantec proposes to fill the north corner area of the lateral expansion at the intersection with Dike D as shown on Figure 3. This approach will reduce the risk of inducing excessive seepage pressures within the former crack zone on Dike D.

We make the following recommendations relative to this proposed method:

1. Filling should be conducted following methods typical for constructing a working base over hydraulically placed ash materials. This includes using dozers to place the first lift wherein the machines operate on a three to four foot bridging lift of bottom ash or other approved material. Geogrid should be staged on site for deployment in association with the work if directed by the Engineer. Once the initial working platform is stabilized, all other fill materials should be placed in compacted 12-inch maximum loose lifts. Work should be performed by TVA Civil Projects Division personell experienced in constructing embankments over pond ash and monitored continuously by the Engineer. It should be anticipated that the platform operations may need to be halted temporarily to allow foundation pore water pressures to dissipate.

2. Final grade should reflect the same minimum target crest elevation of 765 feet. The area of fill is illustrated on Figure 3. Access ramps should be formed which transition down from Dike D to the lateral expansion grade.

3. It should be noted that the available on-site lateral expansion bottom ash is a valuable resource for constructing embankments over the ash pond deposits. Precautions should be made to keep the material relatively free of fly ash. It is envisoned that additional bottom ash material will be excavated as necessary along the northern limits of the lateral expansion as described herein for the bench zone along the east segment of the existing working platform.

4. Geotechnical instrumentation within the vicinity of the work zone should be monitored by the Engineer during the work. In addition, dam safety inspections of the previously buttressed Dike D and Dike C area should be performed daily during these operations until directed otherwise by Stantec.

General Comments and Recommendations

An ash pond system hydraulic analysis was not included in the current Stantec task order scope of work. It is recommended that the ash pond system be evaluated by a professional engineer including flow dynamic impacts associated with the revised channel geometry.

We understand that it is proposed to construct appropriate inlet and outlet controls and impound pool within the lateral expansion to a maximum elevation of 763 feet with a maximum dike elevation of 765 feet. Stantec recommends that the measures detailed in this letter must be in-place prior to impounding the initial raised pool in the lateral expansion to elevation 762 feet. These measures will address Stantec's requirements for Phases 1 and 2 of the lateral expansion implementation program as detailed in our letter of November 19, 2009. It is our understanding that Jacobs will continue to be the engineer of record for sluicing inlet and expansion outlet design elements.

Phase 3 of the lateral expansion implementation includes a proposal for mechanical dredging and initial decant water control systems. Stantec was verbally requested to consider excavation of a dredge sluice channel or other forms of mechanical excavation inside the raised expansion dike. At this time we are evaluating this request and initial results indicate engineering controls will need to be implemented. Design features that must be considered in the evaluation include the following elements:

1. Upstream and overall slope stability considering the proposed configuration of the sluice channel, wet stockpiles, initial decant water, and construction/operations equipment traffic;

2. Potential scour from sluicing operations and operational controls on dredging methodology; and

3. Expansion Area outlet structure flow controls.

Elements not addressed in the current scope include:

- Regulatory Networking or Permitting;
- Developing Construction Documents;
- Assessing the dynamic fluid impacts (waves, scour, etc.) associated with a release of the proposed impoundment; and
- Evaluating impoundment settling efficiency or flow controls.
- Although the condition of the internal divider dike slopes between the ash pond and stilling basin have not been evaluated, similar geometry appears to be present on that structure, particularly in the ash pond exit channel formed between the lateral expansion and divider dike. Raising the water level in the lateral expansion would not have a significant effect on the divider dike; however if the divider dike were to fail it could trigger a chain reaction that would likely cause the east lateral expansion dike to fail due to rapid draw down.

If you have any questions or need additional information concerning our findings presented in this letter report, please call.

Sincerely,

STANTEC CONSULTING SERVICES INC.

Don W. Fuller II

Don W. Fuller, II, PE
Principal

/cmw

Attachments