ANDREWS
ENGINEERING, INC.

June 6, 2013

Joe Feldmann P.E., L.S.
Franklin County Highway Department
400 East Locust
Room 003A
Union, MO 63084

Re: Proposed Coal Ash Waste Landfill
Ameren – Labadie Power Plant
Franklin County, Missouri

Dear Mr. Feldman:

Per your request, we have reviewed available records as relevant to the proposed Ameren-Labadie coal ash landfill referenced above in regards to the Engineering Design.

Documents reviewed are:

- Ameren Missouri Labadie Energy Center, Construction Permit Application and accompanying set of Permit Drawings for a Proposed Utility Waste Landfill, Franklin County, Missouri, January 2013

Based upon our review of the Engineering Design, Andrews Engineering, Inc. has generated a draft set of comments for Franklin County as its Independent Registered Professional Engineer. Enclosed is a summary of the Engineering Design review comments.

If you have any questions or concerns, please do not hesitate to contact me.

Very truly yours,

Douglas W. Mauntel, P.E.
Andrews Engineering, Inc.

DWM:dwm:slm

cc: Kenneth Liss, L.P.G. Vice President of Operations, Andrews Engineering, Inc.
Karl Finke, P.E., Andrews Engineering, Inc.

3300 Ginger Creek Drive, Springfield, Illinois 62711 ◆ 217.787.2334 fax 217.787.9495 www.andrews-eng.com

Liner & Cover

The separation between the compacted soil component of the composite liner shall be two feet above the Natural Water Table in the site area. Provide a potentiometric surface map for the critical monitoring events from the DSI with the post-settlement base grades provided of the landfill footprint. In any area where the potentiometer surface map illustrates that the surface is above the existing topography, use the top of the existing topography (pre-land disturbance) for those areas.

On Sheets 22 and 23, show the bottom of the clay liner on the cross section drawings.

If soils from onsite are acceptable for clay liner, prior to use for such, a test pad for these materials would be necessary since the offsite borrow soils are different.

No demonstration was made to not use one foot (1') of $1x10^{-5}$ cm/sec soil in the final cover directly under the geomembrane. A demonstration is required and must be approved for the use of an alternate final cover. 10 CSR 80-11.010(14)(C)3. "As each phase of the utility waste landfill is completed, a final cover system shall be installed consisting of one foot (1') of compacted clay with a coefficient of permeability of 1×10^{-5} cm/sec or less and overlaid with one foot (1') of soil capable of sustaining vegetative growth." 10 CSR 80-11.010(14)(C)5. "The department may approve the use of an alternative final cover system provided that the owner/operator can demonstrate to the department that the alternative design will be at least equivalent to the final cover system described in paragraph (14)(C)3. of this rule." The proposed final cover in the permit application consists of "a textured 40-mil HDPE geomembrane liner placed directly on the CCRs, overlain by a 16-oz/yd^2 non-woven, needle-punched geotextile, and covered with two (2) feet of nominally compacted vegetative soil capable of supporting the final vegetation cover." The proposed final cover does not include all the minimum requirements, specifically the 1-foot low-permeability compacted clay layer, nor is it demonstrated that the proposed final cover would be equivalent to those requirements.

The plan sheets don't match the CQA Plan for the top crown HDPE. Please revise and provide the appropriate calculations as necessary.

Sheet 19 shows one anchor trench containing the liner geomembrane, the geocomposite drain, and the final cover geomembrane. A second anchor trench for the cover system is necessary to prevent damage to the previously installed geosynthetic components.

On Sheet 19, the Perimeter Ditch at Closure shows 12" of cover soils over the geomembrane with no clay liner beneath the geomembrane. A minimum of two feet of soil cover must be over the landfilled CCR. Additionally, erosion protection in the perimeter ditch is necessary to prevent exposure of the geomembrane.

Leachate Collection

The landfill liner and overlying leachate collection system must have a minimum slope of 1%, pre and post settlement. Revise the landfill grades to meet this requirement during all times within the landfill footprint. Provide plan sheets with the critical cross sections which show the pre and post settlement landfill base grades.

Specify the geotextiles for the cushion fabric and the filter fabric shown in the Bottom Liner and Leachate Collection System Detail. Provide the supporting documentation and any necessary calculations.

Provide detail drawings for the pipe perforation or slotting pattern for the leachate collection lines and sump riser pipe.

H.E.L.P. models include only fly ash layers. Section 3.1.4 of the report states that waste are predicted to include "approximately 70% fly ash and 30% bottom ash". This report also discusses the acceptance of Flue Gas Desulfurization (FGD) byproducts. Neither bottom ash nor FGD byproducts were included in any of the H.E.L.P. models. The H.E.L.P. models used default values for fly ash when some values, such as hydraulic conductivity, were tested for in Appendix J.

Leachate Storage and Conveyance

The leachate storage tanks have no capacities or sizes listed or illustrated in the drawings. The leachate storage tanks must be sized based upon the pumping rates of the sumps within the landfill, and the maintenance and inspection schedule or control systems for each.

Leachate storage tank appears misplaced on Sheet 6.

The Leachate and Stormwater Forcemains are shown in the Exterior Berm without the depths noted. The forcemains must be installed at a depth to prevent freezing during cold weather conditions. Additionally, account for these forcemains being located in a berm above grade and the landfill will not have exothermic reactions.

Due to the size of the cells, provide calculations to show the removal rate of leachate generated from a storm event during the first couple of weeks of filling. Justify the storm event, calculate the removal rate and describe disposal method utilized.

Stormwater

The stormwater management plan for the site allows most stormwater to become contact waters and thus leachate. Based upon the stormwater management plan, no waters onsite will be allowed to discharge from the site and must be contained and treated as leachate. Additionally, a one-way valve rather than a gate valve alone would be required in the Stormwater Ponds (Leachate Ponds) to prevent leachate out of the ponds during the equalization. These ponds will additionally need to be designed with a liner system which meets the requirements of MDNR's Solid Waste Management and Water Protection Programs for storing leachate (waste waters). The use of these waters will be limited to within the composite lined landfill area or for use as makeup waters within the power plant's future scrubber systems.

The 25-year, 24-hour rainfall event is greater than 5.6 inches based upon the NOAA Atlas 14 Volume 8, Version 2 Point Precipitation Frequency Estimates. Increase the 25-year, 24-hour rainfall event to the recently revised amount.

Section 4.1.2 Sequence of Phase Construction describes the construction sequence of each phase. The Phase 1 Construction Sequence doesn't discuss the timing of constructing the stormwater pond, but Phases 3 and 4 Construction Sequence discuss constructing the stormwater ponds after placing CCR in the phase area. The construction of each stormwater pond and the CQA report for each must be approved prior to placing CCR into the phase area associated with the stormwater pond.

In 4.2.1 UWL Disposal Operational Description section, the perimeter ditches around each phase must not provide storage of stormwater but must be designed to rapidly convey stormwater to the stormwater ponds for storage.

The perimeter ditches are designed with flat slopes. This may lead to standing water retained in these ditches which does not minimize infiltration. This design also may not empty expeditiously after storms. Additionally, this doesn't take into account the anticipated differential settlement. 10 CSR 80-11.010(8)(B)1.F.: "Provisions for surface water runoff control to minimize infiltration and erosion of cover. All Water Pollution Control Program permits and approvals necessary to comply with requirements of the Missouri Clean Water Law and corresponding rules shall be obtained from the department." 10 CSR 80-11.010(8)(B)1.F.(IV): "On-site drainage and channels shall be designed to empty expeditiously after storms to maintain the design capacity of the system."

Since the perimeter ditches are designed with flat slopes, it would be difficult to estimate the amount of watershed area that would collect into the two separate ponds that serve Cells 3 and 4. The notes for Tables N-2 to N-5 state that "flows are split generally at half the distance between the entrances to the pond along the perimeter ditch." While this would seem like a reasonable assumption in theory, actual field conditions, subject to settlement and weathering, will probably not result in a perfectly flat ditch slope. Additionally, no consideration is given to the differences in times of concentration that would be present along the perimeter ditches due to the varying flow lengths down the final cover slopes.

On Sheets 5 and 7, show how the stormwater from Cell 2 will flow into the Stormwater Pond 1.

After closure, all stormwater should be routed through the stormwater ponds to reduce sediment loading rather than allowing the letdown structures to discharge over the exterior berms.

Berms

Interior berms filled with CCR must be constructed immediately after receiving the Operating Permit or Authorization to Operate due to placing waste within the landfill footprint. Additional CQA reporting will then be required for the construction of the interior berm and requires approval prior to placing CCR material onto it.

The design of the landfill has the interior berms exposed the same as the exterior berms during the filling of Cells 1 and 3, thus it is required to have the same protection as the exterior berms since they would be considered exterior berms during the filling of cells 1 and 3, prior to the construction of cells 2 and 4.

In the interior berms, the geomembrane needs to wrap back over the leachate collection and protection layers at the point of future tie in to prevent backup leachate from seeping through the exterior slope.

Section 3.3.2.3 Franklin County Requirement – Erosion Protection in the Landfill Design discusses 2.2-inch thick fabric-formed concrete mats and Appendix K states that the exterior berm slopes will be lined with a 6-inch thick, fabric-formed articulated concrete mat. Section 9.0

Erosion Protection From Levee Overtopping of Failure in Appendix J provides a 56mm (2.2-inches) thick fabric-formed concrete mat such as Hydrotex FP220. The drawings include no dimensions. Revise all section and have the same dimensions listed for each. Additionally, add details to the drawings for the fabric-formed concrete mats.

Operations

The procedure for the placement of the first lift of CCR to prevent damage to the underlying layers needs to be developed and included in the operations section.

Flooding of the phase due to not having adequate CCR in place would need a contingency plan developed and included in the construction permit application. The inundation of the phase area would need to be equalized to prevent significant differential head on the liner. Additionally, the pumping down would need to occur relative to the floodwaters surrounding the phase as they recede to prevent a high differential head.

The Solid Waste Excluded lists Major Appliances and Whole Waste Tires. Modify these to list as Any Appliances and Waste Tires.

Dust suppression must be employed to prevent the migration of CCR offsite during all phases of construction, including mining activities, if and when allowed.

Backup equipment or additional equipment is necessary more quickly than within 3 days due to the volume of waste generated. If a piece of equipment goes down, backup or replacement equipment should be in use within 24 hours.

Seeding to establish vegetation on the intermediate side slope cover needs to occur within a much shorter period than annually as provided in the Phases 1, 2, 3 and 4 Aesthetic Cover section.

General Comments

The waste boundary should be reduced to allow the groundwater monitoring wells to be installed in the area of the DSI. If the wells are installed outside the area of the DSI, the data from the wells must be complied and correlated to existing DSI data and provided as an addendum to the DSI.

Provide the approved design and drawings of the proposed underpass for Labadie Bottom Road and all approvals from the controlling authorities.

Sheet 8 appears to be missing leaders and detailed descriptions. Please update for further review.

Appendix D

Appendix D should be renamed “Violation History Disclosure Form” rather than the older language which has a negative connotation.

Appendix H

The only document contained in Appendix H Floodplain Documentation is a review letter for the "Floodplain Analysis of the Missouri River for the Ameren Missouri Labadie Energy Center" by the Independent Registered Professional Engineer (IRPE). Please provide the additional documentation that was submit to receive this letter from the IRPE.

Appendix J

The Table of Contents for Appendix J lists that Files on Enclosed CD. AEI was not provided the CD which includes the Files of the Printed Outputs from Computer Runs to review. We will need a copy of the computer runs of the revised report based upon the comment letters.

Friction angles for the geomembrane/clay interface appear to be too high. The direct shear testing performed on the interface did not adequately displace the interface and the normal loads were low. The displacement testing should be on the order of inches and the normal stresses need to meet the full capacity of the landfill design. Additionally, at lower normal stresses, the critical interface may occur between the geomembrane and geotextile or geocomposite. All of the designs need to be analyzed to have the proper inputs for stability analysis. The bottom liner illustrated as detail 3/17 Bottom Liner and Leachate Collection Detail shows a smooth geomembrane, not a textured HDPE geomembrane as was tested and provided in Appendix A-1 of Appendix J. The interface friction angle (15 degrees) utilized in the Analysis and Design of Veneer Cover Soils, Figure E-42, is a more representative value for textured HDPE geomembranes/clay interface.

Friction angles in the stability analyses don't correspond to the testing on the CH clay liner material from the offsite borrow. Triaxial shear testing (CU) on the CH clay resulted in phi of 14.6 effective stress shear angle with cohesion near 0.21 tons per square foot. The effective friction angle used in the stability analysis for the compacted clay liner was listed as 25 degrees. Verify each input providing references for their values.

The stability analysis failed to meet the required and recommended factor of safeties. Cross-section E-E' failed to meet the factor of safety of 1.5 for the static drained global circular failure surface both with the initial and full fill of CCP.

The minimum factor of safety recommended by the draft technical guidance document from MDNR-SWMP and Stark is 1.2 to 1.3, not 1.1 as listed in Table E-2 Results of Slope Stability Analyses.

Liquefaction has been determined to occur in multiple layers. When reviewing the post-liquefied shear strengths provided in the table for the stability analysis, they don't match the shear strengths from correlation charts based upon the SPT blow counts. The chart referenced in the Reitz & Jens report was H. Bolton Seed's 1987 chart. Seed and Harder updated this chart with additional information in 1990 and this chart is available with a 3rd Order Best-Fit curve to simplify the correlation. Please provide the graphed correlations providing the residual shear strengths based upon the SPT blowcount corrected for the percentage of fines.

Liquefaction analysis is typically performed in the upper 50' of unconsolidated materials. Almost every boring was stopped at 35' in depth. Due to the lack of information from the 35' to 50' interval of the unconsolidated materials, provide a narrative justifying why liquefaction would not be anticipated at depths below 35'.

The draft technical guidance document from MDNR-SWMP and Stark wasn't intended for designing landfills within a very young geologic age and active floodplain. Stability analysis for varying phases of filling is necessary due to the proposed location of the landfill.

Protective/drainage layers are missing from the stability analysis. Both designs need analyzed in the stability models if both are considered for permitting and construction.

The boring B-100 is no longer centralized or even under a cell of the landfill. Other soil profiles should be analyzed to provide the critical Shake analysis. This will require additional borings to bedrock within the footprint of the landfill.

The information provided in Section 5.3 Estimate of Yield Acceleration and Lateral Spreading for the short-duration time history appears to be incorrect and/or not the most critical based upon the provided charts. The data provided for the short-duration time history came from chart #10 (page C-9) when chart #2 (page C-10) provide a higher peak rock acceleration = 0.25 and PHGA = 0.24 based upon the output provided from SHAKE2000 analysis using the same soil profile. The values provided are for the unfilled conditions. Additional model runs were completed for the filled conditions for use in the final cover but not discussed in this section. Provide a narrative with the Appendix C Results of Seismic Risk Analyses to detail the assumptions and correlate the model analysis from the inputs to the generated results. Update this information and use it in your modeling.

Provide the actual stability analysis for the deformation analysis and provide with a narrative rather than a table listing the yield accelerations and deformations for the short and long-duration events.

The Table of Contents for Appendix C Seismic Analyses appears to have C-18 & C-19 swapped with C-20 & C-21. Please revise and verify the information.

Settlement analysis demonstrates some differential settlement which could cause ponding in the flat stormwater channels, a reduction in the overall height of the berms and settlement of the base grades of the landfill. Each of these must be discussed including how Franklin County's regulations will be satisfied during all phases of construction, filling and closure. Additionally, the settlement analysis typically has a range of settlement that may occur due to variability in the underlying subgrade and must be conservatively considered in the analysis to prevent overtopping of the exterior and interior berms due to a 500-year flood event.

Provide the calculations correlating the CPT test data to the elastic modulus utilized in the Settlement Analysis. The CPT logs which were provided in the DSI don't provide enough detail to verify the elastic moduli provided in the settlement analyses. Additionally, heavily loaded conditions decrease the modulus, so these factors need to be accounted for relative to their location within the footprint of the fill. The Bowles 1997 reference appears to be dated and newer, more precise correlations are widely available which utilize the normalized cone resistance and normalized friction ration.

Calculate the bearing capacity of the subgrade in varying locations throughout the footprint. Additionally, calculate the bearing capacity during a maximum credible seismic event which induces liquefaction during each phase of construction and filling of the landfill.

The protection of liner from hydrostatic uplift discusses the flooding with the gravel drainage layer and sand protective layer. The alternate design with the geocomposite drain and protective sand layer must also be discussed in the flooding scenarios.

In Appendix G – Design of Fabric-Formed Concrete Mat (FCM), the factor of safety calculation has a missing value, t (= 0.183 ft) in the numerator after substitution:

$$F.S. = \left[\frac{\mu(t)(\gamma_c - \gamma_w)cos\theta cos \propto -\tau_{DES}}{\sqrt{[t(\gamma_c - \gamma_w)sin\theta]^2 + \tau_{DES}{}^2}}\right]$$

$$F.S. = \left[\frac{0.637(130\ PCF - 62.4\ PCF)\cos(18.435°)cos(0°) - \tau_{DES}}{\sqrt{[(0.183')(130 - 62.4)sin18.435]^2 + \tau_{DES}{}^2}}\right]$$

This reduces the value of the maximum design velocity significantly. Update the calculations with the thickness of the fabric-formed concrete included.

Appendix O

The filter design basis in the Memo from Bruce Dawson, PE to Gredell Engineering Resources, Inc, included in Appendix O-1, requires a tighter gradation for the sand protective layer based upon the R15 provided. The D15 for the sand should range from 0.24 mm to 0.8 mm based upon the D15 of the Fly Ash and the R15 provided from the Peck Hanson Thornburn filter criteria.

Appendix P

The Construction Quality Assurance Plan inadequately addresses the requirements in 10 CSR 80-11.010(6)(B)1.A. "A detailed description of the QA/QC testing procedures that will be used for every major phase of construction. The description must include at a minimum, the frequency of inspections, field testing, laboratory testing, equipment to be utilized, the limits for test failure, and a description of the procedures to be used upon test failure;" Specifically, this section should include tables showing the frequency and acceptable test result values for each testing procedure. The Air Pressure Testing of seams cannot allow a drop of 4 psi during the 5 minute test. It must not drop more than 10% of the equalized pressure of at least 25 psi.

Appendix P Construction Quality Assurance Plan section 3.2 Test Pad references the Demolition Landfill regulations. Please revise to reference the appropriate regulations.

In section 3.5 Quality Assurance Monitoring and Testing, the following statement must be omitted since there is no justification of the reduced testing frequency. "If liner quality soils are stockpiled on site prior to the beginning of placement, a reduced frequency of verification testing will be requested."

A log of soils should be maintained for soils brought in from offsite. The log should provide the testing performed and the intended use on site. This will assist in construction planning for each cell construction.

Appendix V

Need a full size Survey Plat for review of Appendix V.

Appendix Y

In Appendix Y(a) Leachate Pipe and Pump Calculations, the leachate storage tank is listed as a 12-ft diameter horizontal tank. The drawings provided for the site have a vertical storage tank shown without any detail drawings for the storage tanks. Provide a detailed drawing for the storage tanks and the anticipated operations of the tanks to prevent them from exceeding capacity. Provide the pump details for the pumps within the leachate storage tanks. This should be included in the leachate management plan.

In Appendix Y(a) Pipe Capacities, the flow capacity calculation in this section was miscalculated by a factor of 10:

$$Q = \frac{1.49}{.009} \times 0.156 \times 0.111^{2/3} \times 0.005^{1/2} \neq 4.2\ cfs$$
$$= 0.42\ cfs$$

In Appendix Y(a), the Leachate Pipe Crushing and Buckling Scenarios, Scenario 1 provides an H20 truck in the analysis. This size of truck is normal for highway use but it is anticipated based upon the amount of CCR being deposited that the size of the equipment and tire loads could be greater. Scenario 3 uses a live load of a 3 ton skid steer on the sump riser trench with one foot of CCR placed over the top of the sump riser trench. In all likelihood, this loading would occur prior to the placement of the CCR and the geotextile, and would be used to place the clean gravel. Additionally, Scenarios 1 and 3 drawings appears to be in error that CCR would be placed as the protective cover over the geocomposite drainage. Please revise these drawings and recalculate with the proper loading. It also appears that the pipe values were not reduced due to the perforations in Scenarios 1 and 2. Density of waste is listed as 75 pcf. Testing results in Appendix J report higher densities for CCPs. A density of 93 pcf is assumed in calculations in Appendix Y(d).

In Appendix Y(c) – Water Management Calculations, the second paragraph of the concluding statements reads "Backup leachate management will be at an offsite POTW." The permit should specify which POTW will manage the leachate as backup and a signed agreement pertaining to this management should be included.

In Appendix Y(d) – Flood Mitigation Calculations, Pumping Rates for Flood Water Protection – Cell 3, the concluding statement reads, "A pumping rate of 13,194 gpm, pumping 24 hours per day, is required to fill Cell 3 in 10 days for 100-year flood protection." The source and location of the required water supply, as well as the necessary equipment for pumping should be specified.

Included in Appendix Y(e), the clay/geomembrane interface for the side slope cover material stability calculates with a factor of safety of 1.46, below the 1.5 as stated. The interface friction angles used for the clay and geomembrane are stated to be taken from Table 5.6 and Table 5.7. Analysis and Design of Veneer Cover Soils is included in Appendix J with an interface friction angle of 15 degrees. In hand written calculations provided in Appendix Y(e), the factor of safety for CCR to geomembrane is calculated as 1.2 in static conditions. Provide a detailed narrative with additional calculations to support the provided calculations and how they relate to each other. If the fly ash were to be utilized as being in intimate contact with the geomembrane with moistures approximately five percent over optimum, this interface would need laboratory testing as part of the demonstration for an alternative final cover system and included in the stability analysis.

In Appendix Y(e), the attached printout for the 60 mil Geomembrane has 23.00 kN/m provided as the Allowable Force in Geosynthetic, TDESIGN. The valve for the Strength at Yield in the GSE Product Data Sheets has 22 n/mm. Update the value in the printout.

Liner & Cover

1. The separation between the compacted soil component of the composite liner shall be two feet above the Natural Water Table in the site area. Provide a potentiometric surface map for the critical monitoring events from the DSI with the post-settlement base grades provided of the landfill footprint. In any area where the potentiometer surface map illustrates that the surface is above the existing topography, use the top of the existing topography (pre-land disturbance) for those areas. (Article 10, Section 238 C.3.c.)

2. On Sheets 22 and 23, show the bottom of the clay liner on the cross section drawings. (Article 10, Section 238 C.3.c., Article 10, Section 238 C.3. 10 CSR 80-11.010(4)(B)6.)

3. If soils from onsite are acceptable for clay liner, prior to use for such, a test pad for these materials would be necessary since the offsite borrow soils are different. (Article 10, Section 238 C.3. & 10 CSR 80-11.010(10)(C)1.)

4. No demonstration was made to not use one foot (1') of 1×10^{-5} cm/sec soil in the final cover directly under the geomembrane. A demonstration is required and must be approved for the use of an alternate final cover. 10 CSR 80-11.010(14)(C)3. "As each phase of the utility waste landfill is completed, a final cover system shall be installed consisting of one foot (1') of compacted clay with a coefficient of permeability of $1 \text{ X } 10^{-5}$ cm/sec or less and overlaid with one foot (1') of soil capable of sustaining vegetative growth." 10 CSR 80-11.010(14)(C)5. "The department may approve the use of an alternative final cover system provided that the owner/operator can demonstrate to the department that the alternative design will be at least equivalent to the final cover system described in paragraph (14)(C)3. of this rule." The proposed final cover in the permit application consists of "a textured 40-mil HDPE geomembrane liner placed directly on the CCRs, overlain by a 16-oz/yd^2 non-woven, needle-punched geotextile, and covered with two (2) feet of nominally compacted vegetative soil capable of supporting the final vegetation cover." The proposed final cover does not include all the minimum requirements, specifically the 1-foot low-permeability compacted clay layer, nor is it demonstrated that the proposed final cover would be equivalent to those requirements. (Article 10, Section 238 C.3. & 10 CSR 80-11.010(14)(C)3.)

5. The plan sheets don't match the CQA Plan for the top crown HDPE. Please revise and provide the appropriate calculations as necessary. (Article 10, Section 238 C.3. & 10 CSR 80-11.010(14)(B)8.)

6. Sheet 19 shows one anchor trench containing the liner geomembrane, the geocomposite drain, and the final cover geomembrane. A second anchor trench for the cover system is necessary to prevent damage to the previously installed geosynthetic components. (General Engineering Comment)

7. On Sheet 19, the Perimeter Ditch at Closure shows 12" of cover soils over the geomembrane with no clay liner beneath the geomembrane. A minimum of two feet of soil cover must be over the landfilled CCR. Additionally, erosion protection in the perimeter ditch is necessary to prevent exposure of the geomembrane. (Article 10, Section 238 C.3. & 10 CSR 80-11.010(14)(C)3.)

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8. The landfill liner and overlying leachate collection system must have a minimum slope of 1%, pre and post settlement. Revise the landfill grades to meet this requirement during all times within the landfill footprint. Provide plan sheets with the critical cross sections which show the pre and post settlement landfill base grades. (Article 10, Section 238 C.3.; Article 10, Section 238 C.3.e. & 10 CSR 80-11.010(10)(B)4.)

9. Specify the geotextiles for the cushion fabric and the filter fabric shown in the Bottom Liner and Leachate Collection System Detail. Provide the supporting documentation and any necessary calculations. (General Engineering Comment)

10. Provide detail drawings for the pipe perforation or slotting pattern for the leachate collection lines and sump riser pipe. (Article 10, Section 238 C.3.; Article 10, Section 238 C.3.e. & 10 CSR 80-11.010(9)(B)1.C.)

11. H.E.L.P. models include only fly ash layers. Section 3.1.4 of the report states that waste are predicted to include "approximately 70% fly ash and 30% bottom ash". This report also discusses the acceptance of Flue Gas Desulfurization (FGD) byproducts. Neither bottom ash nor FGD byproducts were included in any of the H.E.L.P. models. The H.E.L.P. models used default values for fly ash when some values, such as hydraulic conductivity, were tested for in Appendix J. Use the anticipated waste composition for modeling purposes. (Article 10, Section 238 C.3.; Article 10, Section 238 C.3.e. & 10 CSR 80-11.010(9)(B)1.E.)

Leachate Storage and Conveyance

12. The leachate storage tanks have no capacities or sizes listed or illustrated in the drawings. The leachate storage tanks must be sized based upon the pumping rates of the sumps within the landfill, and the maintenance and inspection schedule or control systems for each. (Article 10, Section 238 C.3.; Article 10, Section 238 C.3.e. & 10 CSR 80-11.010(9)(B)1.A.)

13. Leachate storage tank appears misplaced on Sheet 6. (General Engineering Comment)

14. The Leachate and Stormwater Forcemains are shown in the Exterior Berm without the depths noted. The forcemains must be installed at a depth to prevent freezing during cold weather conditions. Additionally, account for these forcemains being located in a berm above grade and the landfill will not have exothermic reactions. (Article 10, Section 238 C.3.; Article 10, Section 238 C.3.e. & 10 CSR 80-11.010(9)(B)1.D.)

15. Due to the size of the cells, provide calculations to show the removal rate of leachate generated from a storm event during the first couple of weeks of filling. Justify the storm event, calculate the removal rate and describe disposal method utilized. (Article 10, Section 238 C.3.; Article 10, Section 238 C.3.e. & 10 CSR 80-11.010(9)(B)1.E.)

Stormwater

16. The stormwater management plan for the site allows most stormwater to become contact waters and thus leachate. Based upon the stormwater management plan, no waters onsite will be allowed to discharge from the site and must be contained and treated as leachate. Additionally, a one-way valve rather than a gate valve alone would be required in the Stormwater Ponds (Leachate Ponds) to prevent leachate out of the ponds during the

equalization. These ponds will additionally need to be designed with a liner system which meets the requirements of MDNR's Solid Waste Management and Water Protection Programs for storing leachate (waste waters). The use of these waters will be limited to within the composite lined landfill area or for use as makeup waters within the power plant's future scrubber systems. (Article 10, Section 238 C.3.; Article 10, Section 238 C.3.e.; 10 CSR 80-11.010(8)(B)1.F.(V); 10 CSR 80-11.010(8)(C)2. & 10 CSR 80-11.010(9)(C)2.)

17. The 25-year, 24-hour rainfall event is greater than 5.6 inches based upon the NOAA Atlas 14 Volume 8, Version 2 Point Precipitation Frequency Estimates. Increase the 25-year, 24-hour rainfall event to the recently revised amount. (Article 10, Section 238 C.3.; 10 CSR 80-11.010(8)(B)1.F.(III) & 10 CSR 80-11.010(9)(B)3.)

18. Section 4.1.2 Sequence of Phase Construction describes the construction sequence of each phase. The Phase 1 Construction Sequence doesn't discuss the timing of constructing the stormwater pond, but Phases 3 and 4 Construction Sequence discusses constructing the stormwater ponds after placing CCR in the phase area. The construction of each stormwater pond and the CQA report for each must be approved prior to placing CCR into the phase area associated with the stormwater pond. (General Engineering Comment)

19. In 4.2.1 UWL Disposal Operational Description section, the perimeter ditches around each phase must not provide storage of stormwater but must be designed to rapidly convey stormwater to the stormwater ponds for storage. (Article 10, Section 238 C.3. & 10 CSR 80-11.010(8)(B)1.F.(IV))

20. The perimeter ditches are designed with flat slopes. This may lead to standing water retained in these ditches which does not minimize infiltration. This design also may not empty expeditiously after storms. Additionally, this doesn't take into account the anticipated differential settlement. 10 CSR 80-11.010(8)(B)1.F.: "Provisions for surface water runoff control to minimize infiltration and erosion of cover. All Water Pollution Control Program permits and approvals necessary to comply with requirements of the Missouri Clean Water Law and corresponding rules shall be obtained from the department." 10 CSR 80-11.010(8)(B)1.F.(IV): "On-site drainage and channels shall be designed to empty expeditiously after storms to maintain the design capacity of the system." (Article 10, Section 238 C.3.; 10 CSR 80-11.010(8)(B)1.F. & 10 CSR 80-11.010(8)(B)1.F.(IV))

21. Since the perimeter ditches are designed with flat slopes, it would be difficult to estimate the amount of watershed area that would collect into the two separate ponds that serve Cells 3 and 4. The notes for Tables N-2 to N-5 state that "flows are split generally at half the distance between the entrances to the pond along the perimeter ditch." While this would seem like a reasonable assumption in theory, actual field conditions, subject to settlement and weathering, will probably not result in a perfectly flat ditch slope. Additionally, no consideration is given to the differences in times of concentration that would be present along the perimeter ditches due to the varying flow lengths down the final cover slopes. (General Engineering Comment)

22. On Sheets 5 and 7, show how the stormwater from Cell 2 will flow into the Stormwater Pond 1. (General Engineering Comment)

23. After closure, all stormwater should be routed through the stormwater ponds to reduce sediment loading rather than allowing the letdown structures to discharge over the exterior berms. (General Engineering Comment)

Berms

24. Interior berms filled with CCR must be constructed immediately after receiving the Operating Permit or Authorization to Operate due to placing waste within the landfill footprint. Additional CQA reporting will then be required for the construction of the interior berm and requires approval prior to placing CCR material onto it. (Article 10, Section 238 C.3.d.)

25. The design of the landfill has the interior berms exposed the same as the exterior berms during the filling of Cells 1 and 3, thus it is required to have the same protection as the exterior berms since they would be considered exterior berms during the filling of cells 1 and 3, prior to the construction of cells 2 and 4. (Article 10, Section 238 C.3.d.)

26. In the interior berms, the geomembrane needs to wrap back over the leachate collection and protection layers at the point of future tie in to prevent backed-up leachate from seeping through the exterior slope. (Article 10, Section 238 C.3.; Article 10, Section 238 C.3.e. & 10 CSR 80-11.010(9)(C)2.)

27. Section 3.3.2.3 Franklin County Requirement – Erosion Protection in the Landfill Design discusses 2.2-inch thick fabric-formed concrete mats and Appendix K states that the exterior berm slopes will be lined with a 6-inch thick, fabric-formed articulated concrete mat. Section 9.0 Erosion Protection From Levee Overtopping of Failure in Appendix J provides a 56mm (2.2-inches) thick fabric-formed concrete mat such as Hydrotex FP220. The drawings include no dimensions. Revise all section and have the same dimensions listed for each. Additionally, add details to the drawings for the fabric-formed concrete mats. (Article 10, Section 238 C.3.d.)

Operations

28. The procedure for the placement of the first lift of CCR to prevent damage to the underlying layers needs to be developed and included in the operations section. (Article 10, Section 238 C.3. & 10 CSR 80-11.010(2)(C)1.)

29. Flooding of the phase due to not having adequate CCR in place would need a contingency plan developed and included in the construction permit application. The inundation of the phase area would need to be equalized to prevent significant differential head on the liner. Additionally, the pumping down would need to occur relative to the floodwaters surrounding the phase as they recede to prevent a high differential head. (Article 10, Section 238 C.3.; Article 10, Section 238 C.3.e. & 10 CSR 80-11.010(9)(B)1.E.)

30. The Solid Waste Excluded lists Major Appliances and Whole Waste Tires. Modify these to list as Any Appliances and Waste Tires. (Article 10, Section 238 C.3 & 10 CSR 80-11.010(3)(A))

31. Dust suppression must be employed to prevent the migration of CCR offsite during all phases of construction, including mining activities, if and when allowed. (Article 10, Section 238 C.3; 10 CSR 80-11.010(12)(A) & 10 CSR 80-11.010(13)(C)1.)

32. Backup equipment or additional equipment is necessary more quickly than within 3 days due to the volume of waste generated. If a piece of equipment goes down, backup or replacement equipment should be in use within 24 hours. (Article 10, Section 238 C.3 & 10 CSR 80-11.010(15)(B)1.)

33. Seeding to establish vegetation on the intermediate side slope cover needs to occur within a much shorter period than annually as provided in the Phases 1, 2, 3 and 4 Aesthetic Cover section. (Article 10, Section 238 C.3 & 10 CSR 80-11.010(13)(B))

General Comments

34. The waste boundary should be reduced to allow the groundwater monitoring wells to be installed in the area of the DSI. If the wells are installed outside the area of the DSI, the data from the wells must be complied and correlated to existing DSI data and provided as an addendum to the DSI. (Article 10, Section 238 C.3; 10 CSR 80-2.015(1)(D) & 10 CSR 80-2.015 Appendix I)

35. Provide the approved design and drawings of the proposed underpass for Labadie Bottom Road and all approvals from the controlling authorities. (Article 10, Section 238 C.3 & 10 CSR 80-11.010(4)(C)1.)

36. Sheet 8 appears to be missing leaders and detailed descriptions. Please update for further review. (General Engineering Comment)

Appendix D

37. Appendix D should be renamed "Violation History Disclosure Form" rather than the older language which has a negative connotation. (Article 10, Section 238 C.3 & 10 CSR 80-2.020(2)(A)2.I.)

Appendix H

38. The only document contained in Appendix H Floodplain Documentation is a review letter for the "Floodplain Analysis of the Missouri River for the Ameren Missouri Labadie Energy Center" by the Independent Registered Professional Engineer (IRPE). Please provide the additional documentation that was submitted to receive this letter from the IRPE. (Article 10, Section 238 C.3; 10 CSR 80-11.010(4)(B)1.)

Appendix J

39. The Table of Contents for Appendix J lists the Files on Enclosed CD. AEI was not provided the CD which includes the Files of the Printed Outputs from Computer Runs to review. We will need a copy of the computer runs of the revised report based upon the comment letters. (Article 10, Section 238 C.3 & 10 CSR 80-2.020(2)(A)2.B.)

40. Friction angles for the geomembrane/clay interface appear to be too high. The direct shear testing performed on the interface did not adequately displace the interface and the normal loads were low. The displacement testing should be on the order of inches and the normal stresses need to meet the full capacity of the landfill design. Additionally, at lower normal stresses, the critical interface may occur between the geomembrane and geotextile or geocomposite. All of the designs need to be analyzed to have the proper inputs for stability analysis. The bottom liner illustrated as detail 3/17 Bottom Liner and Leachate Collection Detail shows a smooth geomembrane, not a textured HDPE geomembrane as was tested and provided in Appendix A-1 of Appendix J. The interface friction angle (15 degrees) utilized in the Analysis and Design of Veneer Cover Soils, Figure E-42, is a more representative value for

textured HDPE geomembranes/clay interface. (Article 10, Section 238 C.3; 10 CSR 80-11.010(5)(A)4.B. & *Draft Technical Guidance Document on Static and Seismic Slope Stability for Solid Waste Containment Facilities* produced by The Solid Waste Management Program/DEQ/MDNR and Timothy D. Stark, Ph.D., P.E. Associate Professor of Civil Engineering, Department of Civil Engineering, University of Illinois at Urbana-Champaign)

41. Friction angles in the stability analyses don't correspond to the testing on the CH clay liner material from the offsite borrow. Triaxial shear testing (CU) on the CH clay resulted in phi of 14.6 effective stress shear angle with cohesion near 0.21 tons per square foot. The effective friction angle used in the stability analysis for the compacted clay liner was listed as 25 degrees. Verify each input providing references for their values. (Article 10, Section 238 C.3; 10 CSR 80-11.010(5)(A)4.B. & *Draft Technical Guidance Document on Static and Seismic Slope Stability for Solid Waste Containment Facilities* produced by The Solid Waste Management Program/DEQ/MDNR and Timothy D. Stark, Ph.D., P.E. Associate Professor of Civil Engineering, Department of Civil Engineering, University of Illinois at Urbana-Champaign)

42. The stability analysis failed to meet the required and recommended factor of safeties. Cross-section E-E' failed to meet the factor of safety of 1.5 for the static drained global circular failure surface both with the initial and full fill of CCP. (Article 10, Section 238 C.3; 10 CSR 80-11.010(5)(A)4. & *Draft Technical Guidance Document on Static and Seismic Slope Stability for Solid Waste Containment Facilities* produced by The Solid Waste Management Program/DEQ/MDNR and Timothy D. Stark, Ph.D., P.E. Associate Professor of Civil Engineering, Department of Civil Engineering, University of Illinois at Urbana-Champaign)

43. The minimum factor of safety recommended by the draft technical guidance document from MDNR-SWMP and Stark is 1.2 to 1.3, not 1.1 as listed in Table E-2 Results of Slope Stability Analyses. (Article 10, Section 238 C.3; 10 CSR 80-11.010(5)(A)4. & *Draft Technical Guidance Document on Static and Seismic Slope Stability for Solid Waste Containment Facilities* produced by The Solid Waste Management Program/DEQ/MDNR and Timothy D. Stark, Ph.D., P.E. Associate Professor of Civil Engineering, Department of Civil Engineering, University of Illinois at Urbana-Champaign)

44. Liquefaction has been determined to occur in multiple layers. When reviewing the post-liquefied shear strengths provided in the table for the stability analysis, they don't match the shear strengths from correlation charts based upon the SPT blow counts. The chart referenced in the Reitz & Jens report was H. Bolton Seed's 1987 chart. Seed and Harder updated this chart with additional information in 1990 and this chart is available with a 3rd Order Best-Fit curve to simplify the correlation. Please provide the graphed correlations providing the residual shear strengths based upon the SPT blowcount corrected for the percentage of fines. (Article 10, Section 238 C.3; 10 CSR 80-11.010(5)(A)4. & *Draft Technical Guidance Document on Static and Seismic Slope Stability for Solid Waste Containment Facilities* produced by The Solid Waste Management Program/DEQ/MDNR and Timothy D. Stark, Ph.D., P.E. Associate Professor of Civil Engineering, Department of Civil Engineering, University of Illinois at Urbana-Champaign)

45. Liquefaction analysis is typically performed in the upper 50' of unconsolidated materials. Almost every boring was stopped at 35' in depth. Due to the lack of information from the 35' to 50' interval of the unconsolidated materials, provide a narrative justifying why liquefaction would not be anticipated at depths below 35'. (Article 10, Section 238 C.3; 10 CSR 80-11.010(5)(A)4. & *Draft Technical Guidance Document on Static and Seismic Slope Stability for Solid Waste Containment Facilities* produced by The Solid Waste Management Program/DEQ/MDNR and

Timothy D. Stark, Ph.D., P.E. Associate Professor of Civil Engineering, Department of Civil Engineering, University of Illinois at Urbana-Champaign)

46. The draft technical guidance document from MDNR-SWMP and Stark wasn't intended for designing landfills within a very young geologic age and active floodplain. Stability analysis for varying phases of filling is necessary due to the proposed location of the landfill. (Article 10, Section 238 C.3; 10 CSR 80-11.010(5)(A)4. & *Draft Technical Guidance Document on Static and Seismic Slope Stability for Solid Waste Containment Facilities* produced by The Solid Waste Management Program/DEQ/MDNR and Timothy D. Stark, Ph.D., P.E. Associate Professor of Civil Engineering, Department of Civil Engineering, University of Illinois at Urbana-Champaign)

47. Protective/drainage layers are missing from the stability analysis. Both designs need analyzed in the stability models if both are considered for permitting and construction. (Article 10, Section 238 C.3; 10 CSR 80-11.010(5)(A)4.B. & *Draft Technical Guidance Document on Static and Seismic Slope Stability for Solid Waste Containment Facilities* produced by The Solid Waste Management Program/DEQ/MDNR and Timothy D. Stark, Ph.D., P.E. Associate Professor of Civil Engineering, Department of Civil Engineering, University of Illinois at Urbana-Champaign)

48. The boring B-100 is no longer centralized or even under a cell of the landfill. Other soil profiles should be analyzed to provide the critical Shake analysis. This will require additional borings to bedrock within the footprint of the landfill. (Article 10, Section 238 C.3; 10 CSR 80-11.010(5)(A)4. & *Draft Technical Guidance Document on Static and Seismic Slope Stability for Solid Waste Containment Facilities* produced by The Solid Waste Management Program/DEQ/MDNR and Timothy D. Stark, Ph.D., P.E. Associate Professor of Civil Engineering, Department of Civil Engineering, University of Illinois at Urbana-Champaign)

49. The information provided in Section 5.3 Estimate of Yield Acceleration and Lateral Spreading for the short-duration time history appears to be incorrect and/or not the most critical based upon the provided charts. The data provided for the short-duration time history came from chart #10 (page C-9) when chart #2 (page C-10) provide a higher peak rock acceleration = 0.25 and PHGA = 0.24 based upon the output provided from SHAKE2000 analysis using the same soil profile. The values provided are for the unfilled conditions. Additional model runs were completed for the filled conditions for use in the final cover but not discussed in this section. Provide a narrative with the Appendix C Results of Seismic Risk Analyses to detail the assumptions and correlate the model analysis from the inputs to the generated results. Update this information and use it in your modeling. (Article 10, Section 238 C.3; 10 CSR 80-11.010(5)(A)4. & *Draft Technical Guidance Document on Static and Seismic Slope Stability for Solid Waste Containment Facilities* produced by The Solid Waste Management Program/DEQ/MDNR and Timothy D. Stark, Ph.D., P.E. Associate Professor of Civil Engineering, Department of Civil Engineering, University of Illinois at Urbana-Champaign)

50. Provide the actual stability analysis for the deformation analysis and provide with a narrative rather than a table listing the yield accelerations and deformations for the short and long-duration events. (Article 10, Section 238 C.3; 10 CSR 80-11.010(5)(A)4. & *Draft Technical Guidance Document on Static and Seismic Slope Stability for Solid Waste Containment Facilities* produced by The Solid Waste Management Program/DEQ/MDNR and Timothy D. Stark, Ph.D., P.E. Associate Professor of Civil Engineering, Department of Civil Engineering, University of Illinois at Urbana-Champaign)

51. The Table of Contents for Appendix C Seismic Analyses appears to have C-18 & C-19 swapped with C-20 & C-21. Please revise and verify the information. (General Engineering Comment)

52. Settlement analysis demonstrates some differential settlement which could cause ponding in the flat stormwater channels, a reduction in the overall height of the berms and settlement of the base grades of the landfill. Each of these must be discussed including how Franklin County's regulations will be satisfied during all phases of construction, filling and closure. Additionally, the settlement analysis typically has a range of settlement that may occur due to variability in the underlying subgrade and must be conservatively considered in the analysis to prevent overtopping of the exterior and interior berms due to a 500-year flood event. (Article 10, Section 238 C.3; Article 10, Section 238 C.3d.i.; 10 CSR 80-11.010(5)(A)4.A & 10 CSR 80-11.010(8)(B)1.F.(IV))

53. Provide the calculations correlating the CPT test data to the elastic modulus utilized in the Settlement Analysis. The CPT logs which were provided in the DSI don't provide enough detail to verify the elastic moduli provided in the settlement analyses. Additionally, heavily loaded conditions decrease the modulus, so these factors need to be accounted for relative to their location within the footprint of the fill. The Bowles 1997 reference appears to be dated and newer, more precise correlations are widely available which utilize the normalized cone resistance and normalized friction ration. (Article 10, Section 238 C.3 & 10 CSR 80-11.010(5)(A)4.A)

54. Calculate the bearing capacity of the subgrade in varying locations throughout the footprint. Additionally, calculate the bearing capacity during a maximum credible seismic event which induces liquefaction during each phase of construction and filling of the landfill. (Article 10, Section 238 C.3 & 10 CSR 80-11.010(5)(A)4.A)

55. The protection of liner from hydrostatic uplift discusses the flooding with the gravel drainage layer and sand protective layer. The alternate design with the geocomposite drain and protective sand layer must also be discussed in the flooding scenarios. (General Engineering Comment)

56. In Appendix G – Design of Fabric-Formed Concrete Mat (FCM), the factor of safety calculation has a missing value, t (= 0.183 ft) in the numerator after substitution:

$$F.S. = \left[\frac{\mu(t)(\gamma_c - \gamma_w)cos\theta cos \propto - \tau_{DES}}{\sqrt{[t(\gamma_c - \gamma_w)sin\theta]^2 + \tau_{DES}{}^2}}\right]$$

$$F.S. = \left[\frac{0.637(130\ PCF - 62.4\ PCF)\cos(18.435°)cos(0°) - \tau_{DES}}{\sqrt{[(0.183')(130 - 62.4)sin18.435]^2 + \tau_{DES}{}^2}}\right]$$

This reduces the value of the maximum design velocity significantly. Update the calculations with the thickness of the fabric-formed concrete included. (General Engineering Comment)

Appendix O

57. The filter design basis in the Memo from Bruce Dawson, PE to Gredell Engineering Resources, Inc, included in Appendix O-1, requires a tighter gradation for the sand protective layer based upon the R15 provided. The D15 for the sand should range from 0.24 mm to 0.8

mm based upon the D15 of the Fly Ash and the R15 provided from the Peck Hanson Thornburn filter criteria. (Article 10, Section 238 C.3 & 10 CSR 80-11.010(9)(B)1.D.)

Appendix P

58. The Construction Quality Assurance Plan inadequately addresses the requirements in 10 CSR 80-11.010(6)(B)1.A. "A detailed description of the QA/QC testing procedures that will be used for every major phase of construction. The description must include at a minimum, the frequency of inspections, field testing, laboratory testing, equipment to be utilized, the limits for test failure, and a description of the procedures to be used upon test failure;" Specifically, this section should include tables showing the frequency and acceptable test result values for each testing procedure. The Air Pressure Testing of seams cannot allow a drop of 4 psi during the 5 minute test. It must not drop more than 10% of the equalized pressure of at least 25 psi. (Article 10, Section 238 C.3 & 10 CSR 80-11.010(6)(B)1.A.)

59. Appendix P Construction Quality Assurance Plan section 3.2 Test Pad references the Demolition Landfill regulations. Please revise to reference the appropriate regulations. (Article 10, Section 238 C.3 & 10 CSR 80-11.010(10)(C)1.)

60. In section 3.5 Quality Assurance Monitoring and Testing, the following statement must be omitted since there is no justification of the reduced testing frequency. "If liner quality soils are stockpiled on site prior to the beginning of placement, a reduced frequency of verification testing will be requested." (Article 10, Section 238 C.3 & 10 CSR 80-11.010(6)(C)1.)

61. A log of soils should be maintained for soils brought in from offsite. The log should provide the testing performed and the intended use on site. This will assist in construction planning for each cell construction. (General Engineering Comment)

Appendix V

62. Need a full size Survey Plat for review of Appendix V. (General Engineering Comment)

Appendix Y

63. In Appendix Y(a) Leachate Pipe and Pump Calculations, the leachate storage tank is listed as a 12-ft diameter horizontal tank. The drawings provided for the site have a vertical storage tank shown without any detail drawings for the storage tanks. Provide a detailed drawing for the storage tanks and the anticipated operations of the tanks to prevent them from exceeding capacity. Provide the pump details for the pumps within the leachate storage tanks. This should be included in the leachate management plan. (Article 10, Section 238 C.3.; Article 10, Section 238 C.3.e. & 10 CSR 80-11.010(9)(B)1.A.)

64. In Appendix Y(a) Pipe Capacities, the flow capacity calculation in this section was miscalculated by a factor of 10:

$$Q = \frac{1.49}{.009} \times 0.156 \times 0.111^{2/3} \times 0.005^{1/2} \neq 4.2\ cfs$$
$$= 0.42\ cfs$$

(Article 10, Section 238 C.3.; Article 10, Section 238 C.3.e. & 10 CSR 80-11.010(9)(B))

65. In Appendix Y(a), the Leachate Pipe Crushing and Buckling Scenarios, Scenario 1 provides an H20 truck in the analysis. This size of truck is normal for highway use but it is anticipated based upon the amount of CCR being deposited that the size of the equipment and tire loads could be greater. Scenario 3 uses a live load of a 3 ton skid steer on the sump riser trench with one foot of CCR placed over the top of the sump riser trench. In all likelihood, this loading would occur prior to the placement of the CCR and the geotextile, and would be used to place the clean gravel. Additionally, Scenarios 1 and 3 drawings appears to be in error that CCR would be placed as the protective cover over the geocomposite drainage. Please revise these drawings and recalculate with the proper loading. It also appears that the pipe values were not reduced due to the perforations in Scenarios 1 and 2. Density of waste is listed as 75 pcf. Testing results in Appendix J report higher densities for CCPs. A density of 93 pcf is assumed in calculations in Appendix Y(d). (Article 10, Section 238 C.3.; Article 10, Section 238 C.3.e. & 10 CSR 80-11.010(9)(B)1.C.)

66. In Appendix Y(c) – Water Management Calculations, the second paragraph of the concluding statements reads "Backup leachate management will be at an offsite POTW." The permit should specify which POTW will manage the leachate as backup and a signed agreement pertaining to this management should be included. (Article 10, Section 238 C.3.; Article 10, Section 238 C.3.e. & 10 CSR 80-11.010(9)(B)4.)

67. In Appendix Y(d) – Flood Mitigation Calculations, Pumping Rates for Flood Water Protection – Cell 3, the concluding statement reads, "A pumping rate of 13,194 gpm, pumping 24 hours per day, is required to fill Cell 3 in 10 days for 100-year flood protection." The source and location of the required water supply, as well as the necessary equipment for pumping should be specified. (General Engineering Comment)

68. Included in Appendix Y(e), the clay/geomembrane interface for the side slope cover material stability calculates with a factor of safety of 1.46, below the 1.5 as stated. The interface friction angles used for the clay and geomembrane are stated to be taken from Table 5.6 and Table 5.7. Analysis and Design of Veneer Cover Soils is included in Appendix J with an interface friction angle of 15 degrees. In hand written calculations provided in Appendix Y(e), the factor of safety for CCR to geomembrane is calculated as 1.2 in static conditions. Provide a detailed narrative with additional calculations to support the provided calculations and how they relate to each other. If the fly ash were to be utilized as being in intimate contact with the geomembrane with moistures approximately five percent over optimum, this interface would need laboratory testing as part of the demonstration for an alternative final cover system and included in the stability analysis. (Article 10, Section 238 C.3 & 10 CSR 80-11.010(5)(A)4.D.)

69. In Appendix Y(e), the attached printout for the 60 mil Geomembrane has 23.00 kN/m provided as the Allowable Force in Geosynthetic, TDESIGN. The valve for the Strength at Yield in the GSE Product Data Sheets has 22 N/mm. Update the value in the printout. (General Engineering Comment)