November 20, 2006

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of	)	
	)	
SYSTEM ENERGY RESOURCES, INC.	)	Docket No. 52-009-ESP
	)	
(Early Site Permit for Grand Gulf ESP Site)	)	

NRC STAFF PRE-FILED TESTIMONY CONCERNING HEARING ISSUE A:
SITE CHARACTERIZATION

Q.1. Please state your name, occupation, by whom you are employed and your professional qualifications.

A.1. (GB) Goutam Bagchi. I am employed as a Senior Advisor in the Office of Nuclear Reactor Regulation by the U.S. Nuclear Regulatory Commission ("NRC"). A statement of my professional qualifications is attached.

A.1. (LV) Lance W. Vail. I am employed as a Senior Research Engineer II with the Hydrology Group at the Department of Energy's Pacific Northwest National Laboratory, operated by Battelle. I am providing testimony under a technical assistance contract with the staff of the U.S. Nuclear Regulatory Commission ("NRC"). A statement of my professional qualifications is attached.

A.1. (TC) Thomas M. Cheng. I am employed as a Senior Structural/Geotechnical Engineer in the geosciences and Civil Engineering Branch A (EGCA), Division of Engineering (DE), Office of Reactor Regulation (NRR), NRC. A statement of my professional qualifications is attached.

Q.2. Please describe your professional responsibilities with regard to the review of the application by System Energy Resources, Inc. ("SERI" or "Applicant") for an early site permit

("ESP") for a new nuclear power plant or plants to be located on the existing Grand Gulf Nuclear Station ("GGNS") site near Port Gibson, Mississippi.

A.2. (GB) As part of the NRC Staff's health and safety review of the SERI ESP application, documented in NUREG-1840, the "Safety Evaluation Report for an Early Site Permit (ESP) at the Grand Gulf Site," April 2006 ("SER"), I reviewed the hydrology aspects of the Applicant's Site Safety Analysis Report. This review included evaluating the adequacy of hydrology-related site characterization data related to surface and subsurface hydrologic processes and the reliability of the safety-related conclusions that SERI made based on this characterization data.

A.2. (LV) As part of the NRC Staff's environmental review of SERI's ESP application, documented in the FSER, I assisted the NRC Staff in its analysis of the aspects of the Applicant's SSAR that concerned hydrology.

A.2. (TC) As part of the NRC Staff's health and safety review of the SERI ESP application, documented in NUREG-1840, the "Safety Evaluation Report for an Early Site Permit (ESP) at the Grand Gulf Site" ("SER"), I reviewed the aspects of the Applicant's Site Safety Analysis Report that concerned geotechnical engineering related issues.

TESTIMONY ON EXISTING SITE CHARACTERIZATION DATA

I. Hydrogeologic Characterization

Q.3. In its November 6, 2006, Order, the Atomic Safety and Licensing Board ("Board") identified certain issues to be addressed in connection with the mandatory hearing. With regard to the site characterization, the Board asked that the NRC Staff summarize and discuss the existing site characterization data, and any additional data that will be needed at the COL stage relating to the hydrogeologic characterization of the shallow aquifers in the loess and alluvium and the deeper aquifers of the Catahoula/old alluvium that was used to estimate aquifer yield, water quality, and drawdown conditions for the purpose of (a) demonstrating that

an adequately designed ground water well system capable of withdrawing 3,570 gpm could be provided for the proposed plant(s) without impacting the water quality of the aquifer; and (b) defining construction dewatering requirements, and drawdown effects on existing structural support and lateral loads against finished foundation walls. Please address these issues.

A.3. (LV, GB) The Staff does not specify the specific methodologies or the specific data that an applicant utilizes in preparing an SSAR or an ER. However, the Staff does review the appropriateness of the methodologies and the completeness of the data used by the applicant. Limitations on available site characterization data and lack of specific plant design information may require the Staff to propose Permit Conditions or COL Action Items in the safety review and to not resolve specific issues in the environmental review.

In the Staff's safety review of SERI's ESP application for the Grand Gulf site, one Permit Condition (#2) and nine COL Action Items (2.4-1 through 2.4-9) related to hydrology were proposed by the Staff. In the Staff's environmental review the issue of impacts to the Catahoula aquifer was "unresolved."

The Staff was unable to determine that either the specific isotopes chosen by SERI or the distribution coefficients (Kd) of the chosen isotopes were appropriate. Information on both the chemistry of the radwaste system and the aquifer itself did not preclude the possibility that the radionuclides' mobility might be significantly increased through chemical chelation. Permit Condition #2, which precludes the release from the radwaste system, eliminated the necessity for further characterization information.

If SERI continues to propose to withdraw water from the Catahoula Formation for construction and operation of the ESP facility, the Staff will require further characterization of the Catahoula aquifer. The Staff will review the applicant's proposed aquifer characterization program based on: the location and depth of the proposed wells; the location and depth of existing and proposed subgrade plant structures; and the location and properties of existing and

proposed fill material. Since the construction of subgrade facilities would alter the subsurface environment and, thereby, could alter the geohydrologic characteristics of the Catahoula Formation, the determination of an appropriate aquifer characterization plan requires subgrade design information not available at the ESP stage. At the COL stage, a combination of pump tests, numerical modeling, boreholes, geophysical logging, and chemical characterization of groundwater may be used to develop an adequate understanding of the impacts of pumping on the Catahoula Formation. Since the Catahoula aquifer is designated as a sole-source aquifer by the EPA, the Staff will coordinate the aquifer characterization requirements with the EPA.

Listed below are the existing data supporting subsurface characterization of the ESP site:

1. geologic maps of site area (SSAR Figure 2.5-27)
2. description of regional geologic formations (SSAR Table 2.4-20)
3. hydrogeologic cross sections located in Mississippi River floodplain (SSAR Figure 2.4-33/UFSAR Figure 2.4-27, SSAR Figure 2.4-36/UFSAR Figure 2.4-28, and SSAR Figure 2.4-37/UFSAR Figure 2.4-28)
4. chemical analyses results of surface and ground water samples (SSAR Table 2.4-23/UFSAR Table 2.4-21)
5. water quality sampling data from three ground water wells in the Catahoula formation that are used to supply water for general site purposes of the existing plant (SSAR Table 2.4-25); sampled water quality parameters include pH, alkalinity, aluminum, chloride, sulphate, fluoride, free carbon dioxide, iron, magnesium, manganese, calcium, sodium, potassium, zinc, total dissolved residue, and hardness
6. ground water levels measured in piezometers (SSAR Table 2.4-30/UFSAR Table 2.4-24; two piezometers in alluvium, five in terrace deposits, and eight in the Catahoula formation), in observation wells (SSAR Table 2.4-31/UFSAR Table 2.4-25), in

monitoring wells (SSAR Table 2.4-32/UFSAR Table 2.4-29), and in on-site wells (SSAR Table 2.4-33); hydrographs of piezometers and wells (SSAR Figure 2.4-39/UFSAR Table 2.4-32), construction observation wells (SSAR Figure 2.4-44/UFSAR Figure 2.4-36), and replacement observation wells (SSAR Figure 2.4-45/UFSAR

7. location of perched water zones (SSAR Figure 2.4-33/UFSAR Figure 2.4-27)
8. hydrogeologic properties of subsurface material (SSAR Table 2.4-34/UFSAR Table 2.4-26; hydraulic conductivity measured using pumping tests in seven wells in the terrace deposits, using variable head permeability tests in three wells in the terrace deposits and one in the Catahoula formation, and using laboratory consolidation tests at five locations in the Catahoula formation and two in the alluvium); hydraulic conductivity and transmissivity of the terrace deposits
   (SSAR Table 2.4-35/UFSAR Table 2.4-26a; 22 wells)
9. projected ground water level contours under 8000 gpm of continuous pumping from all six radial collector wells (SSAR Figure 2.4-55/UFSAR Figure 2.4-44) -- only four of the radial collector wells were constructed for GGNS
10. USGS water quality data for the Mississippi River at Vicksburg 1961 to 1999
    (URL: http://nwis.waterdata.usgs.gov/nwis/qwdata?site_no=07289000)

Only limited site characterization data was obtained recently by the Applicant (items 1, 2, 5, and part of 6 (ground water levels in on-site wells), listed above). All other items listed above, except for item 10, were reported in the GGNS UFSAR.

GGNS UFSAR Figure 2.4-27 shows the locations of radial collector wells. The Applicant reported results from pumping tests conducted in collector wells # 3 and # 5. These were long term pumping tests lasting 134 days from August through December, 1979. The average pumping rates for these two collector wells were 8000 gpm and 7600 gpm, respectively. The

collector wells were installed to draw water indirectly from the Mississippi River through the alluvium.

Three wells that draw water from the Catahoula formation are used to provide water for general site purposes of the existing plant. These wells are rated at 513, 535, and 577 gpm, respectively.

The Staff reviewed the existing data to determine the groundwater characteristics near the ESP site. The radial collector wells can sustain pumping rates in excess of 7600 gpm for a sustained duration; the wells finished in the Catahoula formation can sustain pumping rates in excess of 500 gpm. Based on the available groundwater characterization data, the Staff determined that it is not unreasonable to expect that a suitable system of groundwater wells can be designed to extract water at a maximum rate of 3570 gpm from the Catahoula formation. The design of the groundwater well system will depend on the specific plant design chosen by the COL applicant and the layout of the plant infrastructure. The Staff will review the adequacy of the groundwater well system design at the COL stage, using appropriate NRC regulations and regulatory guidance.

The Applicant stated that dewatering will be required during construction of the ESP facility. The effects of any dewatering during construction of the ESP facility on existing structures will be reviewed at the COL stage under the requirements of 10 CFR Part 50 and 10 CFR Part 52. There are many engineered solutions to resolve specific conditions that can arise during the construction process; the Applicant has proposed a tried method of dewatering during construction. However, limited use of sheet piling, injection grouting, etc. can resolve construction circumstances in the future. Nevertheless, the maximum withdrawal rate is short-term and the safety-related SSCs of the existing plant are distant from the ESP site boundary. Therefore, it is expected that the potential for affecting the structural integrity of the safety-related SSCs of the existing plant from ground subsidence due to any dewatering activity at the

ESP site would be temporary and minimal. The Applicant stated that inspection and monitoring procedures will be developed for the construction phase of the ESP facility. Observation wells would be installed and monitored periodically throughout the construction of the ESP facility to measure ground water levels and to verify that ground water drawdown and the radius of influence evolve as predicted. The Staff concluded that it is feasible to conduct construction activities in a completely safe manner at the proposed ESP site and the site does not have any intrinsic characteristics that preclude its choice as a suitable site for locating future reactor or reactors, should a permit be granted. A dewatering system can be designed such that its effects on existing structures and systems are minimized, and existing regulatory criteria and review guidance will ensure a completely adequate review at the COL stage.

II. Fill Material Characterization

Q.4. In its November 6, 2006, Order, the Board identified certain issues to be addressed in connection with the mandatory hearing. With regard to the site characterization, the Board asked that the NRC Staff summarize and discuss the existing site characterization data, and any additional data that will be needed at the COL stage relating to the characterization of the existing fill material for foundation design and to define construction conditions. Please address these issues.

A.4. (TC) The existing fill materials are located at an elevation approximately 130 ft (at planned plant grade) and were placed over time in an uncontrolled condition.[1] Therefore, there is no significant information on the strength and stiffness properties of the material, grain size distribution, and expected behavior under design load conditions. However, since the plant grade will be located at a depth of about 132.5 ft MSL, this fill material will have a negligible impact on the design of the facility. According to the Applicant's response to RAI 2.5.4-11, this

[1] An uncontrolled condition exists where the engineering properties do not need to be reasonably estimated.

fill material will be removed during plant construction and, where needed, new fill material will be placed under controlled conditions. Some minor impacts on construction may occur, although the Staff believes that any such impacts will be negligible.

III. Characterization Relating to Potential Karst Formation

Q.5. In its November 6, 2006, Order, the Board identified certain issues to be addressed in connection with the mandatory hearing. With regard to the site characterization, the Board asked that the NRC Staff summarize and discuss the existing site characterization data, and any additional data that will be needed at the COL stage relating to deep explorations in the power block footprint to evaluate the potential for a karst formation. Please address these issues.

A.5. (TC) The issue of the potential for development of sinkholes, dissolution cavities or soft zones in calcareous clays and limestone below any nuclear sites, including the Grand Gulf site, needs to be evaluated. If such soft zones or voids exist in the soil/rock profile below the site, the potential for the collapse of these zones during and following a seismic event can lead to differential settlements of power block foundations and at the ground surface. Such effects are of serious concern at other sites housing critical facilities.

The geotechnical report, ER-02, indicates that materials below the plant are calcareous and therefore potentially susceptible to the effects of dissolutioning. The Staff believes that it is, however, most likely inappropriate to use deep borings or other such penetrations to investigate this potential at the Grand Gulf site. First, the fact that such penetrations do not encounter such a soft zone does not imply that such zones do not exist. Second, the number and spacing of such penetrations will depend on the estimated size of these features. As a common engineering practice for determining the potential of a karst formation, the Applicant should search and investigate the available database of information for the known site materials, and determine the opinions of recognized geologic experts versed in the area. This

data would then be provided to the Staff. The Staff would also perform a chemical evaluation of available soil samples to support any of the conclusions drawn from the Applicant's study of the database. These evaluations should be performed prior to planning any deep boring program. During the COL stage, the Applicant will perform additional borings and laboratory testing as committed in the response to RAI 2.5.4-3. SER at 2-233. The Applicant's field exploration information and test results will be available to the Staff during its review of the COL Application.

IV. Characterization Relating to Effect of River Flooding on Bluff

Q.6. In its November 6, 2006, Order, the Board identified certain issues to be addressed in connection with the mandatory hearing. With regard to the site characterization, the Board asked that the NRC Staff summarize and discuss the existing site characterization data, and any additional data that will be needed at the COL stage relating to the effect of river flooding on future erosion of the bluff and any retrogressive sloughs of the bluff. Please address these issues.

A.6. (TC, GB) The Staff notes that the levee systems and the revetments built on the banks of the Mississippi river by the Corps of Engineers focus on flooding on the west bank; on the east bank, protection is provided by revetments, which limit any erosion of the bank. The proposed ESP site is located on the east bank of the Mississippi River at an elevation of approximately 132.5 ft MSL. The ESP site is not subject to any significant flooding from the Mississippi River. The levees on the west bank of the river near the ESP site have a crest elevation between 101 and 103 ft MSL. If a future river flood overtops the levees on the west bank, the ESP site will still be above the river flood water elevation. During floods, the Mississippi River overtops the revetments on the east bank and flows through the floodplain located to the west of the bluffs. The Staff, in consultation with the U.S. Army Corps of Engineers, determined during its review of the design basis flood in the Mississippi River that

the static flood water surface elevation would not be substantially greater than 103 ft MSL near the GGNS site because of the large discharge capacity of the Mississippi River floodplain west of the levees. The bluff on the east bank, adjacent to the ESP site, is not protected from erosion from river flooding by engineered revetments. The bluff on the west of the ESP site area steeply falls from an approximate elevation of 160 ft MSL to 90 ft MSL. The bluff west of the foot of this steep portion then gradually slopes towards Gin and Hamilton Lakes. During the design basis flood, the static flood water surface elevation of 103 ft MSL will result in the inundation of the gradually sloping portion of the bluff and a smaller extent of the steeply sloping portion of the bluff.

(TC) The response to this question dealing with retrogressive sloughing is provided in the response to Hearing Issue D Question 7.

V. Mississippi River Sediment Characterization

Q.7. In its November 6, 2006, Order, the Board identified certain issues to be addressed in connection with the mandatory hearing. With regard to the site characterization, the Board asked that the NRC Staff summarize and discuss the existing site characterization data, and any additional data that will be needed at the COL stage relating to Mississippi River sediment characterization for construction of the intake and discharge structures and operation of the water intake and treatment plant. Please address these issues.

A.7. (GB, TC) The Mississippi River intake and the discharge for the proposed ESP site are related to the normal operation of the plant, so they are not safety-related. The applicant has proposed the construction of a cooling tower with a water storage underneath, should there be a need for a water cooled ultimate heat sink. The Staff determined that it is not necessary to characterize the sediment deposition rate or associated data for the COL application. The Staff also determined that the Mississippi River is deep and has a very high

continuous flow rate to allow the applicant to design a well engineered and satisfactory intake and discharge system for the normal cooling of a future plant.

VI. Characterization of the Loess

Q.8. In its November 6, 2006, Order, the Board identified certain issues to be addressed in connection with the mandatory hearing. With regard to the site characterization, the Board asked that the NRC Staff summarize and discuss the existing site characterization data, and any additional data that will be needed at the COL stage relating to shear strength and creep characteristics of the loess for retrogressive slope deformations of the bluff that might impact the integrity of the proposed plant(s). Please address these issues.

A.8. (TC) The loess formation is an extensive formation that exists over large areas in this region of the country. The generic properties of the loess formation have been developed and studied for many years and a large database of information has been compiled. According to its response to RAI 2.5.4-11, the Applicant committed to locate the power block foundation on stiff and compact materials that are located well below the loess materials. SER at 2-243. The Applicant also noted that it modified the ESP site plan to restrict the location of the proposed power block area (PPBA) to a distance grater than 100 ft from the bluff area on the west side of the site. The Staff believes that the Applicant's commitment will eliminate the significant impacts of the loess material on the design of the plant structures.

VII. Surface and Ground Water Characterization

Q.9. In its November 6, 2006, Order, the Board identified certain issues to be addressed in connection with the mandatory hearing. With regard to the site characterization, the Board asked that the NRC Staff summarize and discuss the existing site characterization data, and any additional data that will be needed at the COL stage relating to baseline surface and ground water quality to quantify potential impacts for the existing plant to assure sufficient

data is available to discriminate between the existing plant and the proposed plant(s). Please address these issues.

A.9. (GB) Data available for characterization of the subsurface at and near the ESP site is discussed in response to Board's Hearing Issue A, Question 3. Data that would be needed in the future depend upon the monitoring system that will be put in place. The system selected would depend upon many different factors such as: the reactor, the design of its radwaste facility, radioisotope inventory, etc. The Staff believes that it would be speculative to make a list of any additional data that will be needed at the COL stage.

With regard to radiation levels in surface and ground water at and near the ESP site that may impact the existing plant, the Staff concluded that there will be no impact on the existing GGNS plant from accidental releases from the ESP facility. The Staff's proposed Permit Condition 2 requires that the ESP facility be designed such that any and all accidental releases of radionuclides into any potential liquid pathway are precluded. An overwhelming majority of evolutionary and advanced reactor designs employ the concept of a nuclear island or a power block that is buried into the ground at a depth of approximately 40 ft to 60 ft. In some advanced designs the radwaste facility is located on the nuclear island, which is protected from leakage by a stainless steel liner and leakage collection drains. The radwaste tank is also protected by high surrounding walls to contain any inadvertent spillage during radwaste handling or any unanticipated component failure. The Staff concluded that it is technically feasible to design engineered barriers and other hydraulic conditions to meet the requirements of Permit Condition 2.

With respect to normal releases, the Staff reviewed the Grand Gulf radiological environmental monitoring program (REMP). The requirements for the REMP are in 10 CFR 50.34a(a); 10 CFR 50.36a(a); SEC IV, B.2 of Appendix I in 10 CFR Part 50 and the REMP for the operating unit has been reviewed and approved by NRC Staff. Environmental

monitoring has been performed around the Grand Gulf site since 1978. The REMP includes monitoring of the airborne exposure pathway, direct exposure pathway, water exposure pathway, aquatic exposure pathway with control and indicator locations within a 29 km (18 mi) radius of the site. The pre-operational program included collection and analysis of samples of air particulates, precipitation, milk, crops, soil, well water, surface water, fish, and silt as well as measurement of ambient gamma radiation.

Related to surface and groundwater sampling, three surface water samples are taken, one upstream, one downstream and one downstream during a Liquid Radwaste Discharge. The surface water samples are taken at 92 day intervals and a gamma isotropic and tritium analysis are performed. The groundwater sample is taken at two wells once a year and a gamma isotropic and tritium analysis are also performed. Review of data from 2002 and 2003 showed no results above the lower limit of detection (LLD).

VIII. Aquifer Characterization

Q.10. In its November 6, 2006, Order, the Board identified certain issues to be addressed in connection with the mandatory hearing. With regard to the site characterization, the Board asked that the NRC Staff summarize and discuss the existing site characterization data, and any additional data that will be needed at the COL stage relating to subsurface hydrological and chemical properties of the aquifer and definition of composition of the radwaste effluent. Please address these issues.

A.10. (GB) There is only limited data available regarding hydrological and chemical properties of the subsurface at and near the ESP site. At the ESP stage, the reactor type for the proposed facility has not been finalized and therefore the composition of the liquid radwaste effluent is not known.

The Staff's proposed Permit Condition 2 requires the ESP facility to be designed in such a way that any and all accidental releases of radionuclides are precluded. The Staff's proposed

COL Action Item 2.4-9 addresses the need to obtain detailed groundwater characterization for dewatering system design.

The Staff requested that the Applicant provide more detailed data so the Staff could understand all the ground water pathways from points of release to the accessible environment. The Staff also requested that the applicant provide the chemical properties of the subsurface environment, since the mobility of radionuclides in the subsurface depends on the chemical properties of the subsurface media. Based on the Applicant's response, the Staff determined that, at the ESP stage, due to the incomplete characterization of subsurface hydrological and chemical properties in addition to the unknown composition of the liquid radwaste effluent of the proposed ESP facility, a comprehensive radionuclide migration analysis cannot be performed. The Staff determined that the proposed ESP site does not have any unique characteristics that could make a suitable system for monitoring or arresting radionuclide transmission through liquid pathway technically infeasible. The Staff imposed Permit Condition 2 to ensure that effective measures can be put in place during the COL stage. The Staff concluded, therefore, that further characterization of the composition of the liquid radwaste effluent and that of the subsurface hydrological and chemical properties was not needed, provided that Permit Condition 2 is not violated. As discussed in the Staff's response to the Board's Hearing Issue A, Question 9, the Staff concluded that it is technically feasible to design engineered barriers and other hydraulic conditions to meet the requirements of Permit Condition 2.

TESTIMONY ON LONG TERM STABILITY OF THE BLUFF

Q.11. In its November 6, 2006, Order, the Board identified certain issues to be addressed in connection with the mandatory hearing. With regard to the site characterization, the Board asked that the NRC Staff summarize and explain the factual record concerning the long term stability of the bluff and its potential impact on the integrity of the proposed plant(s). Please address these issues.

A.11. (TC) The long term stability of the bluff can impact the evaluation of the plant design from several points of view. From a static perspective, the erosion of the bluff will reduce confining pressures on soils underneath the toe of the foundation mat at the edge adjacent to the bluff. This reduction in confinement can reduce strength and stiffness of the toe soils needed to provide gross seismic overturning and sliding capacity for the plant. In response to RAI 2.4.5-11, the Applicant made a commitment to locate the foundation of seismic Category I structures at a depth where the minimum shear wave velocity is 1000 fps. SER at 2-236, A-17. Adherence to the minimum shear wave velocity would ensure that the foundation will be at a depth of between 120 and 140 ft below grade. Consequently, concerns related to seismic overturning and sliding will be resolved by such a deeply embedded foundation.

The impacts of erosion of the bluff on calculated seismic responses of the plant are more difficult to evaluate, since there is little to no experience with seismic response calculations for unbalanced site configurations. (All the current techniques used for seismic analyses are based on the assumption of uniform or balanced site conditions on all sides of the plant facility.) This behavior can potentially impact the computation of both seismic-induced element stresses (and therefore estimates of resulting demand/capacity ratios of structural plant elements) and the computation of in-structure floor response spectra.

TESTIMONY ON SUBSURFACE HYDROLOGICAL AND CHEMICAL PROPERTIES OF THE AQUIFER

Q.12. In its November 6, 2006, Order, the Board identified certain issues to be addressed in connection with the mandatory hearing. With regard to the site characterization, the Board asked that the NRC Staff summarize and explain the factual record concerning the sufficient knowledge of the subsurface hydrological and chemical properties of the aquifer and composition of the radwaste effluent to meet 10 C.F.R. § 100.20(c)(3) requirements for site

suitability determination factors relating to accidental releases to the liquid pathway. Please address these issues.

A.12. (GB) Data available for characterization of the subsurface at and near the ESP site is discussed in response to Board's Hearing Issue A, Question 3.

There is only limited data available regarding hydrological and chemical properties of the subsurface at and near the ESP site. At the ESP stage, the reactor type for the proposed facility has not been finalized and therefore the composition of the liquid radwaste effluent is not known.

The Staff's proposed Permit Condition 2 requires the ESP facility to be designed in such a way that any and all accidental releases of radionuclides are precluded. The Staff's proposed COL Action Item 2.4-9 addresses the need to obtain detailed groundwater characterization for dewatering system design.

10 CFR Part 100.20(c)(3) requires that factors important to hydrological radionuclide transport be obtained from on-site measurements. These factors include subsurface soil characteristics, hydrological conditions, and pathways.

The Staff requested that the Applicant provide more detailed data so the Staff could understand all the ground water pathways from points of release to the accessible environment. However, the subsurface at the ESP site will be substantially disturbed during construction of the ESP facility. A COL recipient referencing a Grand Gulf ESP may be required to use an engineered fill to finish the grade at the ESP site. Underground portions of structures constructed as part of the ESP facility will act as barriers to regional groundwater flow and thus will modify flow pathways. The Staff concluded that a more useful and comprehensive analysis of subsurface pathways can only be carried out at the COL stage when the plant design including location and layout of ESP facility structures are known.

The Staff also requested that the Applicant provide chemical properties of the subsurface environment since the mobility of radionuclides in the subsurface depend on the chemical properties of the subsurface media. Based on the Applicant's response, the Staff determined that, at the ESP stage, due to the incomplete characterization of subsurface hydrological and chemical properties and the unknown composition of the liquid radwaste effluent of the proposed ESP facility, a comprehensive radionuclide migration analysis cannot be undertaken. The Staff determined that the proposed ESP site does not have any unique characteristic that could make a suitable system for monitoring or arresting radionuclide transmission through liquid pathways technically infeasible. The Staff imposed Permit Condition 2 to ensure that effective measures can be put in place during the COL phase. The Staff concluded, therefore, that further characterization of the composition of the liquid radwaste effluent and that of the subsurface hydrological and chemical properties was not needed provided that Permit Condition 2 is not violated. As discussed in the Staff's response to the Board's Hearing Issue A, Question 9, the Staff concluded that it is technically feasible to design engineered barriers and other hydraulic conditions to meet the requirements of Permit Condition 2.