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CNRO-2008-00029

August 29, 2008

U. S. Nuclear Regulatory Commission
Washington, DC 20555-0001
Attention: Document Control Desk

SUBJECT: Grand Gulf Unit 3 Combined License Application, Responses to Information Needs for the Hydrology Safety Audit Items Serial No. 1, 6, 7, 15 and 21

Grand Gulf Nuclear Station, Unit 3
Docket No. 52-024

REFERENCE:

1. Entergy Operations, Inc. (EOI) letter to USNRC – Application for Combined License for Grand Gulf Unit 3 (CNRO-2008-00008), dated February 27, 2008

2. NRC Memorandum dated July 22, 2008, Trip Report – June 16 and 17, 2008, Hydrology-Related Site Visit in Support of Grand Gulf Combined License Application, ADAMS Accession No. ML081980156

Dear Sir or Madam:

In Reference 1, Entergy Operations, Inc. (Entergy) submitted an application for a Combined License (COL) for Grand Gulf Nuclear Station (GGNS), Unit 3.

During the week of June 16, 2008, representatives of the NRC Office of New Reactors and supporting contractors conducted an Environmental and Safety Site Audit of the Grand Gulf Nuclear Station (GGNS), Unit 3 combined license application (COLA). During the audit, the reviewers requested certain additional information related to site hydrology. The Reference 2 memorandum documents those items that were resolved at the audit and those for which additional supplemental information or actions would be requested from Entergy. Attachment 1 provides a description of the information needs or actions for audit items (of the enclosure to the Reference 2 memorandum) Serial No. 1, 6, 7, 15 and 21, and the associated Entergy response. Attachments 2 and 3 provide draft markups of the COLA FSAR related to Serial No. 6 and 15, respectively.

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This letter contains new commitments, as identified in Attachment 4.

Should you have any questions, please contact me or Mr. Tom Williamson of my staff. Mr. Williamson may be reached as follows:

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E-Mail Address: twilli2@entergy.com

I declare under penalty of perjury that the foregoing is true and correct.

Executed on August 29, 2008.

Sincerely,

WKH/gaz

Attachments:

1. Responses to NRC Hydrology Safety Audit Information Need Items, Serial No. 1, 6, 7, 15 and 21
2. Draft FSAR Change for NRC Hydrology Safety Audit Information Need Item Serial #6
3. Draft FSAR Change for NRC Hydrology Safety Audit Information Need Item Serial #15
4. Regulatory Commitments

cc:

Mr. T. A. Burke (ECH)
Mr. S. P. Frantz (Morgan, Lewis & Bockius)
Mr. B. R. Johnson (GE-Hitachi)
Ms. M. Kray (NuStart)
Mr. P. D. Hinnenkamp (ECH)

NRC Project Manager – GGNS COLA
NRC Director – Division of Construction Projects (Region II)
NRC Regional Administrator - Region IV
NRC Resident Inspectors' Office: GGNS

ATTACHMENT 1

CNRO-2008-00029

RESPONSES TO NRC HYDROLOGY SAFETY AUDIT

INFORMATION NEEDS

SERIAL NO. 1, 6, 7, 15 AND 21

Audit Topic: Surface Hydrology

NRC Audit Information Need

Serial #1 FSAR Section 2.4.2

Provide an SME (subject matter expert) to discuss the process used to determine that the postulated unit hydrographs employed in the local-intense precipitation calculation are the most conservative plausible.

In Figure 2.4.2-201, the labels pointing to Culvert 1 and Outfall B need to be switched.

UNRESOLVED: The staff will prepare an RAI.

Entergy Response

The labels for Culvert 1 location and for Sedimentation Basin B are reversed on FSAR Figure 2.4.2-201.

Proposed COLA Revision

FSAR Figure 2.4.2-201 will be revised to correct the mislabeling of the two points on the figure.

Audit Topic: Surface Hydrology

NRC Audit Information Need

Serial #6 FSAR Section 2.4.3

Provide an SME to discuss the blockages of culverts for the PMF on local steams.

Staff discussed the assumption that Culvert 1 was 50% blocked. The applicant provided justifications for this assumption, and the staff indicated that it will be reviewing these assumptions once the HEC-RAS inputs are provided.

UNRESOLVED: The staff will prepare an RAI asking for justification of the assumption.

Entergy Response

During the site audit hydrology discussions of the assumption in FSAR 2.4.3.3.2 that Culvert #1 was 50% blocked, Entergy indicated to the NRC staff that this was considered a reasonable assumption for this input to the analysis for flooding on local streams. The basis for this conclusion of "reasonableness" is summarized below:

1. The culvert is a 15 ft. diameter corrugated metal culvert [see Grand Gulf Nuclear Station (GGNS) Early Site Permit (ESP) Site Safety Analysis Report (SSAR) Figure 2.4-13, Sh. 1; and GGNS COLA Final Safety Analysis Report (FSAR) Section 2.4.3.4.2]; this large culvert has substantial hydraulic capacity and would accommodate (pass) large debris without blockage of the inlet.
2. Stream B, leading to the culvert, is a concrete-lined open channel, with riprap above the concrete channel to Unit 1 plant grade that extends along the entire south side of the drainage basin [SSAR Figures 2.4-13 Sh. 1, 2.4-20 Sh. 2, 2.4-23 and 2.4-24; Reference 2.4.1-202 (GGNS Unit 1 Updated Final Safety Analysis Report (UFSAR)], Section 2.4.3.5.2] minimizing encroachment on the stream course by vegetation.
3. Culvert #1 has a smooth tapered inlet (SSAR Section 2.4.3.5.2, SSAR Figure 2.4-23 and SSAR Table 2.4-12), reducing the possibility of debris catching or hanging up on the inlet.
4. The culvert provides a drainage path for a relatively small basin (i.e., 0.36 sq. miles per FSAR 2.4.3.4.2) that primarily consists of mostly unvegetated areas, open fields or areas where trees have been cleared, and cleared and maintained areas of the GGNS site owner-controlled area, including the Unit 1 powerblock and cooling tower area and the Unit 1 switchyard area (FSAR Figure 2.1-201).
5. Stream B is an intermittent, normally dry, stream (FSAR Reference 2.4.1-202, Section 2.4.1.2), and therefore, the potential for debris accumulation and culvert blockage during non-weather related events is further minimized. That is, the potential for debris accumulation during times other than weather related events is reduced.

6. Limiting Condition for Operation (LCO) 6.7.5 included in the GGNS Unit 1 Technical Requirements Manual[1] (TRM) states that "blockage of Culvert No. 1 shall be ≤45% of its cross-sectional area," and the TRM includes a yearly surveillance requirement to verify the culvert meets the criteria specified, and the same surveillance is required "following the occurrence of earthquakes, hurricanes, tornadoes, or intense local rainfalls." The TRM also has provisions for visual verification (5 year frequency) of drainage basin slope stability along the stream course and verification of downstream access road slope at the culvert. Based on a review of approximately 8 years of recent data from the annual surveillance by GGNS Unit 1, no blockage of any consequence was noted (observed blockage was less than 1%).

Given the above factors, an assumption that the culvert is essentially free from debris and is fully functional for the analysis is reasonable; therefore, the assumption of 50% blockage is considered very reasonable and provides further conservatism[2] to an already conservative analysis. To ensure the assumption remains valid for Unit 3, periodic inspections of the Culvert #1 inlet will be conducted.

By contrast, the analysis for flooding due to local intense precipitation on Basin A, to the north of the Unit 1 and Unit 3 sites, considers that Culvert #9 is 100% blocked (FSAR Section 2.4.3.3.2). An assumption of 100% blockage is considered appropriate for analysis of this culvert for the following reasons:

- Culvert #9 drains Basin A which is larger than Basin B (approximately 2.7 sq. miles per FSAR Section 2.4.3.5.2),
- The drainage area which feeds Stream A and Culvert #9 is significantly more vegetated (FSAR Figures 2.1-201 and 2.4.2-201),
- The Culvert #9 is smaller in diameter and is generally submerged making routine surveillance more difficult, and
- The stream channel is and remains its natural channel (unlined or unaltered until reaching the culvert).

FSAR Section 2.4.3.5.2 incorrectly identifies the size of Culvert No. 1 as 12 ft. diameter; the correct size is 15 ft. diameter as given in FSAR Section 2.4.3.4.2, and indicated on SSAR Figure 2.4-13 Sh. 1 and in SSAR Table 2.4-12.

Proposed COLA Revision

FSAR Sections 2.4.3.3.2 and 2.4.3.5.2 will be revised as indicated in the draft markup pages of Attachment 2.

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[1] The GGNS Unit 1 Technical Requirement Manual (TRM) contains requirements relocated from the Unit 1 Technical Specifications. These requirements were allowed to be relocated from the Technical Specifications by the NRC with the understanding that the requirements relocated (reg., operability, applicability, and surveillance requirements) will continue to be enforced by GGNS Unit 1 and that any changes to these requirements will be reviewed in accordance with the requirements of 10CFR50.59.

[2] See FSAR 2.4.2.3 for discussion of conservative assumptions already included in this analysis.

Audit Topic: Groundwater Hydrology

NRC Audit Information Need

Serial #7 FSAR Section 2.4.12

Provide an SME to describe how that applicant determined that the postulated conceptual model of the subsurface environment is the most conservative plausible conceptual model for the site.

The applicant described the process used in developing the subsurface site characterization and monitoring plans.

UNRESOLVED: The staff will prepare an overarching RAI.

Entergy Response

The following is a description of the process used in the development of the subsurface hydrogeologic characterization of the Grand Gulf Nuclear Station (GGNS) site and for the GGNS Unit 3 combined license application (COLA). The overall process and the resulting subsurface hydrogeologic characteristics are described in Section 2.4.12 of the Unit 3 COLA Final Safety Analysis Report (FSAR), and in Section 2.4.12 of the Grand Gulf early site permit (ESP) application site safety analysis report (SSAR).

Historical information and web-based research were used to establish the overall site and vicinity subsurface environment characteristics for the ESP application. This research resulted in a basic understanding of the site geology and groundwater regime. The information reviewed included historical reports, dating back to the 1970s, developed from subsurface investigations that had been performed at the GGNS site, specifically including the investigations related to the licensing of the existing GGNS Unit 1 (and now cancelled Unit 2) plant, and subsequent site groundwater investigations during Unit 1 operations in the 1990s. This Unit 1 information regarding site geology and hydrology was used to establish the overall groundwater characterization for the site at the ESP stage. A comprehensive data collection plan was developed that would provide the information necessary to confirm subsurface information for the Unit 3 site at the COL stage.

ESP Groundwater Characterization (SSAR Section 2.4.12)

The ESP SSAR, Section 2.4.12, which documents hydrogeologic characterization of the proposed ESP site (that is, the GGNS Unit 3 site), was based on the previous site investigations described in the GGNS Unit 1 UFSAR (Section 2.4.12), and additional groundwater monitoring during operation of GGNS Unit 1 (also documented in the Unit 1 updated final safety analysis report (UFSAR)), supplemented with additional research information related to groundwater usage on and in the vicinity of the overall GGNS site. Three geotechnical borings were completed on the ESP site, as part of the ESP application on-site investigation activities; however, no hydrological investigations on the ESP site were conducted in support of the ESP application. The hydrogeologic description in the ESP SSAR provided sufficient information to demonstrate site suitability for additional nuclear power plant construction and operation on the ESP site, and the issuance of an early site permit (ESP-002) for the site.

Groundwater characteristics of the region are described in ESP SSAR, Section 2.4.12.1.1, and local groundwater characteristics are described in ESP SSAR, Section 2.4.12.1.2. Groundwater levels and movement on the ESP site are discussed in ESP SSAR, Section 2.4.12.2.3. Groundwater recharge on the ESP site is discussed in ESP SSAR, Section 2.4.12.2.6.

Hydrogeologic properties of the Mississippi River alluvium, terrace deposits, and Catahoula Formation were determined by field and laboratory methods as described in SSAR Section 2.4.12.4.

COL Stage Site Groundwater Investigations

As documented in the NRC's final safety evaluation report (NUREG-1840, Appendix A), and in the early site permit (ESP-002, Appendix C) issued to Entergy for the Grand Gulf ESP site, additional confirmatory hydrological investigations would be required for the COLA. The requirement for this additional investigation and characterization in these documents is in the form of combined license (COL) action items. Specifically, they are:

2.4-8 A COL or CP applicant should demonstrate that an adequately designed ground water well system capable of withdrawing a maximum of 3570 gpm is provided for the ESP facility.

2.4-9 A COL or CP applicant should provide detailed ground water information including location and depth of perched aquifers.

<u>Unit 3 Site Characterization Work Plans</u>

The conduct for site investigations to support Unit 3 site area subsurface hydrogeologic characterization was documented in a hydrology data collection plan that was designed to provide confirmation of existing site groundwater information; and to provide sufficient additional information to resolve the ESP COL Action Items (and the related Permit Condition, 3.E(2)) included in the early site permit. The hydrology data collection plan was developed based on knowledge of the groundwater environment, geologic cross sections, and potentiometric surface maps, developed from the Unit 1 investigations described in the ESP SSAR and the GGNS Unit 1 UFSAR. The hydrology data collection plan was prepared concurrently with the COL stage geotechnical data collection plan. Boring and monitoring well locations were selected based on the specific area of the ESP site selected for Unit 3, and the Unit 3 (GEH ESBWR) building layout/arrangement. The exploration program was tailored to the dimensions, layout, and foundation depths for an ESBWR plant. Details of the hydrologic investigations and results are provided in the FSAR, Section 2.4.12, and the geologic investigation and descriptions, including subsurface cross-sections, are provided in FSAR Section 2.5.4.

<u>Groundwater Monitoring Program</u>

A monitoring well cluster was established at each groundwater monitoring location based on the visual observations and reviews of borehole lithologic logs. Each monitoring well cluster was paired with a continuously cored boring also utilized to obtain geotechnical information. Three-well clusters were established at select groundwater monitoring locations. The screened intervals for the groundwater monitoring well network were established by review of the continuous collection of subsurface lithologic materials, visual observation of the occurrence of subsurface moisture or groundwater in the borehole samples, and review of borehole logs from across the site. Well screen intervals were set to confirm the existence of perched groundwater suspected from borehole samples taken near the base of the loess; to determine heterogeneity of alluvial materials of the water table aquifer in the Upland Complex; and to evaluate for a potential aquitard between the Upland Complex and the underlying Catahoula Formation water bearing layers.

During the Unit 3 site characterization investigation, 97 soil borings were drilled to characterize subsurface geologic conditions and to obtain laboratory geotechnical test samples. A total of 44 groundwater monitoring wells were installed in 23 locations selected to further characterize the Unit 3 site area, as described in FSAR Section 2.4.12.2.3. Well locations are shown in FSAR Figure 2.4.12-201.

Data Collection and Evaluation

Monthly groundwater monitoring data was collected for a period of one year. Pumping tests were conducted on wells screened in the Upland Complex and in the Catahoula Formation, and a step test was conducted on a well in the Mississippi River alluvium. Well data and data from pumping tests were collected to establish the water table elevation for the Unit 3 powerblock and immediate surrounding area, and to confirm previous information related to groundwater movement and flow directions, hydraulic conductivity and transmissivity, soil permeability and other important hydrogeologic parameters.

As indicated in Table 2.4.12-202, the potentiometric surface of the water table aquifer in the Upland Complex during the monitoring period was approximately 72 to 76 ft. above mean sea level (msl), consistent with previous data. Hydraulic gradient values were obtained from groundwater elevation measurements for wells screened in the Upland Complex in the vicinity of the Unit 3 powerblock. The groundwater gradient observed in the Upland Complex is generally to the west toward the Mississippi River, as indicated in FSAR Figures 2.4.12-203 and 2.4.12-204. The gradient is consistent with the historical gradient reported for the Unit 1 investigations.

Transmissivities from the Unit 3 investigations are somewhat lower than previous Unit 1 test results; however, these results for Unit 3 are generally consistent with previous estimates developed during Unit 1 site characterization. The hydraulic conductivity results from the Unit 3 laboratory tests are similar to the values determined from the Unit 1 tests that were conducted on similar materials, and the hydraulic conductivity determined from pumping tests compare to the previous Unit 1 data.

Based on data from wells established at the base of the loess, it was noted that groundwater levels in some wells indicated perched groundwater above the water table aquifer of the Upland Complex near the powerblock area of Unit 3, but the perched groundwater was of very limited lateral extent. The limited extent of perched conditions made determination of a flow direction not possible.

It was also determined that, based on groundwater potentiometric heads in well clusters that there was hydraulic separation between the groundwater in the Upland Complex and groundwater in the upper saturated intervals of the Catahoula Formation. Pump tests revealed no indication of water level movement in the Upland Complex when the pump test was completed in the Catahoula Formation. Similarly, there was no water level reaction to pumping in the Catahoula Formation when the pump test was performed in the Upland Complex. There were consistent records of potentiometric head differences between the formations. In addition, data indicated differential movement of water levels between the Upland Complex and the Catahoula Formation. Altogether, these findings indicate the potential that local recharge of the Catahoula Formation by overlying Upland Complex alluvial materials is limited.

The COL stage investigations produced monitoring and sampling results that confirm hydrogeologic subsurface information related to physical characteristics and groundwater flow conditions in the area of the Unit 3 powerblock and immediate surroundings to be consistent with that reported in the ESP SSAR and the GGNS Unit 1 UFSAR.

Proposed COLA Revision

None

Audit Topic: Groundwater Hydrology

NRC Audit Information Need

Serial #15 FSAR Section 2.4.13

FSAR Section 2.4.13.2.2 (p. 2-165) states that radionuclides are assumed to be released directly to groundwater. However, one of the basic design assumptions of RESRAD is that the source of radionuclides is in soil above the groundwater table, and that radionuclides enter groundwater by downward leaching from this soil. Provide an SME to discuss how the assumed liquid release is represented in your use of the RESRAD model to simulate radionuclide transport following a hypothetical release.

The above description of the release process is correct. The wording in the FSAR might more accurately have referred to "release to the environment" rather than "release to groundwater."

UNRESOLVED: An RAI will be developed by staff to document this change.

Entergy Response

Entergy concurs that "release to the environment" is more accurate terminology to use in this FSAR description of an accidental release of radionuclides from the Unit 3 Radwaste Building.

Proposed COLA Revision

FSAR 2.4.13.2 will be revised as indicated in the draft markup pages of Attachment 3.

Audit Topic: Groundwater Hydrology

NRC Audit Information Need

Serial #21 FSAR Section 2.4.13

Provide an SME to describe the process the applicant used to determine that the conceptual model of the parameters, spatial configuration, and controlling physical processes of the subsurface environment that were used in the applicant's analysis of the dose consequences of an accidental release is bounding.

The applicant described the process used in developing the radionuclide transport characterization.

UNRESOLVED: The staff will prepare an overarching RAI to describe the process used to determine that the conceptual model used in the analysis was the most conservative plausible.

Entergy Response

In addition to the above information need, the NRC Staff, during the site audit, observed that the description of FSAR Figure 2.4.13-201 may not be appropriate. Entergy concurs that the description of the figure in Section 2.4.13.2 and the figure title do not accurately reflect the figure content; therefore, Section 2.4.13.2 and the figure title will be revised to provide an improved description of the figure.

The development of a model for the postulated accidental release dose consequence analysis described in FSAR Section 2.4.13 integrated the characteristics of the subsurface soils and groundwater described in FSAR Section 2.4.12 and Section 2.5.4 with the design and source term characteristics for the Unit 3 facility as given in the ESBWR Design Control Document (DCD). NRC Branch Technical Position (BTP) 11-6 directs that the accident evaluation be performed for the nearest potable water source within an unrestricted area. The Mississippi River was identified during the site investigation process as that potable water source; although, the nearest user is over 100 miles downstream of the site (per FSAR 2.4.13.2.2).

The RESRAD-OFFSITE, Version 2.0, software was used for the offsite dose consequence analysis.

The release is assumed to occur as a result of failure of the Equipment Drain Collection Tank, which was determined to be the bounding case. The Radwaste Building structure was not considered as an inhibitor, thus allowing the contaminants to flow directly to the subsurface environment and enter groundwater (see FSAR 2.4.13.2). River stage, groundwater flow direction and linear distance to a surface water body are varied in the pathway scenarios evaluated in Table 1, to establish a conservative pathway and analysis model.

Transport Pathway Scenarios

Five pathway scenarios were considered, as described in Table 1 below, for use in the analysis of an accidental release of radioactive liquids to the environment.

Table 1
Transport Pathway Scenarios

Scenario	Assumed GW Flow Direction	MS River Stage	Nearest Surface Water Body	Distance to Surface Water Body	Evaluation
1	Westerly	Low Or Normal	MS River	5,800 ft	This scenario is based on gradient maps and historical data which show groundwater gradients to the west at low and normal river stages (SSAR Figures 2.4-33, 2.4-50, 2.4-55). Distance to the nearest surface water body is larger than in all other scenarios considered. This scenario was not considered to be conservative at high groundwater levels during extreme river flood stages.
2	Westerly	Low Or Normal	Hamilton Lake	2,400 ft	This scenario is based on gradient maps which show groundwater gradients to the west at low and normal river stages (SSAR Figures 2.4-33, 2.4-50, 2.4-55). Although GGNS Unit 1 investigations found no hydraulic connection between Hamilton Lake and groundwater (GGNS Unit 1 UFSAR Sections 2.4.12.1.2 and 2.4.12.2.5), for the purpose of this scenario, groundwater is presumed to discharge to the lake at groundwater elevations above 55 ft. above mean sea level (amsl). Distance to the nearest surface water body is larger than in scenarios 3, 4 and 5. This scenario was not considered to be conservative at high groundwater levels during extreme river flood stages.

Table 1
Transport Pathway Scenarios

Scenario	Assumed GW Flow Direction	MS River Stage	Nearest Surface Water Body	Distance to Surface Water Body	Evaluation
3	Northerly, North-easterly	N/A	Sedimentation Basin A, Stream A	1,200 ft	This scenario assumes groundwater flow to the north-northeast, which is highly unlikely because groundwater flow is generally westerly, and the Unit 3 site and Radwaste Building is to the south of Sedimentation Basin A/Stream A (FSAR Figures 2.4.1-201, 2.4.12-203, 2.4.12-204). This scenario was not chosen because of the unlikely flow path for the groundwater, and the travel distance is longer than that in Scenario #5.
4	Southerly, South-westerly	N/A	Sedimentation Basin B, Stream B	700 ft	This scenario assumes groundwater flow to the south, which is considered unlikely because groundwater flow is generally westerly, and the Unit 3 site and Radwaste Building is to the north of Sedimentation Basin B/Stream B in the upland area of the site (FSAR Figures 2.4.1-201, 2.4.12-203, 2.4.12-204). Additionally, the typical groundwater elevation, except at high groundwater levels during extreme Mississippi River flooding, is indicated to be below the lowest elevation of Stream B (SSAR Figures 2.4-33; FSAR Figures 2.5.4-226 and 2.5.4-228).

Table 1
Transport Pathway Scenarios

Scenario	Assumed GW Flow Direction	MS River Stage	Nearest Surface Water Body	Distance to Surface Water Body	Evaluation
5	Westerly	High	MS River	800 ft	The Mississippi River is assumed to be at extreme high flood stage, resulting in extreme high groundwater levels at Unit 3. The dominant flow direction with normal and low river stages is generally westerly with the potential for temporary flow reversal as discussed in ESP SSAR 2.4.12.2.5 and FSAR 2.4.12.2.3. Any reversal of groundwater would be temporary and would be expected to return toward a westerly flow direction once river water levels fall below extreme flood stages. In general, the duration of possible flow reversal would be much less than the total travel time from the release source to the river. This scenario would not be likely because of relatively short amount of time the river would remain in an extreme high flood stage condition (less than 2 to 3 months per SSAR Figures 2.4-15, 2.4-17 and 2.4-41) and the long time for any release to travel from the radwaste building 800 ft to the west (travel time reported in FSAR 2.4.13.2.2 is 4.2 yr for a distance of about 5800 ft, or about 7 months to travel a distance of 800 ft).

Conservative Model Inputs

Groundwater flow has been determined to be westerly from the Unit 3 site location in both the COL investigations for Unit 3 and in the investigations completed for licensing GGNS Unit 1. From the evaluations of the scenarios in Table 1, those that are considered plausible are those with westerly groundwater flow. Scenario 5 (Table 1), associated with the Mississippi River flooded at an extreme level, results in a minimized distance (approximately 800 ft.) from release source to the surface water feature (i.e., the flooded river) in the westerly direction. While this scenario flow direction is plausible with extreme river flood stages declining, the likelihood of tank failure contemporaneous with the flooded river and the relatively short time that the river at this high condition is low; thus the potential for Scenario 5 is considered to be small. As described in FSAR Subsection 2.4.13.2.2, for added conservatism, the analysis was performed to determine the concentrations of radionuclides in the groundwater at a distance of 600 ft. from the radwaste building release point, thus bounding all the scenarios in terms of distance traveled to surface water, and in effect removing direction of flow of groundwater as an important parameter from the analysis. This factor along with the numerous other conservative assumptions described below, render this analysis to be appropriately conservative for the purposes of estimating radionuclide concentrations resulting from the hypothetical tank failure.

Choosing the environmental parameters for use in the RESRAD-OFFSITE model began with identifying parameter values that contributed to the most rapid groundwater transport, which subsequently provides the greatest concentration of radionuclides in the receptor body. Sensitivity analyses were performed on numerous parameters to provide assurance that the chosen value for each parameter was appropriate. The sensitivity analyses also demonstrated that under varying conditions which may affect those parameter values, the radionuclide concentration in the receptor body still meets acceptance criteria.

Hydrogeologic site characteristics described in FSAR Section 2.4.12 were used for the dose consequence modeling discussed in FSAR Section 2.4.13 (see Table 2.4.13-201). Distribution coefficient (K_d) values for each isotope were developed from laboratory analysis of samples collected from the Upland Complex, the Catahoula Formation, and the Mississippi River alluvium west of the bluffs. However, as a conservative measure, the lowest K_d values for each radionuclide were used, irrespective of their stratigraphic origin. A value of zero was used for all radionuclides for which laboratory analysis was not performed to determine K_d. For the Radwaste Building, the foundation interface is near the base of the lower loess, which would likely be overexcavated to the Upland Complex alluvium (see FSAR Figure 2.5.4-220). The highest hydraulic conductivity and hydraulic gradient measured at the site (in the Unit 3 COL investigations) in the Upland Complex were used, for additional conservatism. (see FSAR 2.4.13.2.2) In conducting the analysis, numerous input parameters were determined to have no effect on the outcome and subsequently remained as the RESRAD-OFFSITE default value or were disabled, as appropriate.

The radionuclide concentrations used for modeling were obtained from the ESBWR DCD. It was determined that the conservative source term for the dose consequence evaluation would result from the rupture and release of the contents from one of the Equipment Drain Collection Tanks in the Radwaste Building (See DCD Table 12.2-13a) at an elevation of 81.5 ft. msl (see FSAR 2.4.13.2.2).

It is worthy of note that, as discussed in response to NRC FSAR 2.4 Site Audit, Serial #7, and in detail in FSAR 2.4.13.2.2, the dominant direction of groundwater flow is westerly toward the Mississippi River. Groundwater flow is generally below Stream B/Hamilton Lake and discharges directly to the river. Thus, when the river is not at flood stages, the transport path for a release would be generally west through the Upland Complex and then through the Mississippi River Alluvium (see FSAR Figure 2.5.4-224). Given this more likely flowpath, the subsurface conditions in the Mississippi River alluvium would substantially add to the travel time (see GGNS Unit 1 UFSAR Table 2.4-27) in a scenario where contaminants travel toward, and are released to, either Stream B/Hamilton Lake or the Mississippi River. By limiting transport via only the Upland Complex, an additional conservative factor is included in the FSAR 2.4.13 transport analysis.

In summary, the transport analysis for the accidental radioactive release is based solely on linear distance to a point of release to surface water, independent of groundwater flow direction. A bounding distance from the Radwaste Building to any surface water body on site was used, whether a source of potable water or not.

Proposed COLA Revision

FSAR 2.4.13.2 and Figure 2.4.13-201 will be revised as indicated in the draft markup pages of Attachment 3.

ATTACHMENT 2

CNRO-2008-00029

**DRAFT FSAR CHANGE
FOR
NRC HYDROLOGY SAFETY AUDIT
INFORMATION NEED SERIAL #6**

2.4.3 PROBABLE MAXIMUM FLOOD ON STREAMS AND RIVERS

GGNS COL 2.0-14-A

This section of the referenced ESP safety analysis report is incorporated by reference with the following variances and/or supplements.

2.4.3.3.2 Local Streams

Replace the contents of SSAR Section 2.4.3.3.2 with the following information.

GGNS COL 2.0-14-A
GGNS ESP COL 2.4-3
GGNS ESP COL 2.4-5

Runoff models for Streams A and B, and for the Unit 3 plant drainage areas, are discussed in Section 2.4.2.3.2. A description of the stream course model is contained in Section 2.4.2.3.3.2.

In assessing the effect of local PMP of the plant area, the following conservative assumptions have been made:

a. The storm drains are assumed to be blocked and do not hold up or carry any runoff.

b. The runoff coefficient for peak discharges from areas around the plant is C = 1.0, and no loss due to infiltration or retention occurs.

Revise

c. It is ~~conservatively~~ assumed that Culvert #1 is 50 percent blocked, and that Culvert #9 is completely blocked.

2.4.3.4.2 Local Streams

Replace the contents of SSAR Section 2.4.3.4.2 with the following information.

GGNS COL 2.0-14-A
GGNS ESP COL 2.4-3
GGNS ESP COL 2.4-5

The maximum discharges during probable maximum flood for Basins A and B are 19,494 cfs and 6422 cfs, respectively (Figures 2.4.2-202 and 2.4.2-203) at the basin outfalls (Figure 2.4.2-201). For Basin A, the peak flow of 19,494 cfs is equal to a PMF discharge of 6816 cfs/mi^2 and for Basin B a PMF discharge of 6422 cfs corresponds to a discharge of 12,844 cfs/mi^2. Examination of the data in SSAR Table 2.4-6 for observed Mississippi River basin floods indicates that PMF flood discharges of 6816 cfs/mi^2 and 12,844 cfs/mi^2 for Basins A and B, respectively, are several times higher than those observed in basins of these sizes on the east bank of the Mississippi River.

Due to site grading, about 0.36 square miles of the drainage area of Basin B drains to Culvert 1 (Section 2.4.2.3.2). The corresponding PMF discharge in the outlet channel for Basin B at the 15 ft. diameter corrugated metal Culvert 1 (drainage area of 0.36 square miles) is 4646 cfs (Table 2.4.2-204). This value corresponds to the discharge that will be flowing through the Basin B outlet channel during the PMF. The corresponding flow for Culvert 9 (from Basin A) is 18,535 cfs (Table 2.4.2-204) based on a drainage area of 2.71 square miles (Section 2.4.2.3.2).

2.4.3.5.2 Local Streams

Replace the contents of SSAR Section 2.4.3.5.2 with the following information.

<u>STREAM A</u>

GGNS COL 2.0-14-A
GGNS ESP COL 2.4-3
GGNS ESP COL 2.4-5

A 12 ft. diameter corrugated metal culvert (Culvert 9) is provided where the stream draining Basin A crosses under the access road. The drainage area up to Culvert 9 is about 2.71 square miles and has a peak discharge of 18,535 cfs (Table 2.4.2-204). The top of the access road has a minimum elevation of 124 ft. The locally depressed road at this location acts as a broad crested weir during high flows. Water level resulting from the discharge over the access road is calculated using a weir discharge coefficient of 2.6 and an average weir length of 510 ft. It is conservatively assumed that Culvert 9 is completely blocked causing the entire PMF flow to overtop the access road. The resulting water surface elevation at the road (upstream face of Culvert 9) is 130.80 ft., and 104.66 ft. at the downstream face of the culvert. Computations were performed using the HECRAS River Analysis System (Reference 2.4.3-201).

Revise

<u>STREAM B</u>

A ~~12~~<u>15</u> ft. diameter corrugated metal culvert (Culvert 1) is provided where the stream draining Basin B crosses under the access road. The drainage area up to Culvert 1 is about 0.36 square miles, and has a peak discharge of 4646 cfs (Table 2.4.2-204). The top of the access road has a minimum elevation of 132.3 ft. There are no constrictions over the road, so it is modeled as a free outfall weir. Water level resulting from the discharge over the access road is calculated using a weir discharge coefficient of 2.6 and an average weir length of 980 ft. It is ~~conservatively~~ assumed that Culvert 1 is 50 percent blocked. The resulting water surface elevation at the road (upstream face of Culvert 1) is 132.78 ft., and 116.43 ft. at the downstream face of the culvert. Computations were performed using the HECRAS River Analysis System (Reference 2.4.3-201).

Revise

INSERT#1

The maximum PMF flood elevation on the Unit 3 site in the area of the powerblock is driven by the local PMP event flooding around the powerblock structures as

FSAR 2.4.3.5.2, STREAM B

INSERT #1

To ensure this assumption remains valid, inspections of the Culvert #1 inlet will be conducted annually, or at a frequency otherwise determined appropriate, to ensure blockage is not greater than 50%.

ATTACHMENT 3

CNRO-2008-00029

**DRAFT FSAR CHANGE
FOR
NRC HYDROLOGY SAFETY AUDIT
INFORMATION NEED SERIAL #15**

GGNS COL 2.0-24-A

2.4.13.2 LIQUID EFFLUENT RELEASE EVALUATION

Section 2.4.13.1 demonstrates that the ESP permit condition is satisfied by the Unit 3 LWMS design, and the design will preclude accidental release of radionuclides ~~radioactive liquid effluents~~ to the environment. Nevertheless, in accordance with SRP 11.2, an analysis of the bounding accidental release of radioactive liquids ~~effluents~~ to the ~~groundwater and consequently to the surface water~~ environment is performed.

This section provides a conservative and bounding analysis of a postulated, accidental release of radioactive liquids ~~effluents~~ to the environment~~groundwater~~. The accident scenario is described, and the model used to evaluate radionuclide transport is presented, along with potential pathways of contamination to water users. The radionuclide transport analysis is described, and the results are summarized. The radionuclide concentrations are compared against the regulatory limits.

As discussed below, there is no direct surface water pathway to the Mississippi River for the bounding release scenario considered.

2.4.13.2.1 Release Scenario

A liquid radwaste tank outside of containment is postulated to fail, coincident with the non-mechanistic failure of the above described mitigation design features, thus allowing the tank contents to be released to the surrounding environment and into the groundwater. The volume of the liquid assumed released and the associated radionuclide concentrations were selected to produce an accident scenario that leads to the most adverse contamination of groundwater.

Radwaste tanks outside of containment are located on levels B1F and B2F of the radwaste building as shown on DCD Figure 1.2-25. The radwaste tanks having the largest volumes include the three equipment drain collection tanks and the two equipment drain sample tanks, all in the lowest level, B2F. Each of these tanks has a volume of approximately 37,000 gallons (140 m^3) per DCD Table 11.2-2a.

Activity concentrations in various liquid radwaste tanks are provided in DCD Tables 12.2-13a through 12.2-13g. Of these tanks, the limiting tank in terms of radionuclide activity is the equipment drain collection tank; its activity is provided in DCD Table 12.2-13a (see DCD Table 2.0-2, for Section 2.4.13).

The scenario assumes that one of the equipment drain collection tanks fails and its contents are released directly to the surrounding environment and into the groundwater. Note that this accident scenario is extremely conservative because the radwaste building is seismically designed in accordance with RG 1.143, Class RW-IIa, as described in DCD Section 12.2.1.4. Also, each tank cubicle is provided with a steel liner, as described in DCD Section 11.2.2.3, to preclude any potential liquid releases to the environment.

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Part 2, FSAR

2.4.13.2.2 Transport Model[1] and Pathway

Based on the COL stage investigations of the Unit 3 power block and surrounding areas documented in Section 2.4.12, specific Unit 3 site characteristics related to groundwater and transport pathway soils were developed. The key elements and assumptions of the model are described and discussed below.

Figure 2.4.13-201 illustrates the westerly pathway for groundwater, and thus the most probable pathway of contaminants, from ~~model used to evaluate~~ an accidental release of radioactive liquids into the ~~effluent to~~ groundwater, to the nearest surface water body used for potable water, the Mississippi River. ~~The key elements and assumptions of the model are described and discussed below.~~

As indicated above, the worst-case scenario assumes one of the equipment drain collection tanks is the source of the release, with each tank having a capacity of 37,000 gallons and radionuclide concentrations as given in DCD Table 12.2-13a. These tanks are located on the lowest level of the radwaste building (level B2F), which has a bottom floor elevation 52 ft. below finished ground level grade of 133.5 ft. msl. One of the tanks is postulated to non-mechanistically fail, and 80 percent of the liquid volume (29,600 gallons) is released, following the guidance provided in BTP 11-6. It is further assumed that the entire 29,600 gallons immediately enters the surrounding soils and the groundwater ~~in the surrounding soils~~.

The assumption of instantaneous release to the surrounding environment ~~groundwater~~ following tank failure is highly conservative because it requires failure of the floor drain system, and it ignores the barriers presented by the steel liners incorporated into the tank cubicles, and the radwaste building structure and basemat, which are seismically designed. Additionally, the highest groundwater level reported in Section 2.4.12.2.3 is slightly below the radwaste building basemat; therefore, some time would normally be required to reach the groundwater saturated zone.

In the worst-case accidental release scenario, radionuclides are released directly to the surrounding environment~~groundwater~~ and then transported by groundwater to the nearest surface water body. The nearest surface water that is used as a drinking water source is the Mississippi River. The nearest potable water intake from the Mississippi River is more than 100 miles downstream. Refer also to SSAR Section 2.4.12.2 for a discussion of the locations and users of surface waters in close proximity to Unit 3.

Groundwater flow evaluation shows that with the exception of some flow direction changes when the Mississippi River is in extreme flood stages, the dominant

[1] The term "model" in the context used in this section is referring to the overall model and associated input information to the model utilized to analyze the transport of radionuclides from the point of release at the radwaste building to the endpoint of the analysis, at either the nearest surface water body or some defined distance from the release point. Groundwater characteristics such as flow direction, gradient and hydraulic conductivity are included in this definition.

direction of groundwater flow is westerly toward the Mississippi River (see Section 2.4.12.2.3). Although seasonal high groundwater levels may discharge to Hamilton Lake, the groundwater elevation in the vicinity of the lake during lower river stages is generally below El. 55 ft. msl. Groundwater flow is, therefore, generally beneath Hamilton Lake, and discharges directly to the Mississippi River. During extreme flood conditions, the groundwater flow direction is temporarily reversed at the site. An accidental release during extreme flood conditions[2] would result in a temporary movement of contaminants away from the Mississippi River. However, ~~the~~ groundwater flow direction would return to the dominant westerly flow ~~normal~~ after flood conditions wane, and the contaminants would move toward the river.

Hamilton Lake is in the westerly pathway of groundwater flow, approximately 2400 ft. from the radwaste building. However, radionuclides introduced into Hamilton Lake would require either re-infiltration into the Mississippi River Alluvium for continuing transport to the Mississippi River, or transport via the surface flow path at the lake outlet to the Mississippi River during high river stages. Both pathways would result in dilution by Hamilton Lake during transport to the Mississippi River.

The Grand Gulf early site permit, ESP-002, Appendix A indicates a site characteristic for distance to the nearest surface water body as 1017 ft. to Stream B. The radwaste building is located such that the distance from it to Sedimentation Basin B (which is fed by Stream B), directly to the south, is approximately 700 ft. Consideration of a groundwater release to Stream B or Sedimentation Basin B is highly conservative as the elevation at the western and lowest end of Sedimentation Basin B is above El. 85 ft. msl, and groundwater elevation is below this level in all but the most extreme river flood stage conditions. Additionally, Stream B and Sedimentation Basin B are not in a direct pathway of a release from a radwaste tank failure. And, while closer to the location of the radwaste building release point than the Mississippi River, neither Stream B nor Hamilton Lake is a source of drinking water. However, for added conservatism, this analysis was done to determine the concentrations of radionuclides in the groundwater at a distance of 600 ft. from the radwaste building release point.

The radwaste building basemat elevation is approximately the elevation of the top of the Upland Complex (Figure 2.4.13-201). Thus, the release pathway is westerly through the Upland Complex, and toward the Mississippi River alluvium in the floodplain. Following the most probable pathway, ~~G~~groundwater flow ~~is modeled to~~ follows a straight line from the radwaste building toward the Mississippi River to the west.

The analysis allows for radionuclide decay during transport by groundwater, and considers this decay in the analysis. Radionuclide transport by groundwater is affected by adsorption by the surrounding soils. The Grand Gulf site is assumed to continually receive the average annual precipitation; precipitation that does not

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[2] The approximate distance of the Radwaste Building to the Mississippi River (approximate toe of the upland bluffs) during these conditions is approximately 800 ft.

runoff or is not lost to evapotranspiration infiltrates through the unsaturated zone and into the groundwater.

Site-specific parameters such as distribution coefficients, hydraulic conductivity, porosity, and hydraulic gradient used in the analysis are provided in Table 2.4.13- 201. Dilution of the radionuclide source term is not modeled in the analysis. Additionally, no screening of the radionuclide source term was performed (i.e., all radioisotope constituents of the source term in DCD Table 12.2-13a were included in the analysis).

Distribution (adsorption) coefficients (K_d values) were determined by analysis of soil samples from the Upland Complex, Catahoula Formation, and the loess. Measurements were obtained for cobalt, cesium, iron, iodine, nickel, plutonium, strontium, technetium, and uranium. Selection of radionuclides for determination of distribution coefficients was based on the activity of the equipment drain collection tank source term. Radionuclides with long half-lives, daughter products with significant potential exposure risk, and mobility in soil/groundwater were selected. In general, the Upland Complex provided the lowest distribution coefficient values for each element. In the analysis, the minimum values were used irrespective of their stratigraphic origin. Distribution coefficients for other elements in the analysis were assigned a value of zero, which is conservative since it assumes no retardation during transport.

Aquifer parameters were established for the Upland Complex, and the near bluff clay-silt portion of the Mississippi River Alluvium (see Section 2.4.12.2.4). Aquifer hydraulic conductivity was determined to be greater in the Upland Complex than in the Mississippi River Alluvium, based on the results of pump tests in MW1009B and 1042B, respectively. For this accidental release groundwater transport model, the highest hydraulic conductivity and hydraulic gradient measured at the site in the Upland Complex are used for conservatism. Total porosity values were obtained for the Upland Complex by laboratory tests using sample weight, moisture content, and specific gravity. Effective porosity values specific to Unit 3 were not developed during the COL site investigation; therefore, values were obtained from the Unit 1 UFSAR (Reference 2.4.13-201). This is appropriate due to the similarity between the total porosity values of the various soil formations listed in Table 2.4-27 of the Unit 1 UFSAR and the total porosity values obtained during the Unit 3 site investigation. Hydraulic gradient values were obtained from groundwater elevation measurements for wells screened in the Upland Complex in the vicinity of the powerblock, presented in Table 2.4.12-202. The maximum hydraulic gradient was derived from the July 2006 groundwater measurements.

The travel time of the groundwater movement from the radwaste building to the Mississippi River was computed from a variation of Darcy's Law:

$$t = \frac{x}{V} = \frac{x}{KI/\theta}$$

Where: t = time to move distance x (yr)

x = distance of contaminant movement (m)

V = average interstitial groundwater velocity (m/yr)

K = hydraulic conductivity (m/yr)

I = hydraulic gradient

θ = effective porosity

The values of parameters used are shown in Table 2.4.13-201. The computed travel time to the river is approximately 4.2 years.

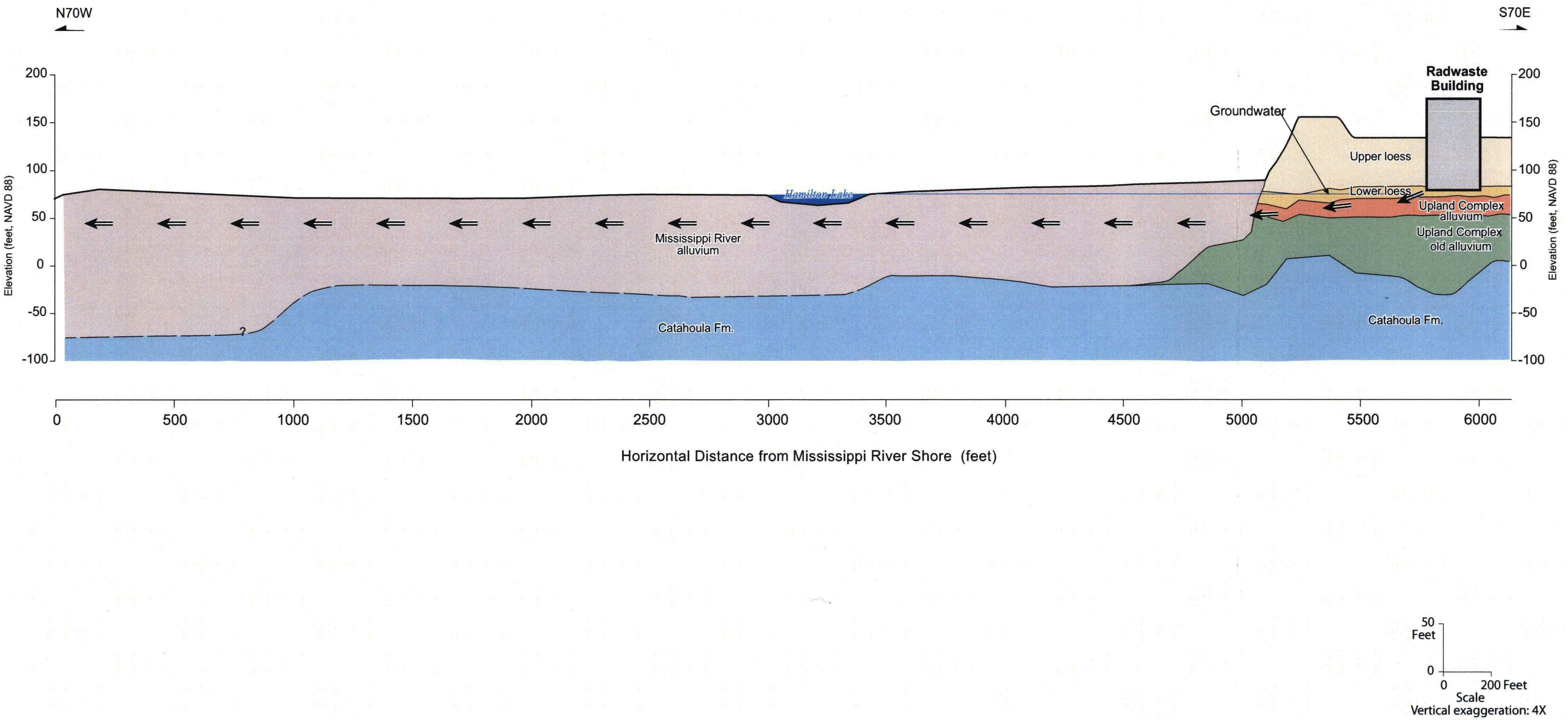
This travel time is approximately one-third of the travel time estimated in the Unit 1 UFSAR analysis (Reference 2.4.13-201). This Unit 3 computation is conservative, considering key modeling assumptions, such as transport only in the Upland Complex geologic unit, which takes no credit for transport through the clay/silt material of the Mississippi River Alluvium (Figure 2.4.13-201 and Figure 2.5.4- 224). As indicated in Figure 2.4.13-201, the Mississippi River Alluvium comprises a large portion of the most probable transport path, and this material exhibits much lower hydraulic conductivity and ground water velocity parameters (thus the resultant Unit 1 higher travel time to the river).

2.4.13.2.3 Radionuclide Transport Analysis

Radionuclide concentrations in groundwater along the westerly transport pathway toward the Mississippi River as a result of an accidental release of an equipment drain collection tank contents directly to the environment ~~groundwater~~ were modeled using RESRAD-OFFSITE (NUREG/CR-6937). The RESRAD-OFFSITE computer code evaluates the radiological dose and excess cancer risk to an individual who is exposed while located outside the area of initial (primary) contamination. The primary contamination, which is the source of all the releases modeled by the code, is a layer of soil below the radwaste building. The code models the movement of the contaminants from the primary contamination to user-defined points along the transport pathway.

The groundwater pathway mechanism is a first-order release model that considers the effects of different transport rates for radionuclides and progeny nuclides, while allowing decay during the transport process. Concentrations of each radionuclide transmitted to the assumed drinking water source (conservatively modeled as 600 ft. from the radwaste building) are determined by the transport through the groundwater system, dilution by groundwater and infiltrating surface water from the overburden soils, adsorption, and decay.

Any radionuclides at the point of analysis are assumed to remain at the analysis point for a period of one year.



REVISE TO: **Cross-Section Depicting Westerly Pathway of Groundwater Contaminants from Radwaste Building to MS River**

Figure 2.4.13-201 ~~**Schematic Model for Evaluating Radionuclide Transport in Groundwater**~~

ATTACHMENT 4

CNRO-2008-00029

REGULATORY COMMITMENTS

The following table identifies those actions committed to by Entergy in this document. Any other statements in this submittal are provided for information purposes and are not considered to be regulatory commitments.

COMMITMENT	TYPE (Check one)		SCHEDULED COMPLETION DATE (If Required)
	ONE-TIME ACTION	CONTINUING COMPLIANCE	
Entergy will implement periodic (annual, or at a frequency otherwise determined appropriate) inspections of Culvert #1 for Unit 3 to ensure the assumption of not more than 50% blockage exists.		✓	Not required.
Entergy will revise FSAR Sections 2.4.3.3.2, 2.4.3.5.2 and 2.4.13.2, and Figures 2.4.2-201 and 2.4.13-201, as discussed in Attachment 1 (Item SN 1), and as indicated in the draft revisions included in Attachments 2 and 3 of this letter, in Revision 1 of Part 3 of the COL application.	✓		Future COLA submittal.