June 12, 2008

MEMORANDUM: Stephanie Coffin, Chief
AP1000 Projects Branch 1
Division of New Reactor Licensing
Office of New Reactors

FROM: Joseph Sebrosky, Senior Project Manager **/RA/**
AP1000 Projects Branch 1
Division of New Reactor Licensing
Office of New Reactors

SUBJECT: TRIP REPORT – MAY 13-16, 2008, HYDROLOGY-RELATED SITE VISIT IN SUPPORT OF THE BELLEFONTE COMBINED LICENSE APPLICATION

This report summarizes NRC travel to Scottsboro, Alabama and Chattanooga, Tennessee during the period of May 13-16, 2008, to review hydrology-related components of the Tennessee Valley Authority's (TVA's) safety report associated with the combined license application (COLA) for Bellefonte Units 3 and 4. The morning of May 13, 2008, the staff met with the applicant at the Bellefonte site. The staff viewed key hydrologic features of the site including: intake and discharge locations along the Tennessee River, location of discharge from site drainage into Town Creek, cooling towers, and an elevated view of the site from atop the turbine building of Bellefonte Units 1 and 2, whose construction permit was terminated in 2006. After the morning tour, the staff traveled upstream of the Bellefonte site to Nickajack Dam and discussed dam breaching scenarios and recent dam safety modifications with TVA's experts.

On May 14, 2008, the staff met with the TVA staff and their consultants at TVA's office in Chattanooga. Discussions over the period of May 14 - 15, 2008, focused primarily on issues associated with site flooding, groundwater, and potential subsurface pathways available for radionuclide transport due to accidental releases. On the morning of the 16th, meetings resumed to close out several issues and to agree on the commitments of both parties.

The individuals participating in the various meetings are listed in Enclosure 1. The agenda for the May 13 - 16, 2008, site visit is provided in Enclosure 2. A more detailed agenda for the discussion held on May 15, 2008, is provided as Enclosure 3. Enclosure 4 provides a detailed map of the Town Creek area near the Bellefonte site that was discussed during the meeting on May 15, 2008. In Enclosure 5 the list of information needs provided by the staff to TVA prior to the audit is presented and augmented with a summary of the information provided by TVA and the associated disposition of each topic. Many of the items were *resolved*. Other items require action on either the part of TVA or NRC. *Pending* items require action from TVA involving either a letter to the NRC and/or revisions to the Bellefonte COLA. Subsequent to the trip, the NRC determined that it would document the pending items in Requests for Additional Information (RAIs). For *Open* items the NRC intends to prepare RAIs. Items listed as *linked* were determined to be disposed with another item.

As a result of the meetings, TVA provided computer input parameters used as part of its flooding analysis. Specifically, TVA used the U.S. Army Corp of Engineers Hydrologic Engineering Center River Analysis System (HEC-RAS) computer model to evaluate drainage of locally-intense precipitation at the site (FSAR Section 2.4.2.3). TVA provided the staff with 5 input files used in the HEC-RAS model. These input file names are: BLN.f01, BLN.prj, BLN.r01, BLN.g01, and BLN.p01. A printout of these files appears as Enclosure 6.

Enclosures 7 and 8 contain presentation materials that TVA provided during the site visit. Enclosure 7 contains a ground water presentation that was presented on May 14, and enclosure 8 contains a hydrology presentation that was presented on May 15, 2008.

On the morning of May 16, 2008, the staff provided the following summary of issues identified during the week:

1) TVA indicated that it planned to defer a revision to the April 17, 2008, white paper regarding hydrology analysis description until after the June workshop. This is not consistent with TVA's plans, as stated in the April 17, 2008, letter for providing a revision of the white paper the week of May 26, 2008. Because the staff provided comments to TVA on the white paper during the meeting, the staff indicated that it did not need a revision to the white paper prior to a June site visit. However, the staff requested that TVA document in a letter that it was revising its schedule and to provide a justification for why the delay should not impact the overall review schedule.

2) The staff discussed the June 2008 workshop, which will be held the week of June 23 in Knoxville, Tennessee. The purpose of the workshop is to familiarize the staff with the Simulated Open Channel Hydraulics (SOCH) numerical model that TVA used for calculating the probable maximum flood height and dam breach analysis. The staff had previously requested that a version of the model and a user's manual be provided to the staff prior to the meeting. TVA indicated that it was unwilling to do this. As an alternative, the staff and TVA agreed to begin the workshop in the morning of June 23 and end the workshop the evening of June 27 to allow as much time as possible for the staff to understand the model. The staff also identified that it would like to know as soon as possible the schedule for the following issues:

   - Date that the confirmatory check for all input data packages to the SOCH model and its related modules. TVA indicated that this date is slipping. TVA had previously indicated in an April 25 meeting that the date for completing the quality assurance for all data packages would extend beyond the June 23 workshop. However, the staff had previously understood that all data packages would have completed the confirmatory check stage before the June 23 workshop;

   - date the results of three SOCH model simulations will be available including: 1) a sensitivity run for peaking the unit hydrographs, 2) a sensitivity run increasing the precipitation excess for the watershed (i.e., decreasing the infiltration losses),and 3) a verification run of the SOCH model by simulating results of the 2003 flood event. The staff is interested in the results of these runs because they will provide an indication of conservatisms in the code and the code's capability to predict the results of actual events; and

- Date that all aspects of the SOCH computer code will be verified and validated.

3) During the meeting, TVA indicated that the porosity value used in the ground water analysis was found to be incorrect and that portions of the analysis would have to be redone. During the meeting the staff identified additional issues with the ground water analysis. TVA indicated that it was targeting the end of June to provide the new analysis and would provide the staff with a more definite schedule by the end of May 2008.

4) In addition to the individual RAIs identified above, the staff indicated that it would provide TVA with three broad RAIs. These RAIs are related to the following review areas: 1) ground water review, 2) accidental releases of radioactive liquid effluents in ground and surface waters, and 3) probable maximum flood and dam failure analysis. Each RAI involves a single major theme but can encompass multiple distinct but related items.

Docket Nos.: 52-014 and 52-015

CONTACT: Joseph Sebrosky, NRO/DNRL/NWE1
(301) 415-1132

Enclosures:
As stated

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| DATE | 06/12/08 | 06/12/08 | 06/12/08 |

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Bellefonte 5/13 – 5/16 Hydrology Site Visit List of Attendees

| Name | Organization | Title | 5/13 Site Visit | 5/13 Nickajack Dam tour | 5/14 am | 5/14 Chicamauga Dam tour | 5/14 pm | 5/15 | 5/16 am | 5/16 exit |
|---|---|---|---|---|---|---|---|---|---|---|
| Joe Sebrosky | NRC/DNRL/NWEI | Senior Project Manager | x | x | x | | x | x | x | x |
| Steve Breithaupt | PNNL | Hydrologist | x | x | x | x | | x | x | x |
| Lance Vail | PNNL | Hydrologist | x | x | x | | x | x | x | x |
| Philip Meyer | PNNL | Hydrologist | x | x | x | | x | x | x | x |
| Ken See | NRC/DSER/RHEB | Hydrologist | x | x | x | x | | x | x | x |
| Chris Cook | NRC/DSER/RHEB | Senior Hydrolgist | x | x | x | x | | x | x | x |
| Henry Jones | NRC/DSER/RHEB | Hydrologist | x | x | x | x | | x | x | x |
| Mark McBride | NRC/DSER/RHEB | Hydrologist | x | x | x | | x | x | x | x |
| Ron Davis | ENERCON | Engineer | x | x | x | x | | x | x | x |
| Andre Sterdis | TVA | Mgr, TVA NGDC Lic | x | | | | | | | x |
| Tom Ryan | TVA | Sr. Project Mgr | x | x | x | x | x | x | x | x |
| Perry Maddux | TVA | Project Mgr. | x | x | x | | x | x | x | x |
| Kurt Roblter | ENERCON | Tech Specialist | x | x | x | | x | x | x | x |
| Phillip Ray | TVA | Sr. Project Mgr | x | x | x | x | | x | x | x |
| Bob Davis | TVA | Elec Engineer | x | | | | | | | |
| James Niznik | TVA | Navigation Specialist | | x | | x | | | | |
| Shelley Kowkabany | ENERCON | Mgr, TVA New Nuclear | | | x | x | | x | x | x |
| Richard Ely | ENERCON | Consultant | | | x | | x | x | x | x |
| Gerald Williams | ENERCON | Sr. Project Mgr | | | x | | x | x | x | x |
| Eddie R Grant | NuStart | BLN Licensing Lead | | | x | | x | x | x | x |
| Randall Lantz | ENERCON | Hydrologist | | | x | | x | x | x | x |
| Bill Godwin | ENERCON | Eng Geologist | | | x | | x | x | | |
| Rich Grumbir | NuStart | COLA PM | | | x | | | x | x | x |
| Greg Lowe | TVA | Contractor | | | | | | x | ** | |
| Ramon Lee | TVA | Contractor | | | | | | x | ** | |

x- Indicates individual was present at this portion of the meeting ** indicates individual participated via phone

Enclosure 1

# NRC - BLN Hydrology Site Visit
# Agenda
May 13-16, 2008

Tuesday

8:00 AM CDT - Meet at BLN Training Center

8:15 AM - Entrance or opening meeting
Discuss the week's and Tuesday's agenda

8:30 AM - Tour
- Barge dock
- Intake station
- Cooling towers
- Drainage ponds
- Town creek shoreline (accessible parts)
- Roof of Turbine building
- Other parts

12:00 N - Meet at BLN Training Center to discuss any questions and status

12:30 PM - Lunch

1:30 PM - Travel to Nickajack Dam for site visit
- View dam structure
- View dam's surroundings
- View Dam safety changes

4:30 PM - Meeting to discuss any questions and status

5:00 PM - Travel to Chattanooga

Wednesday

8:00 AM EDT - Meet in Chattanooga at TVA Missionary Ridge Building

8:15 AM - Badging for those not badged

8:45 AM - Morning meeting
Discuss Wednesday's schedule provide any wanted information from Tuesday

9:00 AM - Presentation of COLA sections regarding ground water

10:30 AM - Discussion of ground water information

12:00 N - Lunch

1:00 PM - Presentation of COLA sections regarding tank rupture

1:45 AM - Discussion of tank rupture

2:30 PM - Travel to Chickamauga Dam for site visit
View dam structure
View dam's surroundings
View Dam safety changes

5:00 PM - Meeting to discuss any questions and status

Thursday

8:00 AM - Morning meeting
Discuss Thursday's schedule provide any wanted information from Wednesday

8:15 AM - Presentation of COLA sections regarding surface water

9:30 AM - Discussion of surface water information

12:00 N Lunch

1:00 PM - Presentation of status of hydrology activities

5:00 PM - Meeting to discuss any questions and status

Friday

8:00 AM - Morning meeting
Discuss Friday schedule provide any wanted information from Thursday

8:15 AM - Wrap-up discussions

10:00 AM - Exit meeting and status of review

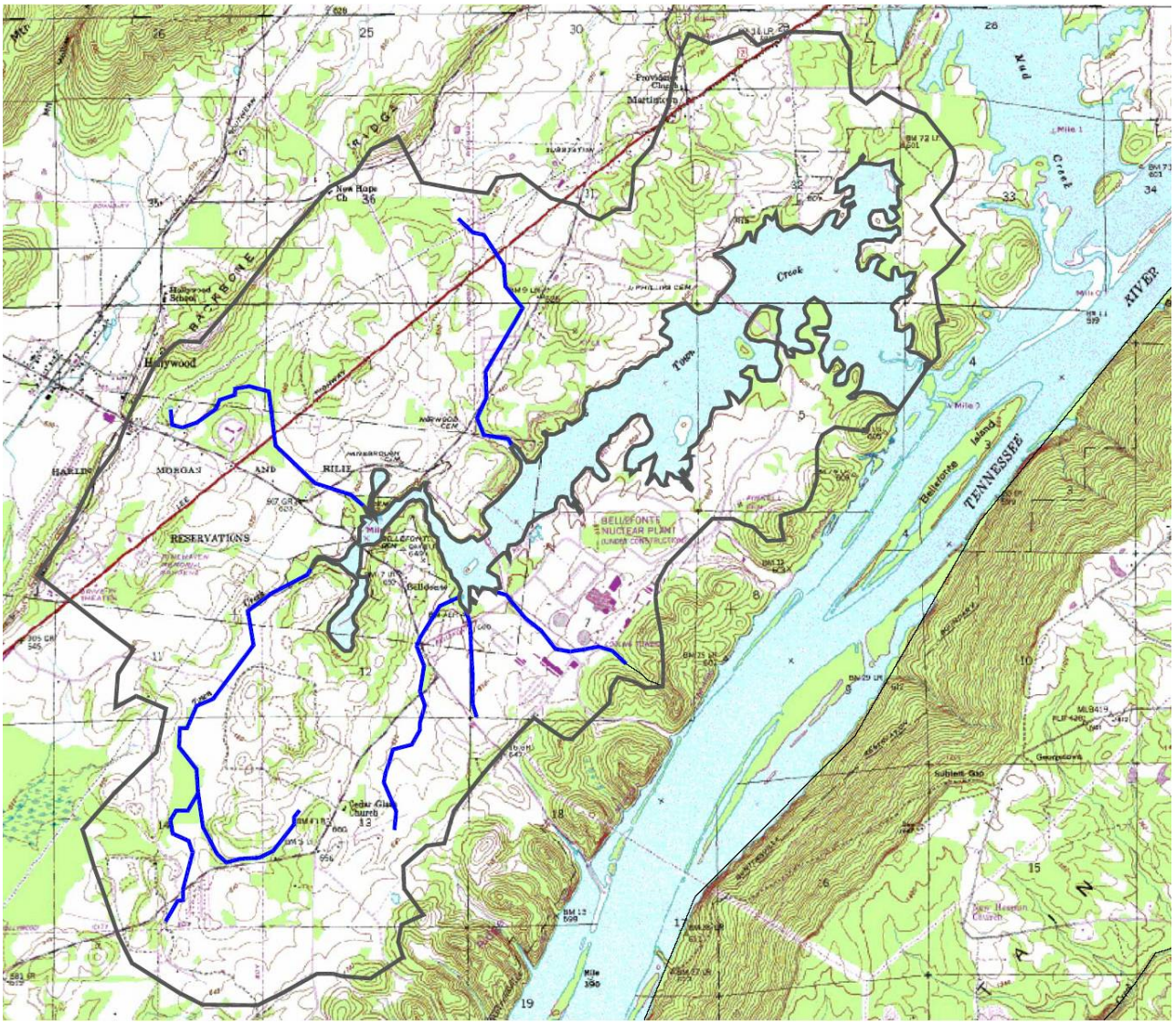
Bellefonte Nuclear Plant Units 3 and 4
TVA / NRC Site Inspection Meeting
Chattanooga, TN
Thursday May 15th - 1:00 to 5:00 PM

Agenda

1. Introductions / Purpose
2. Unit Hydrograph Input Package
3. Example of Excel Verification Method
4. Geometry Input Package
5. Dam Rating Curve Package
6. Original Basin Area Development and GIS Check Method
7. Example USACE Sedimentation / Contour Data
8. Example of Volume Check Method
9. 10 Minute Break
10. Drawings of Nickajack Dam, Chickamauga Dam, Lock Modifications
11. Identified Anomalies
12. Discussion on Progress / Status / Hard spots
13. Discussion of NRC Information Needs: Items 38 through 49
14. Follow Up Questions on Nickajack / Chickamauga Dam Visits
15. Wrap-up / Action Items

Enclosure 3

Diagram of Watershed in Town Creek Area Near Bellefonte Site




Enclosure 4

List of Items Discussed During Hydrology Site Visit

| Serial # | FSAR Section | Information Needs |
|---|---|---|
| 1 | 2.1.1 | Provide a subject matter expert (SME) to identify the location of the exclusion area boundary (EAB) with respect to these residences near Town Creek and any procedures by which access to the Town Creek portion of the EAB will be limited.<br>*Applicant defined EAB pursuant to 10 CFR 100. While the applicant does not restrict access to Town Creek and the boat docks extend into the EAB, the applicant can control the area in the case of an accident.*<br>**RESOLVED.** |
| 2 | 2.4.1 | Provide an SME to identify the local water users including those around Town Creek.<br>*The applicant stated that the State of Alabama does not require registration of groundwater wells and that the wells on the other side of Town Creek are generally located in a formation distinct from the formation on the plant side of Town Creek. According to the applicant the closest large capacity well (Hollywood #2) is over 2 miles away and has been abandoned.*<br>**Pending:** Applicant to identify location of the discussion of the wells in a separate formation in the ER or FSAR. (also see 4 and 34). Captured as electronic request for additional information (eRAI 426 item a).<br>**Open:** NRC will prepare a request for additional information (RAI) regarding plausible alternative conceptual models of groundwater transport at the site. Captured as eRAI 407<br>**Open:** NRC will prepare a request regarding plausible alternative conceptual models of groundwater conditions at the site. Captured as eRAI 396 |
| 3 | 2.4.12 | Provide an SME to describe the evidence for the existence of perched or semi-perched conditions at the site.<br>*The applicant stated that the terms 'perched' and 'semi-perched' do not well represent the conditions at the site.*<br>**Pending:** Applicant will document changes to the FSAR to eliminate the use of these terms. Captured as eRAI 426 item b. |
| 4 | 2.4.12 | Provide an SME to describe the process used to determine changes in private water wells since the construction of Units 1 and 2.<br>**Linked**: #2<br>**Open:** NRC will prepare an RAI regarding plausible alternative conceptual models of groundwater conditions at the site. Captured as eRAI 396 |

| Serial # | FSAR Section | Information Needs |
|---|---|---|
| 5 | 2.4.12 | Provide an SME to describe methods used to construct groundwater contours and method to ensure that other plausible sets of contours would not result in different conclusions.<br>*The applicant stated that spatial data was transferred to a uniform grid using a linear interpolation scheme and then contoured by hand.*<br>**RESOLVED.** |
| 6 | 2.4.12 | Provide an SME to explain the large variability in wells WT2 and WT5 (and WT1?) during the 1970s seen in Fig. 2.4.12-211.<br>*The applicant stated that the variability was a result of construction activities and dewatering. Excavations occurred between 1974 and 1975 and were documented in photos of the excavation activities. The applicant also stated that the flood in 1973 may have affected water levels.*<br>**Pending:** The applicant will indicate that the historical data in this figure is not inconsistent with the applicant's conceptual model of the groundwater conditions at the site. Captured as eRAI 426 item c. |
| 7 | 2.4.12 | Provide an SME to identify the 12 aquifer test observation wells.<br>*The applicant identified the figure in the FSAR.*<br>**Pending:** The applicant will provide coordinates of observation wells. Captured as eRAI 426 item d. |
| 8 | 2.4.12 | Provide an SME to elaborate on the explanation of the observed groundwater depression including any more recent groundwater head data obtained after May 2007 that would support that hypothesis.<br>*The applicant believes the wells had adequately equilibrated. The applicant stated that there is no groundwater head data obtained after the date of the data provided in the FSAR. The applicant does not believe groundwater flows beneath Town Creek through deeper formations. The applicant stated that some evidence for deep recharge does exist at the site.*<br>**Open:** NRC will prepare an RAI regarding plausible alternative conceptual models of groundwater conditions at the site. Captured as eRAI 397 and eRAI 404, |
| 9 | 2.4.12 | Have a copy of Reference 221 available for review at the audit.<br>*A copy of the reference 221 (Tennessee Valley Authority, Bellefonte Nuclear Plant, Final Safety Analysis Report, Amendment 30, December 20, 1991) was reviewed by the staff. No further clarification is needed.*<br>**RESOLVED** |

| Serial # | FSAR Section | Information Needs |
|---|---|---|
| 10 | 2.4.12 | Provide an SME to discuss the protocols by which samples were classified as soil, epikarst, or bedrock and the methods used to conceptualize the lithology through various cross sections.<br>*The applicant's SME described the characterization activities and stated the 'top of rock" elevation is based on interpretation of the geotechnical boring logs by the geology expert. A copy of the FSAR Appendix 2.BB was reviewed by the staff. Staff identified some boring logs that were omitted from the document and possible revisions that were not included in the document..*<br>**Pending:** The applicant will provide a copy of the FSAR Appendix 2.BB that includes the latest revision of boring logs for all boreholes. Captured as eRAI 426 item e. |
| 11 | 2.4.12 | Provide an SME to discuss methods used to estimate porosity and the depth of the abrupt porosity change.<br>*The applicant self-identified an error in the porosity estimate. The applicant stated that FSAR 2.5 describes the calculation of the porosity as the fractional length of voids and/or cavities encountered divided by the length of the borehole, and the minimum fracture size in this estimate was of 1/10 ft. The applicant stated that the two porosity values provided in the FSAR were average values above and below the 20 ft. depth, but that there is no abrupt change in porosity.*<br>**Pending:** The applicant will advise NRC of the timeline for completing a revised analysis of porosity and all calculations dependent on the porosity estimate. (See 24) The applicant will provide a discussion of the estimation of both "total porosity" and "Flow porosity." The applicant will ensure that the porosity is consistent with discussion in 2.5 regarding porosity. Captured as eRAI 426 item f.<br>**Open:** Subsequent to the meeting the staff determined it was appropriate to ask a focused question in this area, which is captured as eRAI 406. |
| 12 | 2.4.12 | Provide an SME to discuss methods used to provide a conservative estimate of the hydraulic conductivity.<br>*The applicant stated they will revise calculations and the FSAR to use the highest conductivity value observed. The applicant provided copies of the pump test report and the borehole packer test report which the staff reviewed.*<br>**Pending:** The applicant will revise calculations and the FSAR to use the highest conductivity value and agreed to provide the pump test data. Captured as eRAI 426 item g.<br>**OPEN:** The staff will include some issues with the pump test data in an RAI. Captured as eRAI 405 |

| Serial # | FSAR Section | Information Needs |
|---|---|---|
| 13 | 2.4.12 | Provide an SME to discuss the significance of vertical gradients shown in the data of Table 2.4.12-204.<br>*The applicant stated no significant vertical gradients were observed and measured gradients are small and tend to flip directions.*<br>**RESOLVED.** |
| 14 | 2.4.12 | Provide any available photographs and excavation logs of the subsurface environment exposed during construction of Units 1 and 2 for review during the site audit.<br>*The applicant provided staff viewing of photos taken throughout the excavation process.*<br>**RESOLVED.** |
| 15 | 2.4.12 | Provide an SME to describe the geophysical boring program described in section 2.5, in particular location and evaluation of voids, and groundwater level measurements made in the borings.<br>*A copy of FSAR Appendix 2.BB was reviewed by the staff. No further clarification is needed.*<br>**RESOLVED** |
| 16 | 2.4.12 | Provide an SME to discuss the inferred interconnection of voids detected in bedrock and epikarst.<br>*Applicant stated the subsurface is consistent with fractured media.*<br>**RESOLVED** |
| 17 | 2.4.12 | Provide an SME familiar with the details of hydraulic testing (e.g. slug and pumping tests) conducted in bedrock and epikarst.<br>*The applicant stated no slug tests were performed.*<br>**RESOLVED** |
| 18 | 2.4.12 | Provide an SME to locate springs, seeps, or other discrete locations of groundwater discharge to the surface at the site.<br>*The applicant states that they have identified no springs on site. The applicant has never noticed water in two springs located south of the plant.*<br>**RESOLVED.** |
| 19 | 2.4.12 | Provide an SME to discuss the methods used to estimate the vertical groundwater gradients in bedrock and epikarst.<br>**Linked:** #13 |

| Serial # | FSAR Section | Information Needs |
|---|---|---|
| 20 | 2.4.12 | Provide an SME to define the exact distinction between "dry" wells (i.e. wells that produced very little water) and wells completed above the water table.<br>*The applicant stated that all wells were completed below the water table and that dry wells refer to wells that become dry quickly when pumped and recover very slowly.*<br>**RESOLVED.** |
| 21 | 2.4.12 | Provide an SME to explain the methods used to identify the locations of groundwater supply wells.<br>**Linked:** #2 |
| 22 | 2.4.12 | Provide the correct citation for second complete paragraph on FSAR p. 2.4-50 (Reference 205 is apparently incorrect).<br>*The applicant stated that the citation was in error and would be deleted in future revisions.*<br>**Pending:** Delete reference in future revision**.** Captured as eRAI 426 item h. |
| 23 | 2.4.12 | Provide an SME to discuss rationale for excluding wells completed in the soil zone in preparation of groundwater piezometric surface maps.<br>*The applicant stated that soil zone water level maps were not produced due to limited amount of data with water table in soil zone.*<br>**Pending:** The applicant will clarify wording. Captured as eRAI 426 item i. |
| 24 | 2.4.12 | Provide an SME to discuss the methods used in estimating the effective porosity of bedrock.<br>**Linked:** #11 |
| 25 | 2.4.12 | Provide an SME to discuss the assumptions used in estimating groundwater flow velocities.<br>**Linked:** #12 |
| 26 | 2.4.13 | Provide an SME to discuss the values in the RESRAD input file(s) used in this section.<br>**Pending:** The applicant will provide the RESRAD input files, once the input parameters are revised. Captured as eRAI 427 item a.<br>Note: Subsequent to the trip, the staff determined the need to develop an additional RAI. This is eRAI 409 regarding the basis for the 150,000 $m^3$ dilution volume used in the analysis. |
| 27 | 2.4.13 | Provide an SME to describe the methods employed for the laboratory adsorption measurements.<br>*The applicant stated that the adsorption experiments were conducted using samples from the soil zone. A copy of the laboratory report was reviewed by staff. No further clarification is needed.*<br>**RESOLVED** |

| Serial # | FSAR Section | Information Needs |
|---|---|---|
| 28 | 2.4.13 | Provide an SME to discuss the basis for the source concentrations for the radionuclides included in the transport analysis.<br>*The applicant stated the source of the source term was the DCD and that the initial groundwater concentrations were the same as the source concentrations..*<br>**RESOLVED.** |
| 29 | 2.4.13 | Provide an SME to discuss the basis for the sequence of events and time scales used in the transport analysis.<br>*The applicant stated that the residence time of one year was chosen to coincide with the annual limits in 10 CFR 20 Appendix B, that the 70-day calculation interval was chosen to reduce computation and the amount of output; and that the 50-year simulation period encompassed all concentration peaks.*<br>**Pending**: The applicant will provide a technical basis for the selection of a dilution volume in Town Creek. Captured as eRAI 427 item b.<br>**Linked:** #2<br>**Open:** NRC will prepare an RAI regarding plausible alternative conceptual models of groundwater transport at the site. Captured as eRAI 408.<br>Note: Subsequent to the trip, the staff determined the need to develop an additional RAI. This is eRAI 407 regarding a potential alternative pathway to residences on the opposite site of Town Creek. |
| 30 | 2.4.13 | Provide an SME to discuss the basis for using Parameter Values in Table 2.4.13-203 relative to the minimum observed values as reported in Table 2.4.13-202.<br>*The applicant stated they used Kds based on closest measurement to the source not the lowest measurement. Given the likely variability along the pathway, the applicant stated that using the minimum Kd would be conservative and appropriate.*<br>**Pending:** The applicant will revise transport analyses using the minimum Kds. Captured as eRAI 427 item c. |
| 31 | 2.4.13 | Have a calc package for review (or/and an SME to describe) the computation of the Area of Contaminated Zone in Table 2.4.13-203.<br>*The applicant stated the area was based on a 2 meter deep volume sitting atop the saturated zone. The applicant acknowledged an apparent math error in the estimation of the Area of Contaminated Zone.*<br>**Pending:** The applicant will revise the area based on a corrected computation. Captured as eRAI 427 item d. |

| Serial # | FSAR Section | Information Needs |
|---|---|---|
| 32 | 2.4.13 | Provide an SME to clarify whether the contaminant source is assumed to be directly in the saturated zone as illustrated in Figure 2.4.13-201. If so, explain the use and impact of the contaminated and unsaturated zone parameters.<br>*The applicant stated the area was based on a 2 meter deep volume sitting atop the saturated zone.*<br>**Pending:** The applicant will revise the figure to identify the correct location of the contaminated zone and assumed pathway.. Captured as eRAI 427 item e. |
| 33 | 2.4.13 | Provide an SME to explain how alternative plausible scenarios, consistent with limited data available, for groundwater radionuclide migration eastward from Unit 4 toward the intake structure on Guntersville Reservoir were filtered to determine that the postulated scenario was conservative.<br>*The applicant stated that they are already responding to this item in H8 from the environmental audit.*<br>**Pending:** The applicant will provide a written response through the environmental responses to NRC. Captured as eRAI 427 item f. |
| 34 | 2.4.13 | Provide an SME to discuss whether preferential flow through fractures and solution openings in bedrock and epikarst is a plausible alternative conceptual model for transport of radionuclides.<br>**Linked:** #2<br>**Open:** NRC will prepare an RAI regarding plausible alternative conceptual models of groundwater conditions at the site. Captured as eRAI 408 |
| 35 | 2.5 | Have a copy of Reference 399 available for review at the site audit.<br>*A copy of the document was reviewed by the staff. No further clarification is needed.*<br>**RESOLVED** |
| 36 | 2.4.6 | Provide an SME to discuss the possibility of hill-slope failure-generated tsunami-like waves on inland sites per RG 1.206.<br>**Pending:** The applicant will check for consistency in sections throughout the FSAR related to hillslope failure. Captured as eRAI 440. |
| 37 | 2.4.2 | Provide an SME to discuss the site drainage and a large-format copy of Figure 2.4.2-202 (Grading and Drainage Plan).<br>*The applicant explained that the PDF file included in the application can be blown up without a loss of resolution. The applicant discussed the HEC-RAS analyses for local intense flooding.*<br>**Pending:** The applicant will provide HEC-RAS input files for site drainage.<br>Note: Subsequent to the meeting the staff changed this item to resolved based on TVA providing this information. This information is captured as attachment 6 to this document. |

| Serial # | FSAR Section | Information Needs |
|---|---|---|
| 38 | 2.4.2 | Provide an SME to discuss the rationale for selecting flood records after 1952 as representative of current and future (to the duration life of the COL) floods.<br>*The applicant stated that by 1952 the majority of the major storage projects were complete.*<br>**Pending:** The applicant will clarify 'watershed' versus 'river management infrastructure' terminology. Captured as eRAI 422 question 1. |
| 39 | 2.4.2 | Provide an SME to discuss any field measurements taken near the Bellefonte site (e.g., river discharges, stage heights, water velocities) during the 2003 flood event.<br>*The applicant stated no measurements near the site for Guntersville reservoir exist. The closest location with data is South Pittsburg.*<br>**RESOLVED.** |
| 40 | 2.4.2 | Provide an SME to describe any bounding calculations performed without SOCH to estimate the Probable Maximum Flood (PMF) elevation at the Bellefonte site.<br>*The applicant stated that they had attempted to use bounding approaches to confirm the site was dry. However, they were not unsuccessful to get bounding approaches to result in a dry outcome and they are no longer pursuing assessments without SOCH.*<br>**RESOLVED.** |
| 41 | 2.4.3 | Provide an SME to discuss the method used to estimate precipitation losses.<br>*The applicant provided a binder to review with examples of the calculation packages used to estimate the unit hydrographs including the precipitation losses. A standard approach is adopted wherein unit graphs based on single or multiple storms can be derived. A complete set of binders for all subbasins will be available at the workshop.*<br>**Open:** NRC will prepare an RAI regarding determining whether the applicant's precipitation loss rate represents the most conservative plausible conceptual model of flooding conditions at the site. Captured as eRAI 398 question 2. |

| Serial # | FSAR Section | Information Needs |
|---|---|---|
| 42 | 2.4.3 | Provide an SME to discuss the method used to correct unit hydrographs derived from deconvolution of much smaller storms for a Probable Maximum Precipitation (PMP) event.<br>*The applicant provided a binder to review with examples of the calculation packages used to estimate the unit hydrographs. A standard approach is adopted wherein unit graphs based on single or multiple storms can be derived. A complete set of binders for all subbasins will be available at the workshop. The applicant stated they will peak the unit hydrographs for each sub-basin by 20% to account for their non-linear behavior during the PMF.*<br>**RESOLVED.** |
| 43 | 2.4.3 | Provide an SME to discuss why the Goodrich semi-graphical method was selected for tributary routings.<br>**Pending**: The applicant will provide further explanation and justification of this method. Captured as eRAI 398 question 3. |
| 44 | 2.4.3 | Provide an SME to describe the status of dam safety modifications at the Chickamauga Dam.<br>*The applicant arranged a tour of Chickamauga dam with TVA's dam safety experts. Detailed drawings of the dam site were provided. Plans for major modifications to Chickamauga Dam may never be implemented.*<br>**Pending**: The applicant needs to clarify dam-safety modifications (existing, anticipated, or not) for the Chickamauga dam. Captured as eRAI 398 question 4. |
| 45 | 2.4.3 | Provide an SME to discuss the assumptions about the status of spillway gates and other adjustable structures during the PMF.<br>*The applicant stated that no credit was taken for the spillway gates or adjustable structures during a PMF. However, since historic floods did use spillway gates, spillway gate operation must be considered in calibration to observed floods. Six gates are being affected during construction of the new lock at Chickamauga Dam, and 5 of those will be removed by the construction of the new lock.*<br>**Pending:** The applicant will perform and document sensitivity runs with the gates removed. Captured as eRAI 398 question 5. |

| Serial # | FSAR Section | Information Needs |
|---|---|---|
| 46 | 2.4.3 | Provide an SME to discuss the method used to estimate the initial state of the reservoir, the reservoir state at the end of the antecedent storm and how these assumptions comply with Standard Review Plan 2.4.4 and GDC 2, Appendix A of 10 CFR 50.<br>*The applicant stated that initial reservoir pool elevation prior to the antecedent storm was assumed to be the median pool elevation. The applicant stated that the antecedent storm will fill the reservoirs prior to the major storm. The basin-wide flooding analysis covers a 9-day period: 3 days of antecedent storm runoff, 3 days of recovery, and 3 days of the PMF. At the beginning of the model run the reservoir water levels are set to the median level. Studies have been conducted of the effect of initial conditions.*<br>**Pending**: The applicant will provide documents of the studies of antecedent conditions on reservoir conditions. Captured as eRAI 398 question 6. |
| 47 | 2.4.3 | Provide an SME to discuss the methodology to model embankment breaching.<br>*The applicant stated that the embankment breaching was immediate and total once overtopping had occurred for a fixed period. The basis for the period of overtopping before failure happens is based on a report by Christofano. The Christofano approach is no longer endorsed by Reclamation.*<br>*Note: Subsequent to the trip the staff received a May 23, 2008, letter from the U.S. Department of the Interior Bureau of Reclamation regarding the use of the Cirstofano method (see ADAMS ML081570447). The letter states in part that "the method developed in 1965, by Eugene A. Cristofano of the Bureau of Reclamation for computing the erosion rate for failure of an earthfill dam is no longer being actively used by our agency."*<br>**Pending:** The applicant will investigate the use of this methodology and provide a copy of the Christofano reference. Captured as eRAI 422 question 2. |
| 48 | 2.4.4 | Provide an SME to discuss the impacts on the PMF brought about by a change in the reservoir operation policy discussed in the Reservoir Operations Study conducted by TVA in 2004.<br>**Pending:** Provide a description of impacts on the probable maximum flood brought about by a change in the reservoir operation policy discussed in the Reservoir Operations Study conducted by TVA in 2004. Captured as eRAI 398 question 7. |

| Serial # | FSAR Section | Information Needs |
|---|---|---|
| 49 | 2.4.4 | Provide an SME to describe the collection methods and locations for the most current bathymetric and topographic data available. Also describe how these data relate to data used to develop cross sections in the flood routing analysis.<br>*The applicant has obtained new bathymetric data from the USACE. In addition to the new bathymetric data, GIS data for the drainage basin is being used to update the overall cross-sections subject to PMF conditions.*<br>**Pending:** The applicant will provide the NRC staff with GIS shape files of the new cross sections used in the updated SOCH and HEC-RAS models. Captured as eRAI 422 question 3. |
| 50 | | **Pending:** The applicant will provide diagrams of dam cross sections for the Chicamauga, Nickajack, and Gunnersville dams with levels of PMF and the dam breach clearly marked. TVA will perform a sensitivity run for the Chicamauga lock modifications. TVA is to consider how the Chicamauga lock modifications that are to be done in the future will be captured in the Bellefonte 3 and 4 licensing basis. Captured as eRAI 422 question 4. |
| 51 | 2.4.3 | **Pending:** The applicant will clarify the wind wave runup calculation from U.S. Army Corps of Engineers reference (Coastal Engineering Manual). Captured as eRAI 422 question 5. |
| 52 | 2.4.3 | **Pending:** The applicant to check consistency between winds speeds reported in 2.3 and wind speed used in 2.4.3.6. Captured as eRAI 422 question 6. |
| 53 | | The staff and the applicant established that the nine commitments identified in the applicant's draft white paper regarding SOCH dated April 17, 2008 (ADAMS accession number ML081120497) are observed as commitments by both parties. These commitments include the following:<br>1) Bottom of page 34 last sentence includes a commitment for a comparative analysis<br>2) Cover letter for the white paper indicates that an update will be provided the week of May 26, 2008<br>3) Page 52, section 5.3.1, first paragraph last sentence includes a commitment regarding the verification process<br>4) Page 60 last paragraph contains a commitment regarding the verification process<br>5) Page 62 first and second bullets contain commitments regarding bathymetry data<br>6) Page 62 contains commitments regarding the analysis of the 2003 flood |

| Serial # | FSAR Section | Information Needs |
|---|---|---|
| | | 7) Page 62 contains commitments regarding updating and verifying hydrographs<br>8) Page 62 contains commitments that updated models will be used.<br>9) Page 62 contains commitments regarding reservoir operating guides and spillway rating curves being reviewed |
| 54 | | The staff identified eleven items that should be clarified/corrected in the April 17, 2008 (ADAMS accession number ML081120497) draft white paper before the white paper is finalized. The staff informed TVA that it would not provide a letter that lists these comments and that these comments would be captured in the trip report. The staff further indicated that they believed this mechanism fulfilled the intent of TVA' s request in the cover letter to the white paper for the NRC to provide comments.<br>1) Appendix A figures present observed elevations that fall outside the guide curves. TVA will expand their discussion of these figures in the next version of the white paper to explain these variations.<br>2) Section 4.1, last paragraph (Page 11) refers to "studies done by others and unpublished work by TVA." TVA is to provide clarification of these studies in the white paper and provide copies of the studies for staff review during the June 23, 2008 Knoxville trip<br>3) Using figure 7 and 8 as an example, curves are identified as being "reproduced by composite unit graph." TVA is to provide an explanation in the text where further information on how these figures were developed can be found.<br>4) On figure 10, TVA is to resolve whether or not the "Blue dots" represent real data<br>5) On figure 12, TVA is to explain the note on the graph that states "hoch's estimated inflow"<br>6) Using figure 13 as an example, TVA is to develop text to describe the method used to develop the curve<br>7) Page 27 section 4.2.1 TVA is to clarify overall text on what is meant by stable model and stability criteria and tie this discussion to page 32<br>8) Page 32, last paragraph TVA is to change the word "disadvantage" to "advantage."<br>9) Page 36 Section 4.2.5 first paragraph last sentence TVA is to clarify the the relationship between |

| Serial # | FSAR Section | Information Needs |
|---|---|---|
| | | HEC-2 and the SOCH code.<br>10) Figure 30 through figure 39, TVA will clarify the run sequence associated with these figures in the white paper<br>11) Section 5.3 TVA is to expand the white paper discussion regarding work crew access for reservoir operations during and after the antecedent storm and will include a discussion of the memorandum or understanding with the US Army Corps of Engineers |
| 55 | | TVA will consider adding a discussion in the white paper about the SOCH code's ability to predict the results of the 2003 flood and providing these results to the NRC. |

FSAR 2.4.2.3: Locally-Intense Precipitation Numerical Model (HEC-RAS) Input Files

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   1157
Boundary for River Rch & Prof#=BLN Basins,BLN Basins      , 1
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Up Slope=0.02
Dn Type= 1
Dn Known WS=622.5
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DSS Import StartTime=
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Flow File=f01
Plan File=p01
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X Axis Title(PF)=Main Channel Distance
X Axis Title(XS)=Station
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END DESCRIPTION:
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DSS End Date=
DSS End Time=
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DSS Export Rating Curve Sorted= 0
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Enclosure 6

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      0
      0      0
      1      1      0      F      T      T      0      8     30
      1
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Flow Data
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Flow and Seasonal Roughness Flag (plan)
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      0      F
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UNET DZMax Abort= 100
UNET Convert EG Bridges=-1
UNET Use Existing IB Tables=-1
UNET Froude Reduction=False
UNET Froude Limit= 1
UNET Froude Power= 10
Instantaneous Interval=1HOUR
Write IC File= 0
IC Time=,,
Echo Input=False
Echo Output=False
Write Detailed= 0
Detailed Automatic Start=False, 10