Pacific Northwest National Laboratory
Operated by Battelle for the
U.S. Department of Energy

November 12, 2009

Ms. Karyn Hannum
Division of License Renewal
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Dear Ms. Hannum:

Subject: Final Watts Bar Site Audit Trip Report for JCN J-4261, "Technical Assistance for Operating License Environmental Review – Watts Bar Unit 2 Reactivation" (TAC No. MD8203)

PNNL has completed a summary of the site audit conducted October 6 through October 8, 2009, at the Watts Bar Unit 2 Plant near Sweetwater, TN. The purposes of this trip included: 1) discussions with the applicant, Tennessee Valley Authority (TVA), concerning the operation of Watts Bar Unit 2, 2) review of the TVA 2007 EIS, and 3) tour the site and surrounding area. The final trip report summary for the site audit is enclosed.

If you have any questions regarding this trip report, please call Amanda Stegen at 509-372-4511 or Rebekah Krieg at 509-371-7155.

Sincerely,

Amanda Stegen
Project Team Leader
Radiological Science and Engineering Group
ENERGY & ENVIRONMENT DIRECTORATE

JAS:ll

cc: w/encl.: Dennis Beissel
Andy Imboden
Rebekah Krieg
Joel Wiebe

902 Battelle Boulevard • P.O. Box 999 • Richland, WA 99352

Telephone (509) 372-4511 ■ Email amanda.stegen@pnl.gov ■ Fax (509) 375-3886

Watts Bar Unit 2
Audit Trip Report
October 6–8, 2009

The Watts Bar Unit 2 audit was held the week of October 5, 2009, near at the Watts Bar Nuclear Site near Sweetwater, Tennessee. The applicant is Tennessee Valley Authority (TVA). The following is a list of the NRC, PNNL, and TVA staff that attended the audit.

Nuclear Regulatory Commission (NRC) Team

Dennis Beissel	Environmental Project Team Lead/Hydrology
Dennis Logan	Aquatic Ecology
Allison Travers	Cultural Resources (attended SHPO meeting in Nashville, Tennessee)

Pacific Northwest National Laboratory (PNNL) Team

Amanda Stegen	Project Team Lead
Tonya Keller	Deputy Project Team Lead
Tara O'Neil	Cultural Resources
Eva Eckert Hickey	Radiation Protection/Transportation/Uranium Fuel Cycle/Decommissioning
Rebekah Krieg	Aquatic Ecology
Corey Duberstein	Terrestrial Ecology
Van Ramsdell	Meteorology/Accidents
Bob Bryce	Hydrology
Katie Cort	Socioeconomics/Benefit-Cost/Need for Power

Tennessee Valley Authority (TVA) Team

Suzanne Biddle	TVA Power Supply and Fuel Systems Planning
Nolan Baier	TVA Power Supply and Fuel Systems Planning
Frank Koontz	TVA Engineering
Bob Elis	TVA Engineering
Carla Borrelli	TVA Risk Management
Steve Mass	Westinghouse Risk Applications
Steve Mirski	SAIC
Ken Wastrack	TVA Meteorologist
Jenniffer Call	TVA Meteorologist
Bill Raines	TVA Environmental Radiation Monitoring
George Laurie	TVA Modifications
Gary Springston	TVA River Operations
Jesse Dobson	Emergency Planning/Met Tower
Bo Baxter	Aquatic Biologist
Jason Regg	Transmission Line Right-of-Way
Robert Wilson	TVA Right-of-Way
Greg Scott	TVA Licensing

Joe McCarthy	TVA Licensing
Eddie Woods	TVA Chemistry
Jerri Phillips	TVA Environmental
Ruth Horton	TVA NEPA Compliance
Erin Pritchard	TVA Cultural Resources
Gordon P Arent	TVA Licensing
Keith Jones	TVA River Operations
Paul Hopping	TVA River Operations
Dennis S. Baxter	TVA/AM
J. Mark Boggs	TVA/OER
Paul Byron	TVA Licensing
Beth Selewski	TVA/SBE
Jennifer Call	Meteorology
Teresa Cheek	AQ
Jim Eblen	TVA Socio/EJ
Tom Detchemendy	TVA EP Department
Bruce McDonald	Solid Rad Waste
Dave Jeffrey	Liquid Rad Waste

Schedule of Activities

Staff from NRC and PNNL traveled to Sweetwater, Tennessee, on October 5, 2009. The site audit was held at the Watts Bar Nuclear Site over the next three days. NRC and PNNL staff held technical discussions with TVA staff on October 6 and 7, 2009. PNNL, NRC, and TVA closed out the site audit on the morning of October 8, 2009. The schedule for the site audit was developed in conjunction with NRC and TVA in the weeks leading up to the site audit. Minor revisions occurred during the audit because of availability of key staff and information gathered on previous days.

On Thursday, October 8, NRC and PNNL staff (Allison Travers and Tara O'Neil) met with the Tennessee State Historic Preservation Officer (SHPO) in Nashville, Tennessee, to discuss the NHPA Section 106 compliance status of TVA at the Watts Bar Nuclear Plant. TVA has completed the Section 106 process and the SHPO did not identify issues related to this operating license activity. The SHPO has requested NRC to submit a letter to their office referencing the TVA work and closing out the 106 process for the NRC licensing action.

Passenger vans and boats were provided by TVA for tours around the Watts Bar Nuclear Site. PNNL, NRC, and TVA staff went on the following tours –

October 6 – General Site Tour. TVA, NRC, and PNNL took a walking tour through the Watts Bar Unit 1 and Unit 2 plant site. TVA pointed out the diesel generators and containment buildings as well as various other buildings and plant systems. This tour then took a van tour of the areas outside the protected area. Some of the highlights included the cooling towers for Units 1 and 2, the intake locations, barge loading area, supplemental condenser cooling water (SCCW) outfall, and some of the wetlands. Since Unit 1 is in an outage there was no water moving through the SCCW system, but we looked at the open trench that conveys water to the "glory hole" and then the outfall at the river's edge. The glory hole is a large opening at the end of the open trench through which the water falls and is aerated prior to being released to the river through the shoreline outfall.

At the cooling tower basins, Paul Hopping described how the SCCW system works with the original cooling system. He showed us the location on the Unit 2 cooling tower where the water enters the tower basin; we stopped at the intertie between the two cooling towers, and he described how the system has worked with a single unit in operation and how it will work with both units in operation.

At the barge unloading facility, Paul Hopping explained that temperature monitors are installed on the river bottom to ensure that the water remains below limits set to protect the mussels. Paul also described the two mixing zones that exist for the SCCW outfall. For conditions with no flow the mixing zone extends 1,000 feet downriver and includes the entire width of the river at this location. Fish can still pass the heat plume because it resides near the top of the water column. Under conditions where one or more turbines at the dam are being operated so there is flow in the river, the mixing zone extends 2,000 feet downriver and hugs the shoreline where the plant is located.

This tour also included a tour of the area of potential effect (APE) as well as key cultural resources within the APE. One archaeological site is located within the APE and will be avoided by project activities. An historic steam generating plant is located nearby that the SHPO considers eligible. This structure is not within the APE and will not be impacted by the project.

October 6 – Radiological Environmental Monitoring Tour. Bill Raines provided an offsite tour of 1) the near site groundwater monitoring wells implemented to track the 2002 identified tritium leak (and later used for the NEI groundwater initiative), 2) representative air monitoring and TLD stations that are part of the radiological environmental monitoring plan (REMP), 3) the nearest resident, and 4) the nearest garden. Other sites that are part of the REMP were also observed.

October 6 – Boat Tour. Following the site tour, TVA, NRC, and PNNL hydrologists and ecologists took a boat tour of the SCCW outfall, mussel beds, barge unloading facility, intake pumping station, diffuser location, Yellow Creek outfall, and downstream mussel beds and fish spawning locations. We loaded into the boats at a boat ramp across the river from the plant. Dennis pointed out that the area around the boat ramp is a mussel bed with lots of species because in the past the people collecting mussels would clean their catch at the old boat ramp nearby and throw all the small or undesirable mussels back into the water there, so a rich mussel bed developed.

The SCCW outfall. We looked at the outfall from the river side and Dennis explained that a ramp has been installed in the river bed at the outfall to direct the discharged warm water upward away from the riverbed to protect the mussels that live in the area. Dennis pointed out an approximate 150-square-foot area where mussels were removed prior to installation of the concrete ramp. Mussels in this area were relocated prior to installation of the ramp, so this area is called the Mussel Relocation Zone (MRZ). Paul Hopping explained that temperature monitors are installed on the river bottom to ensure that the water remains below limits set to protect the mussels. Paul also described the two mixing zones that exist for the SCCW outfall. For conditions with no flow, the mixing zone extends 1,000 feet downriver and includes the entire width of the river at this location. Fish can still pass the heat plume because it resides near the top of the water column. Twice a year TVA performs a temperature survey measuring temperature along a transect across the river through this mixing zone to verify the models that they use to determine when they need to shut down the discharge or to release more water from the dam.

Temperature sensors are suspended from floats in the river at the downstream end of this mixing zone so that the temperature is continuously monitored (every 15 minutes) and telemetered to the plant so that adjustments to the cooling system can be made if the limits are being approached. Sensors are located at 3 feet, 5 feet, and 7 feet for the 2,000-foot mixing zone. Sensors are located upstream for comparison, downstream, and on the outer edges of the plume.

Barge unloading facility. Dennis explained that they will not dredge the barge unloading facility because of the mussels in the area. The water is fairly deep (about 20 feet when we were there), and greater depth can be achieved by raising the level of the reservoir.

Mussel beds. Dennis pointed out the location of the mussel beds near the barge unloading facility, the boat ramp, and downstream of the plant. They started performing surveys of the mussels in the 1950s. The riverine mussels are the ones on the decline. Dennis took us downstream to see the locations of the important mussel beds and spawning location for the sauger (near Hunter shoals). The sauger like this area because the gravel percolates well and there are some deep holes near the bluffs where they stage at (or some of them stage at the dam before they return to the shoals) prior to spawning. The last major survey for the mussels was in the 1990s.

Intake pumping station. The station has two interconnected sumps containing the pumps. Workers are installing a divider between the two wells to protect divers who must enter the water to do maintenance while the plant is in operation. The divider will be a large mesh so that water can move through but the divers cannot be pulled into an operating pump. The intake pumping station includes ERCW, RCW, and fire protection pumps.

Diffuser location. We discussed the operation of the diffuser, the 240-foot mixing zone, and whether TVA had ever had problems with the diffuser clogging. Paul Hopping said they had to do maintenance to close the opening at the end of the diffuser because it apparently had come open. When the diffuser end was open, the water flowed out the end of the diffuser rather than out the diffuser ports. They could see this in their temperature monitoring data. He indicated that they use a flow meter to determine the flow out of the plant. They use dye dilution tests and check the high flow and low flow cases.

Yellow Creek outfall. Paul pointed out where Yellow Creek enters the reservoir. This is where water that overflows the Yard Holding Pond (YHP) weir enters the river. Overflow has occurred three times since Unit 1 started operating – twice when the diffusers were closed for maintenance to close the end opening and once during an ice storm.

Temperature monitors. We saw the location of the temperature monitors at the downstream edge of the 2,000-foot mixing zone for the SCCW outfall. The sensors are spaced along a line perpendicular to the shore at the mixing zone edge. The temperature monitors are telemetered into the plant so that adjustments to the cooling system can be made if the limits are approached. They display in the control room, so the operators can see when the river temperature approaches the temperature levels specified in the NPDES permit.

October 7 – Meteorology Tour. PNNL and TVA toured the met tower.

October 7 – SCCW Intake Structure and Onsite Pond Tour. TVA, NRC, and PNNL aquatic ecology and hydrology staff toured SCCW Intake structure and site ponds. We entered the Watts Bar dam structure and were able to look at the intake structure which is built into the

upstream face of the dam. The intake openings are well below the water surface so we could not see them. We went into the screenhouse and looked at the traveling screens.

Sewage Treatment Plant. We first visited the location where the sewage treatment plant stood. The plant was torn down once the hookup to Spring City's STP was completed. The underground tanks have been filled with sand and gravel. Two system overflow tanks have been retained for use should they be needed.

Construction Runoff Holding Pond. This pond used to receive the sewage treatment plant outfall. However, now it just receives storm water runoff. TVA is monitoring the outfall from the pond with an ISCO sampler to demonstrate that the water represents storm water runoff only. The high levels of *e coli* seen at times are attributed to the deer and other mammals that live onsite, not to sewage treatment plant discharges.

Horseshoe Pond. This pond receives storm water runoff only. Originally it was a catfish raising pond. Jerri Phillips also pointed out the landfill onsite, a closed landfill and the closed evaporation percolation pond. The Evaporation Percolation Pond was last used in 1986 and was formally closed by the state in 1999 (the closure letter is listed below).

Yard Holding Pond, Low Volume Waste Pond, and Unlined Holding Pond. The YHP overflow weir is at 706.5 feet. Once water levels exceed that level, water flows out of the pond and discharges to Chickamauga Reservoir through Yellow Creek. The pond level is adjusted by opening the diffusers, and the pond has a capacity of 40 million gallons. Nearby is the Low Volume Waste Pond – this pond receives a number of waste streams and discharges continually to the YHP. It has an oil skimmer at the discharge. It can be isolated from the YHP with a valve on the outlet. There is also an unlined holding pond that is released to the Low Volume Waste Pond in batches. This pond receives a number of waste streams. On the day we drove by, glycol solution was being discharged to the pond from tanks on a truck.

October 7 – Transmission Line Tour. PNNL and TVA staff toured a portion of the transmission lines. They observed habitats underneath maintained transmission lines typical of the region, including open, grass-dominated areas maintained through grazing, agricultural fields, scrub-shrub, and early-successional forest. They discussed maintenance practices in sensitive areas.

Information Needs Tracking

NRC and PNNL staff prepared detailed information needs prior to attending the site audit. This list was discussed with TVA prior to the audit to give them the guidance on what information to have available. TVA staff were available to discuss the information needs and copies of references were available for NRC and PNNL staff to read at the audit. TVA was also provided with a partial list of documents that NRC would be requesting as part of the RAIs.

The status of information needs was tracked by PNNL by obtaining updated spreadsheet files from each team member. At the end of the audit, the status of the information needs was consolidated into a single file. NRC and PNNL discussed the status of each information need with TVA and indicated which issues would likely result in an RAI.

Summary of Issues or Concerns by Technical Discipline

Aquatic Ecology

TVA found that there were spots on the three traveling screens for the SCCW that had flow greater than 0.5 ft/sec. TVA performed an impingement study because the screens did not meet the 0.5 ft/sec EPA Phase II requirement for these screens. TVA did not perform an entrainment study since the EPA Phase II requirements did not require this for a reservoir of the size they are pulling from. We discussed the impingement study and the number of shad that were impinged. We also discussed the timing of studies on planktonic organisms, and Dennis indicated the most recent studies occurred in the 1980s.

We discussed the data and information available on the Chickamauga Reservoir and the changes that occurred in sampling methods over the years. TVA has a draft report that we have requested that discusses this data. In reference to our questions related to ichthyoplankton distributions near the Watts Bar site, Dennis Baxter suggested that the data from the recent ichthyoplankton studies in the vicinity of the Sequoyah plant (also on Chickamauga Reservoir) may be useful. We requested this data in an RAI.

Dennis Baxter confirmed that to date they have no plans to do post-operational monitoring of aquatic biota following the start-up of Unit 2. We requested confirmation of this in an RAI.

We also discussed the mussel surveys and results. Bo Baxter joined us at this point and we were able to establish that the headings in Appendix C of the TVA 2007 EIS had a mistake on them (one column is for the right descending Bank 527-0-528.6 R (1990) and the next column over is for the left descending bank at the same location. Further, it was explained that “Total” meant “total number of observations not total numbers of mussels.” Confirmation of this was requested in an RAI.

TVA discussed the interactions they had with the Fish and Wildlife Service and the habitat creation project they had performed downstream of Watts Bar Dam (related to the placement of boulders for a more stable habitat. They followed up this study with a written report. We requested the report in an RAI.

Cultural Resources

NRC has an action to follow-up with the SHPO to close-out the Section 106 process of the National Historic Preservation Act for the NRC licensing action.

General Information Needs/ Site and Technical Oversight

There were several issues identified that cross-cut into other subject areas and were therefore considered general. We requested RAIs to obtain a current update to the list of permits and authorizations and estimates of irreversible commitments of resources; to obtain information on projects and facilities within the region; and to obtain copies of all the references from the TVA 2007 EIS.

Hydrology

The TVA 2007 EIS does not reflect the extent to which the hydrology of the Watts Bar Site is understood. TVA provided a copy of a report prepared by ARCADIS titled “Groundwater

Investigation Report" to review at the audit. This report includes a much more up-to-date description of site hydrology than is included in the application. The document was prepared in response to the discovery of tritium in groundwater at the site and submitted to TVA in August 2004. It presents a description of groundwater occurrence and movement on the Watts Bar Site – including the impact of the French Drain/Groundwater sump surrounding the Power Block Area, the impact of unlined ponds onsite, and the impact of features that have altered the infiltration properties of the site and impacted groundwater. The report includes an up-to-date water table map that indicates flow directions (entire Watts Bar Site showing water table low at the Power Block Area and flow direction toward intake pumping station).

The document also describes advective transport of tritium on the site – including estimates of groundwater velocities and travel times to the Chickamauga Reservoir based on hydraulic conductivity estimates made by the author. These estimates include the impact of enhanced conductivity along pipelines and other structures. Sections of particular interest include:

- Section 3.1 talks about backfill materials being more transmissive than the engineered backfill providing a preferential transport pathway for contaminants that enter the groundwater.
- Section 3.2 describes groundwater flow directions on the site and how in the vicinity of the power block the French drain around the building creates a gradient toward the building. On the site tour with Jerri Phillips she explained that water pumped from the French drain sump is sent to the ponds before being discharged to the river. Beyond the influence of the French drain, water from the plant generally flows to the south and Chickamauga Reservoir.
- Section 3.7.1 discusses advective water movement – This section includes estimates of hydraulic conductivity, groundwater velocity and travel time to the river.
- Figure 3-2 is a water table map of the site showing the influence of the French drain and the recharge that occurs through the YHP. This would be a good figure to include in the EIS.

The application does not document the current situation for disposal of sanitary sewage from the Watts Bar Site. TVA confirmed that the sewage treatment plant is now gone and a pumping station exists at the location of the plant that pumps the sanitary sewer flow into the pipeline to the Spring City sewage treatment plant. TVA indicated that significant upgrades were done to the Spring City sewage treatment plant including extending the outfall from the plant to Watts Bar Reservoir. It had previously released to the embayment near Spring City.

TVA discussed current downstream water users drawing from the Tennessee River. They had prepared a table of groundwater and surface water users within 20 miles and users for a greater distance downstream. The following table is selected user information for intakes downstream and for the Watts Bar Utility District (groundwater). This information is a subset of the information TVA provided at the audit. We discussed the need for travel time to the downstream users and also dilution factors between the Watts Bar outfalls and the downstream intakes.

Water Supply	Distance from Site – miles	Average Daily Use – gallons	Source
Dayton Water Department	24.2	2,507,000	Surface TRM 503.8
Eastside Utility District	55.2	8,150,000	Surface TRM 472.85
Watts Bar Utility District	3.3	720,000	Groundwater

In addition, we discussed how many staff were onsite for normal operations of Unit 1 and how many were anticipated to operate both units. TVA indicated that 600 staff were onsite for normal Unit 1 operations and they expected 810 to be onsite in 2012 to support the operation of both units. There are currently 1,362 additional workers onsite for the Unit 2 construction and an additional 1,325 for the Unit 1 outage.

Additional information on the Yard Holding Pond discharge during the ice storm was provided to review at the audit. It is reported in OSN 102 Yard Holding pond overflow during an ice storm – 1996 PER 96VAN9606-WBN-1 2/4/96 to 2/5/96. Water was also released to the river through outfall 102 on two other occasions for maintenance of the diffuser.

We discussed the operation of the cooling basin bypass to cool the discharge water from the SCCW. TVA indicated they do not adjust the valve to the bypass frequently – they basically have two modes of operation – winter mode and summer mode. For winter mode, they open the cross-tie about November 1 and then close it about the end of April. The valve is opened 40% for the winter setting. Paul Hopping models the impact of water released to the river and tells operators when to open or close the cross-tie. System Operating Instruction 27.03 provides instructions for operating the SCCW and making these adjustments to system flows.

Radiological Health/ Transportation/Fuel Cycle/Decommissioning

TVA did not use the models required in the ESRP for calculating dose to the public from the gaseous and liquid pathways. In addition, it was not clear from the text in the TVA 2007 EIS (what we are considering the ER) what the input assumptions were for the models they did use. Because of this, PNNL will have to collect all the appropriate inputs to run these models. Applicant did not perform any analysis on dose to biota; therefore, PNNL will have to complete this activity also.

An appropriate technical staff person representing the applicant was not available to discuss the impacts to transportation; therefore, all information needs will have to become RAIs.

Meteorology

TVA did not use PAVAN and has not calculated 50% X/Q for site. PNNL has requested meteorological data in electronic format per SRP 2.7, RG 1.23., 50% X/Qs for use in the design basis accident analysis, and climatological summary of data collected by meteorological system.

Design Basis Accidents/Severe Accidents/Severe Accident Mitigation Alternatives

We discussed DBAs and the need for consistency between EIS (ER) and FSAR. Only difference should be X/Q values. EIS uses 50% and FSAR uses 95% values. FSAR X/Qs are same for Units 1 and 2. We requested sufficient information on DBAs to permit NRC staff to independently evaluate doses resulting from each DBA.

We discussed inconsistencies between various analyses including the 1995 NRC FES Supplement, TVA 2007 FEIS (ER), and Westinghouse SAMDA analysis. We discussed external initiating events and events while shut down. We need more information than what is currently in existing reports, in at least a qualitative discussion. We need consequence assessment for release category when containment holds. We need a discussion (qualitative) on basemat melt-through. We discussed sources for site-specific input to MACCS (WinMACCS) and requested MACCS input and output files. We requested MACCS code input

and output files for all release classes, including the class in which containment remains intact. We requested a discussion of the potential risks from severe accidents initiated by external events and while the reactor is shut down.

We discussed Westinghouse SAMDA and estimates for cost of implementing design alternatives (typically Bechtel estimates for change order). We requested a discussion of the extent to which the January 2009 Westinghouse SAMDA evaluation considers risks associated with external initiating events and events occurring while the reactor is shut down. We requested a discussion of the bases for the implementation cost estimates used to evaluate severe accident mitigation design alternatives in the January 2009 Westinghouse document.

Terrestrial Ecology

TVA confirmed that the Sensitive Area Review (SAR) process used at Watts Bar is identical to what is used at Bellefonte, and the SAR Process document provided for Bellefonte can be referenced for WBN Unit 2.