February 07, 2011

MEMORANDUM TO: Joseph Colaccino, Chief
EPR Projects Branch
Division of New Reactor Licensing
Office of New Reactors

FROM: Prosanta Chowdhury, Project Manager ***/RA/***
EPR Projects Branch
Division of New Reactor Licensing
Office of New Reactors

SUBJECT: FEBRUARY 15 THRU 18, 2011, AUDIT OF PSEG POWER, LLC AND PSEG NUCLEAR, LLC EARLY SITE PERMIT APPLICATION HYDROLOGY ANALYSES

By letter dated May 25, 2010, PSEG Power, LLC an PSEG Nuclear, LLC submitted the PSEG Site Early Site Permit (PSEG Site ESP) application to the U. S. Nuclear Regulatory Commission (NRC). The staff has begun reviewing the application and has identified a need to audit the methodology, analysis, calculations and modeling results in support of Section 2.4 (Hydrology) of the PSEG Site ESP application. The audit will take place at the PSEG's Energy and Environmental Resource Center in Salem, New Jersey, from February 15 through 18, 2011. A copy of the audit plan is enclosed.

Docket Nos.: 52-043

Enclosure:
As stated

CONTACT: Prosanta Chowdhury, NRO/DNRL
301-415-1647

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DISTRIBUTION:

| | |
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|---|---|---|---|---|---|
| **NAME** | PChowdhury | JMcLellan (via email) | JCaverly | RRaione | PChowdhury(s) |
| DATE | 02/03/11 | 02/04/11 | 02/07/11 | 02/07/11 | 02/07/11 |

**OFFICIAL RECORD COPY**

**PSEG SITE EARLY SITE PERMIT APPLICATION**
**HYDROLOGY AUDIT PLAN**

## A. Background

PSEG Power, LLC and PSEG Nuclear, LLC submitted ground and surface water modeling documentation to the Nuclear Regulatory Commission (NRC) as a part of their PSEG Site Early Site Permit (ESP) application. The staff reviewed the documentation within Section 2.4 of the Site Safety Analysis Report (SSAR) and identified information needs that would promote a better understanding of the detailed analyses and bases underlying the formal application.

The purpose of this audit is for the staff to review the ground and surface water models, supporting modeling documentations, and calculation packages. This audit will allow the staff to better understand the modeling results in order to make accurate safety conclusions concerning site characteristics and assess the radiological consequences of accidental releases to ground and surface water. It will also assist the staff in identifying any additional information that the staff may need during its review of PSEG Site ESP application.

## B. Regulatory Audit Bases

This regulatory audit is based on the following:

- NUREG 0800, "Standard Review Plan," Section 2.4
- RS002, "Guidance for Processing Applications for Early Site Permits"
- Regulatory Guide (RG) 1.206, "Combined License Applications for Nuclear Power Plants"

## C. Regulatory Audit Scope or Methodology

- The area of focus for the audit is the PSEG Site ESP application and supporting documentation.

## D. Information and Other Material Necessary for the Regulatory Audit

- ESP Application, Rev. 0, Section 2.4
- Information Needs (*See* Enclosure 1)

## E. Audit Team

The following are the audit team members:

Jill Caverly, NRC Audit Team Lead
Henry Jones, NRC Audit Team
Joseph Giacinto, NRC Audit Team
Richard Raione, NRC Audit Team
Chris Bender, Numark Associates
Patrick Lynett, USGS (TX A&M Univ)
Jason Chaytor, U.S. Geologic Survey
Keith Klaus, Brookhaven National Lab (BNL)
Mike Hauptman, BNL

Terry Sullivan, BNL
Prosanta Chowdhury, NRO Licensing Project Manager
Phyllis Clark, NRO Licensing Project Manager

**F. Logistics**

Date: February 15 - 18, 2011
Time: 8:30 a.m. – 4:30 p.m. (February 15 - 17)
8:30 a.m. – 12:00 p.m. (February 18)

**Location:** PSEG Nuclear Development
Energy and Environmental Resource Center
244 Chestnut St.
Salem, New Jersey

**G. Deliverables**

The audit team will issue a regulatory audit summary within 90 days after completing the audit.

**PSEG Site - Hydrology (Chapter 2.4) Review**
**Site Audit Information Needs**

| Serial No. | FSAR Section | Information Needs |
|---|---|---|
| **1** | 2.4 - General | Have available all HEC-HMS and HEC-RAS model data inputs and outputs files, executables, and source code. Have available a subject matter expert (SME) who is knowledgeable about the impact that the updated HEC-HMS Version 3.5 which was released by HEC in August 2010 will affect the application. Problems fixed by release of Versions 3.4 and 3.5 are identified in the Release Notes. HEC-RAS 4.0 has been superseded by Version 4.1 released in January 2010. Fifty problems in HEC-RAS 4.0 were fixed in Version 4.1. Have available an SME who is knowledgeable about how the simulations may have been effected by the revised versions of HEC-HMS and HEC-RAS. |
| **2** | 2.4 - General | Have available an SME who is knowledgeable about the applicability of adding water elevations at the site from various hydrologic events. The SME should be knowledgeable on whether this is appropriate considering that the hydrodynamics in the bay, as well as in the river, are generally nonlinear. The nonlinear effects may be included by using the stage boundary conditions on HMS, if this boundary condition is appropriate, but it would seem that an estuary model would be needed to evaluate the combined effect of the high tide and the probable maximum flood (PMF) or dam breach flow, or the low tide and negative surge. |
| **3** | 2.4 – General | Have available an SME who is knowledgeable about the differences between the parameters used in the models including flood routing parameters, roughness coefficients, routing coefficients used in the recently published flood model of the Delaware River. Ref: HEC Project report 73, 2010. http://www.hec.usace.army.mil/publications/ProjectReports/PR-73.pdf |
| **4** | 2.4 – General | Have available an SME who is knowledgeable about the roughness coefficients. Given the extreme flows estimated during the PMF or following a dam breach, SME should be knowledgeable on whether lower roughness coefficients would be more conservative. The SME should also be knowledgeable on whether literature values used are representative of extreme high flow conditions in floodplains and natural channels. |
| **5** | 2.4 - General | Have available the digital elevation map (DEM) dataset used for development of the HEC-RAS model. Make available horizontal spatial resolution (10 m, 30 m, 100 m?). Have available an SME who is familiar with the impact of LIDAR dataset and the effects on the HEC-RAS model. |
| **6** | 2.4.1.2.1 | Have available an SME who is familiar with the sentence on tidal flow at PSEG being between 400,000 and 420,000 cfs and with further qualification of the statement. Have available the pages from which the references on this are based. |

| Serial No. | FSAR Section | Information Needs |
|---|---|---|
| **7** | 2.4.1.2.7 | Have available an SME who is familiar with other effects that may contribute to the apparent “sea level rise” including global climate warming, subsidence due to groundwater pumping, and subsidence near a region subject to glacial isostatic rebound. |
| **8** | 2.4.1.3 and other sections | U.S. Geological Survey (USGS) gage station numbers in this area all start with “014” but the significant leading zero is frequently omitted in the report. Have available an SME who is knowledgeable about the gage station numbers to assure the proper data are referenced. |
| **9** | 2.4.1.3 and other sections | Gaging station names are frequently given as “Delaware River near Callicoon, NY,” whereas the official name is “at Callicoon.” The station name “near Callicoon” is a different gage. Have available an SME who is knowledgeable to verify or provide correct gaging station names. |
| **10** | Table 2.4.1-3 | Have available an SME who is knowledgeable about the column labeled “established” and whether this should include footnote or something to indicate that the tide gage records are not continuous from that date. The SME should also be knowledgeable on the period of record for tide gage records. |
| **11** | Table 2.4.1-4 | Have available an SME who is knowledgeable about period of record used for other statistics in table. |
| **12** | Table 2.4.1-5 | Have available an SME who is knowledgeable about gage datums and the conversion method used. |
| **13** | Table 2.4.2-2 | Published peak gage heights for this gage are to NGVD of 1929 but were apparently converted to NAVD of 1988. Have available an SME who is knowledgeable about conversion method used. |
| **14** | 2.4.4 | Have available an SME who is knowledgeable about the reason why a sediment transport model not used to predict sediment transport, erosion, deposition and resuspension during the design dam failures. |
| **15** | 2.4.4 | Have available an SME who is knowledgeable about the basis for assuming that sediment deposition from failure of very large dams in the upper Delaware River basin is insignificant. |
| **16** | 2.4.4 | The report indicates that the 3 New York reservoirs hold 68 percent of the available volume. Have available an SME who is knowledgeable about the basis for developing the scenarios, for example, not including the failure of Neversink in Scenario 1. |
| **17** | 2.4.4 | Have available an SME who is knowledgeable about the known history of sediment transport in the bay at the reactor site |
| **18** | 2.4.4 | Have available an SME who is knowledgeable on how the computed flows during dam failure Scenario 1 compare to recorded floods. |
| **19** | 2.4.4 | Figure 2.4.4-1. Have available the digital Geographic Information System (GIS) data used to generate the figure. |
| **20** | 2.4.4.2 | The combined scenario includes dam breach and one half of the 500-yr flood. The effect of the flood is modeled as a stage boundary |

| Serial No. | FSAR Section | Information Needs |
|---|---|---|
| | | condition for HEC-RAS. Have available an SME who is knowledgeable about the results of this analysis and the reasoning behind the conceptual model used. |
| **21** | 2.4.4.7 | Have available an SME who is knowledgeable to verify that Reference 2.4.4-18 is available online at http://pubs.usgs.gov/of/2008/1203/. |
| **22** | 2.4.4.7 References | Reference 2.4.4-13 is not accessible online as of January 14, 2011. Access to this reference is needed. |
| **23** | Table 2.4.6-1 | The columns titled, "City, Lat, and Long," describe the location of cause of the tsunami and not the location where damage from the tsunami occurred. The fourth tsunami listed is for High Bridge, NJ, which has a ground elevation of 250 ft, well above any tsunami effects. Have available an SME who is knowledgeable to provide clarifying discussion of the table. |
| **24** | 2.4.7 and other sections | Have available an SME who is knowledgeable about usage and consistency of the terms peak elevation, maximum water level, and water surface elevation (WSEL). |
| **25** | 2.4.7.1 | To support findings of historic ice jams, reference to USACE CRREL Ice Jam Database is needed. |
| **26** | 2.4.7.1 | Have available an SME who is knowledgeable about datum used for maximum gage height value of 22.8 ft and conversion used to arrive at 29.6 ft NAVD for 01463500 gage. USGS data lists 30.6 ft NGVD 29. |
| **27** | 2.4.7.1 | Have available data/plots to support claim that Delaware River at Trenton, NJ (USGS 01463500) rose 12 ft in 10 hours in January 1996 from ice jam. |
| **28** | 2.4.7.2.1 | Have available data/datum for peak stage at Delaware River at Trenton, NJ (USGS 01463500) for January 1996. Text indicates 21.2 feet. |
| **29** | 2.4.7.1 | Have available source of meteorological data for the PSEG Site. |
| **30** | 2.4.7.1 | Have available the USGS streamflow gaging station numbers for stations listed in the text. |
| **31** | 2.4.7.1, 2.4.7.2, and 2.4.7.2.2 | Have available an SME who is knowledgeable on examples of low water issues or potential issues as a result of ice jams within the Delaware River Basin. |
| **32** | 2.4.7.2.1 | Have available data for average elevation at the Reedy Point National Oceanic and Atmospheric Administration (NOAA) tidal gage to compare with the peak elevation listed in the text. |
| **33** | 2.4.7.2.1.1 | Have available an SME who is knowledgeable about the input variables into the USACE HEC-RAS model. For example, is the average spring flow the same as the average April base flow, as input into the model simulation? |
| **34** | 2.4.7.2.1.1 | Have available data or reference to verify existing ground slope at the new plant location and surrounding areas. |

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| **35** | 2.4.7.3 and 2.4.7.4 | Have available an SME who is knowledgeable about the reference to the protective measures that will be implemented at the new plant site for situations where the water may freeze at the intake if safety related. |
| **36** | 2.4.7.4 and 2.4.7.1 | Section 2.4.7.4 and Table 2.4.7-2 mentions thickness and concentration of ice at the PSEG Site during the period of record from the 1998/1999 winter to the 2004/2005 winter. Section 2.4.7.1 mentions historic ice observation at the PSEG Site for the period of record from the winter of 1998 to the winter of 2003/2004. Have available an SME who is knowledgeable to verify the period of record used in each section and provide and explanation why each was used |
| **37** | Ref 2.4.7-7 | URL for reference leads to a blank web page; updated or new URL is needed. |
| **38** | Ref. 2.4.7-29 | Have available an SME who is knowledgeable on which dataset was accessed for use in the analysis. |
| **39** | Ref. 2.4.7-4 | URL listed for this reference does not work, try http://www.natice.noaa.gov. Verification of URL is needed. |
| **40** | Table 2.4.7-1 | Have available an SME who is knowledgeable about data and clarification of peak gage-height at Delaware River at Trenton, NJ (USGS 01463500) listed in the table for March 1904. Table indicates 22.8 feet, with no datum listed. |
| **41** | Table 2.4.7-1 | Have available an SME who is knowledgeable about table header labeled "Gage Number," which should indicate if this is for USGS streamflow gaging stations. |
| **42** | Table 2.4.7-2 | Have available an SME who is knowledgeable on the definition of the term thickness code. |
| **43** | 2.4.6.4 | Have available a knowledgeable SME along with the documentation for the following:<br>• The input parameters for the MOST model for each of the cases selected<br>• 2D image of initial conditions (sea surface at t=0) for each simulated source<br>• Results of all model runs conducted in the form of representative time series and instantaneous sea surface elevation maps at four or more different times (e.g., 2D contour map @t=30 min, t=1 hour, etc.) within and offshore of Delaware Bay |
| **44** | 2.4.11 | Have available an SME who is knowledgeable about channel depth or provide figure or elevation of thalweg near plant site. |
| **45** | 2.4.11.1 | Have available link (or reference to another section) for data at Reedy Point, and Lewes, DE stations, and document length of record at Lewes, DE. |
| **46** | 2.4.11.1 | Have available an SME who is knowledgeable about rationale for using 90 % exceedance low-tide for 22-year record at Reedy Point, including other gages which may have longer record. |

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| **47** | 2.4.11.1 | Have available minimum recorded water level at Lewes, DE gage for the 1962 low water event. Have available an SME who is knowledgeable on comparison to observed negative surges associated with hurricanes. |
| **48** | 2.4.11.1 | Have available an SME who is knowledgeable on length of record used from Lewes gage in estimating (interpolating) 90% exceedance low-tide at plant site. |
| **49** | 2.4.11.2.1 | Have available an SME who is knowledgeable on length of record from Lewes gage used for model boundary. |
| **50** | 2.4.12.1.1 | Have available an SME who is knowledgeable on approximate elevations and depths of the geologic sequence on site as described on page 2.4-135 and shown in Figure 2.4.12-1. |
| **51** | 2.4.12.1.1 | Have available an SME who is knowledgeable on recharge rates to the aquifers including recharge rates to the deeper aquifers, travel times for surficial recharge to reach the deeper aquifer system, and vertical hydraulic conductivity values. |
| **52** | 2.4.12.1.1 | Have available an SME who is knowledgeable about the potential for offsite pumping wells to impact the groundwater flow system at the site, and how possible future uses of offsite groundwater could affect plant operations. |
| **53** | 2.4.12.1.1<br>2.4.12.1.2 | Have available an SME who is knowledgeable to clarify the seemly conflicting descriptions on page 2.4-135 where groundwater is indicated to be encountered within 10 to 20 feet below ground surface (bgs) on site, and on page 2.4-136 where groundwater is indicated to be encountered within 5 to 10 ft bgs on site. |
| **54** | 2.4.12.1.1 | Have available an SME who is knowledgeable about potential future uses of groundwater in the region. |
| **55** | 2.4.12.1.1 | Have available maximum design precipitation rate and the allowable site water level (e.g., maximum allowable flood or tsunami surge level and maximum allowable ground water level). |
| **56** | 2.4.12.1.2.2<br>through<br>2.4.12.1.2.14 | Have available an SME who is knowledgeable on hydrogeologic parameters for the units described in Sections 2.4.12.1.2.2 (Alluvium) through 2.4.12.1.2.13 (Merchantville Formation). The only unit discussed in detail was the Potomac Raritan Magothy (PRM) Formation" (Section 2.4.12.1.2.14). |
| **57** | 2.4.12.1.1 | Have available an SME who is knowledgeable about effects of seismic and non-seismic information on the postulated worst-case groundwater conditions for the proposed plant site. |
| **58** | 2.4.12.1.3.7 | Have available an SME who is knowledgeable about: (1) the connection between river hydrographs, and the water levels measured in wells on the western side of the site (Wells 1L, 1U, 3U, 3L) and the hydraulic communication between the river and the hydrologic layers; and (2) the hydrogeologic connection mechanism for upward/downward trend in well hydrographs for the alluvium (Figure 2.4.12-23 and 24) and if the model in this region is in agreement with the observed horizontal and vertical gradients. |
| **59** | 2.4.12.2 | Have available an SME who is knowledgeable to clarify which of the following two statements on groundwater usage by the new plant is correct. Section 2.4.12.2 states, "Based on the plant parameter envelope (PPE), the new plant will use up to 309 million gallons |

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| | | per year (mgy)." Section 2.4.12.3.2 states that, "The groundwater withdrawal based on the plant parameter envelope (PPE) for the new plant is 210 gpm, which equals 110.4 my." It further states that the withdrawal for all three plants is 309. |
| **60** | 2.4.12.4.3.1 | Have available an SME who is knowledgeable about the detail development of the groundwater flow model, the integration of the previous site model, existing regional studies and site specific parameters and data, and discuss the model simulations and calibration including the impacts of boundary conditions on model accuracy. |
| **61** | 2.4.12.4.3.1 | Have available an SME who is knowledgeable about the hydraulic properties of the construction fill. |
| **62** | 2.4.12.3.2 | Have available an SME who is knowledgeable on the horizontal and vertical model grid cell sizing and associated numerical accuracy of the model simulations for the 1988 Dames and Moore study Section 2.4.12.3.2 and the more recent Dewatering Study (Section 2.4.12.4.1.1). |
| **63** | 2.4.12.1.3.5 | Have available an SME who is knowledgeable about the assumptions used for conservative modeling of flow velocity such as the assumptions extending to the hydraulic conductivity, porosity, and hydraulic gradient (Section 2.4.12.1.3.5). Note that porosity values were not reported in the tables of Section 2.4.12 as were other hydrogeologic parameters. |
| **64** | 2.4.12.2.1 and 2.2 | Have available an SME who is knowledgeable about local and regional, and plant groundwater use including the characterization of superposition of pumping influences on drawdown, water levels and flow directions. |
| **65** | 2.4.12.3 | Have available an SME who is knowledgeable about supply wells for the proposed plant and whether existing wells are to be used or if new supply wells are planned. |
| **66** | 2.4.12.3.2 | Have available an SME who is knowledgeable on:<br>(1) why 1988 modeling results for water withdrawals are adequate for the proposed new plant (Section 2.4.12.3.2) and if updates to the model are warranted given information from recent field studies<br>(2) whether existing production wells are to be used for water supply and if not, address the impacts of the proposed new well locations on groundwater flow, vertical gradients, and transport pathways. |
| **67** | 2.4.12.3 | Have available an SME who is knowledgeable on how the 1988 modeling results for the period of 1987 through 2007 compare to groundwater monitoring results for flow and salinity. The SME should be knowledgeable regarding the additional water withdrawals that will be required for the new plant. |
| **68** | 2.4.12.4.1.1 | Have available an SME who is knowledgeable about how various site specific hydro-litho logic units are defined, particularly the distinction between the aquifer units. The SME should be knowledgeable regarding the importance/influence of holes in confining units beneath the footprint of the site including the impacts of these holes (if any) on dewatering. |

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| **69** | 2.4.12.4.1.2 | Have available an SME who is knowledgeable about groundwater model calibration and clarify how the 2009 data were used within the modeling effort. |
| **70** | 2.4.12.4.1.4 | Have available an SME who is knowledgeable about potential impacts of aquifer dewatering on existing site structures including the potential for compaction. |
| **71** | 2.4.12.4.1.4 | Have available an SME who is knowledgeable about why 2005 hydraulic head data (which showed water table elevations several feet higher than other times in the period of 2000 through 2009, Table 2.4.12-6) were not used in any bounding analyses for dewatering or hydrostatic loading. |
| **72** | 2.4.13.1.1 | Have available an SME who is knowledgeable on how tidal influences from the Delaware River have been taken into account to support the premise that the predominant groundwater flow in the Alluvium and the Vincentown are west towards the Delaware River. |
| **73** | 2.4.13.1.1 | Have available an SME who is knowledgeable about the hydrologic basis for the apparent groundwater divide in the marshes that result in the predominant groundwater flow towards the east in the eastern portions of the site over the period of record. |
| **74** | 2.4.13.1.2 | Have available an SME who is knowledgeable about why a release to the Delaware River at western edge of the site is considered the most conservative scenario, while it appears that a release to the marsh in the east would receive less dilution than western release to the river and therefore would be a more conservative scenario. |
| **75** | 2.4.13.1.2 | Have available an SME who is knowledgeable about the bounding concentrations of the release scenario and the derivation of these concentrations. |
| **76** | 2.4.13.1.3 | Have available an SME who is knowledgeable about the impact of Delaware River dredging next to the shoreline on the net groundwater discharge to the river and associated gradient in the Alluvium, and the potential for enhanced tidal influence on groundwater levels in the Alluvium due to the dredging. |
| **77** | 2.4.13.1.3 | Have available an SME who is knowledgeable about the release scenario assuming direct discharge to the Alluvium and why the discharge is to the Alluvium rather than the construction fill, and the potential for tidal action to significantly enhance a release discharge volume within the fill and Alluvium. |
| **78** | 2.4.13.1.3 | Have available an SME who is knowledgeable about the level of confidence regarding the maximum groundwater velocity given the length of the data record. |
| **79** | 2.4.13.1.4 | Have available an SME who is knowledgeable regarding the characterization of the postulated release volume. |
| **80** | 2.4.13.1.4 | Have available an SME who is knowledgeable on why the radionuclides of concern do not generate fractions that need to be considered. |
| **81** | 2.4.13.1.6 | Have available an SME who is knowledgeable about structures and post-construction flow paths in more detail, the decrease in infiltration rates as related to hydraulic gradients in the Alluvium. The SME should be knowledgeable regarding how water table elevations were used to verify that discharge would be to the |

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| | | Alluvium and not the shallower fill deposits and if a lower velocity assumption in the Alluvium is justified. |
| **82** | 2.4.13.1.6 | Have available an SME who is knowledgeable about the analysis results presented in tabular form (Tables 2.4.13-2 and 2.4.13-4). |
| **83** | 2.4.13.1.7 | Have available an SME who is knowledgeable about:<br>(1) Details of groundwater flux determinations<br>(2) The methods of analysis, results and tabular summaries (Tables 2.4.13-3 and 2.4.13-5)<br>(3) Dilution factor derivations<br>(4) The specific factor by which the concentrations of each radionuclide would be lessened due to the retardation<br>(5) The determination of a tidally-influenced mixing zone |
| **84** | 2.4.13.1.8 | Have available an SME who is knowledgeable about:<br>(1) The exceedance of unity by the sum of fractions without dilution or adsorption that is based solely on Cs-137. This one radionuclide is driving the analysis at 123,000 times its EFFLUENT CONCENTRATION LEVEL (ECL) without any additional safety factor. The SME should be knowledgeable regarding why an additional factor of safety should not be provided for in the analysis.<br>(2) The estimated rate of hypothetical release to the river requiring only 112 cfs flow to reach a sum of fractions for all radionuclides to be less than one and how the estimated rate of release to the river was calculated or if this flow rate is a concentration-based estimate.<br>(3) Justification of utilizing 2/3 of the entire Delaware River flow to estimate maximum dilution concentrations.<br>(4) The details of the estimated results including retardation effects, if the numerical results are tabulated, and the development of Section 2.4.13.1.8. |
| **85** | 2.4.13.1.9 | Have available an SME who is knowledgeable about the following:<br>(1) Section 2.4.13.1.9 (Potential Migration to Deeper Aquifers) and the assumption that radionuclides enter the Vincentown Formation and travel towards the Delaware River. The SME should be knowledgeable regarding justification for flow in the Vincentown being always toward the river even from a potential release on the east side of the power block and why is easterly migration not expected.<br>(2) Why the analysis is considered less conservative than the Alluvium because of longer transport time to the river and greater formation thickness to provide dilution. The SME should be knowledgeable about why the entire Vincentown formation thickness would be available for infiltration from the overlying Alluvium.<br>(3) Why one part of the narrative says the Vincentown outcrops in the river and another part says that contaminants would need to migrate through the Kirkwood Aquitard and Alluvium to reach the river.<br>(4) Why the analysis for the Alluvium is considered more conservative than for the Vincentown and if this conclusion |

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| | | based on the nominal travel times.<br>(5) In more detail the statement that the rate of induced downward migration would slow in the event of a release.<br>(6) How dilution of radionuclide concentrations in a pumping well to less than detectable levels is compliant with requirements. |
| **86** | 2.4.13.1.10 | Have available an SME who is knowledgeable about the potential for easterly migration in the Alluvium and the Vincentown. |
| **87** | 2.4.12/13 | Have available the following calculation packages:<br>• Digital copies of groundwater flow model input and output files in native formats with explanations of data and formats.<br>• Digital copies of files used for radionuclide transport analysis in native formats with explanations of data and formats.<br>• Digital copies of input and output files used for the aquifer test analysis in native formats with explanations of data and formats.<br>• Digital copies of laboratory distribution coefficient analysis results and a map showing site locations of samples submitted for analysis. |

**Additional information needs**

**Section 2.4.6.1 (Historical Tsunami Record):**
1918 Puerto Rico Tsunami (SSAR 2.4.6.3)

- Have available an SME who is knowledgeable about what they consider to be the source fault(s) for the 1918 Puerto Rico earthquake and provide additional information about the tsunami, its source generator and it relevance with regard to tsunamis from this region that may affect the site. It is stated that the 1918 earthquake occurred within the Puerto Rico Trench and that it was responsible for the tsunami. It is believed that the earthquake actually occurred in the Mona Passage or just north of it and that a landslide likely contributed to the tsunami.

Paleotsunami deposits (Missing from SSAR)

- Have available an SME who is knowledgeable about whether there is any geologic evidence of tsunami deposits at the PSEG site or at nearby regions, such as from borings or other subsurface information collected by the applicant. Cross-reference with Section 2.5 of the SSAR is needed where applicable. Additionally, the SME should be knowledgeable regarding whether there are geologically conducive locations for the deposition and preservation of tsunami deposits in the vicinity of the PSEG site. If such paleo-tsunami evidence exists, the SME should be knowledgeable on how they are distinguished from storm wash-over deposits.

**Section 2.4.6.2 (Probable Maximum Tsunami):**
Local Slope Stability (SSAR 2.4.6.2 1st Paragraph)

- Have available an SME who is knowledgeable about evaluation of the stability of local slopes. The applicant states, "...the occurrence of locally-generated waves due to subaerial or submarine landslide events is unlikely. Figure 2.4.6.1 shows that the slopes near the PSEG site are largely in the range of 1(vertical):500(horizontal)." This way of stating slope is confusing, as it sounds like it is saying the slopes are in a range between vertical and horizontal. T he range given on the Figure 2.4.6.1 is 0-2 degrees, and many of the slopes are at the maximum of the color scale, making it somewhat unclear if the slopes are actually higher (there appear to be some slopes greater than 2 degrees in the region). Have available a better figure to support the applicant's conclusion. Also, the conclusion is based on the assumption that a 2 degree slope is insufficient to allow for a landslide to initiate: have available evidence to support this contention.

Other Regional Landslide Sources (Missing from SSAR)

- Have available an SME who is knowledgeable about why other submarine landslides along the U.S. East Coast and the Caribbean were not considered as PMT sources. (Currituck is the only one discussed.)

Activity of Offshore Portugal Seismic Zone (SSAR 2.4.6.2 2nd Paragraph)

- Have available an SME who can explain what the applicant means by "inactive" as applied to the seismic zone offshore Portugal. This is an important consideration with regard to the historical tsunami record and tsunami generating potential from that region.

**Section 2.4.6.4 (Tsunami Analysis):**

Verification of Model (SSAR 2.4.6.4 1st Paragraph)

- Have available an SME who is knowledgeable about whether the applicant ran simulations and compared their results with results using a different test source than the ones described in the SSAR. Have available results and figures of the verification experiment.

Appropriateness of Shallow Water Wave Models (SSAR 2.4.6.4.1)

- Have available an SME who is knowledgeable regarding the appropriateness of using a model (MOST) based on the non-linear shallow water equations to simulate landslide-generated tsunamis which may be weakly dispersive.

Water Levels for Bottom Friction Experiment (SSAR 2.4.6.4.1 and 2.4.6.4.5)

- Have available an SME who is knowledgeable about the discrepancy between the water levels shown in Figure 2.4.6-2 with the water levels stated in the last paragraph of Section 2.4.6.4.5

Input Parameters and Results for all Water Level Models (SSAR 2.4.6.2)

- Have available all input parameters to the MOST model for each of the cases selected. Have available results of all model runs conducted in the form of representative time series and wave amplitude maps within and offshore of Delaware Bay.

Determination of Simulation Time (SSAR 2.4.6.4.4)

- Have available an SME who is knowledgeable about whether the "simulation time" listed in Tables 2.4.6-3, 2.4.6-4, and 2.4.6-5 are real elapsed time (starting from tsunami generation) or computational run times. If the former, the SME should be knowledgeable on justifying the values chosen with regard to the tsunami-seiche set up in Delaware Bay that has a dominant period of 250 min (more than 4 hours) as suggested by Table 2.4.6-6.

Sensitivity Experiments for Atlantic Marin Landslides (SSAR 2.4.6.4.5 2nd Paragraph)

- Have available an SME who is knowledgeable on the details on the source characteristics of additional events analyzed north of the Currituck landslide, and whether the applicant is using the Currituck parameters. If a Currituck source is used for these events, the SME should be knowledgeable on justification for using these characteristics along an adjacent, but potentially geologically/geomorphically different section of the margin. Have available results for all the model runs conducted.

Landslide Initial Conditions (SSAR 2.4.6.4.5 and 2.4.6.4.6)

- Have available an SME who is knowledgeable on details of the equations used to specify the landslide tsunami initial conditions. Have available all input parameters to those equations and discuss with respect to their conservativeness.

Effective Filtering of Delaware Bay (SSAR 2.4.6.4.5 3rd Paragraph, 2.4.6.4.6 1st Paragraph, and SSAR 2.4.6.4.7 3rd Paragraph)

- Have available an SME who is knowledgeable about the statement that the Delaware Bay filters the high frequency components. Physical justification is needed to ensure that the model is not unrealistically damping these components. The high frequency components may be especially important to the predicted velocities, which are used to discount erosion and deposition near the intake in Section 2.4.6.7.

Effects of Sea-Level Rise (Missing from SSAR)

- Have available an SME who is knowledgeable about whether the effects of long-term sea-level rise were included in the water-level calculations for tsunamis. If so, have available the values estimated for long-term sea-level rise. If not, the SME should be knowledgeable about any justification for why sea-level rise is not included in the analysis.

Exceedance High Tide for La Palma and Hispaniola Sources (Missing from SSAR 2.4.6.4.6 and 2.4.6.4.7)

- Have available an SME who is knowledgeable about whether 10 percent exceedance high tide is included in the analysis for all sources, owing to the fact that the estimated water levels are similar for each of the three sources considered, as indicated in Table 2.4.6-6.

Hispaniola Earthquake Source Parameters (SSAR 2.4.6.4.7 2nd Paragraph)

- Have available an SME who is knowledgeable about how the Hispaniola earthquake source parameters listed in Table 2.4.6-2 were determined.

Description of Refractive Redirection of Waves (SSAR 2.4.6.4.7, 3rd Paragraph)

- Have available an SME who is knowledgeable about where the refractive effect that redirect waves away from Delaware Bay takes place. Have available results in the form of wave amplitude maps outside of Delaware Bay as discussed previously.

**Section 2.4.6.7 (Effects of Sediment Erosion and Deposition):**

Erosion and Scour Effects on Intake Structure (Missing from SSAR 2.4.6.7)

- Have available an SME who is knowledgeable about the expected effects of tsunami-related erosion with specific reference to intake structures within the plant envelope, and whether the effects of 10 percent exeedance tidal currents considered in the analysis of erosion and scour. Have available an indication of the substrate where the intake structure would be located.

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