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

Serial No.	SSAR Section	Information Needs	Action
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 HEC-RAS 4.0 has been superseded by Version 4.1 released in January 2010.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. Staff notes: The staff requests that the HEC model input files submitted to docket for staff use in verification. Upgraded versions have been reviewed by applicant. No effects to HMS model. HEC RAS upgraded version affected time step for dam break. RAS was not used in dam break analysis Section 2.4.4. It was used in 2.4.7 to simulate the break of an ice dam. The intervals were not affected by changes in the program. There was no effect to RAS model used in 2.4.5. The change to the RAS model affected the time steps if about 30 minutes or more. The applicant used 10 to 30 second time steps in its analysis. RAI will be issued by the staff requesting DSS files	**RAI** - (Possible combined RAI for No. 5 (DEM files), No. 19 (GIS files for Fig 2.4.4-1), and all HEC-RAS/HMS related files
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. Staff Notes: See Table 2.4.4-5 – non-linear effects are shown in this table. 10 % exceedence is the result of the RAS run. RAS Model - Processes include: tides, (calibrated to a low flow event), flood events (calibrated northern section of model), precipitation events… will check on PMP or 500 year. One scenario is 500 year and dam break. The applicant verified the model is split into two separate runs – one simulates dam breach, second simulates surge/storm.	**No further action at this time.**

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		The staff will review the applicability of the RAS model for the physical characteristics of the site and the estuary. The model is calibrated to normal conditions Wind effects addressed separately. Surge was modeled (Bodine model) to mouth of bay. Surge propagated to site by RAS model (See Section 2.4.5, page 2.4-67)	
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 Staff Notes: Staff notes that the model was used for flood studies not for review public water supply. HEC Ressim used two types of routing Muskingum and lag. The applicant used manning value to calibrate their version of model. The staff will review studies and HMS model. Review may generate future RAI depending on staff's conclusion.	**No further action at this time.**
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. Staff Notes: TR-55 and Chow were used to develop manning n, calibrated the models using the manning number. Calibrated to recent floods for hydrographs at existing gaging stations. Reddy Point was generally calibration target. Other sites used depending on model. First calibration to tides, generally low Manning's number used to amplify tide through estuary. Therefore, lower Manning's numbers were required to replicate tide. See Section 2.4.3.1.1.3 page 2.4.-39 Possible RAI, staff will review section.	**No further action at this time.**

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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. Staff Notes: RAI will request DEM data. The applicant has incorporated all data including bathymetry data.	RAI under Serial No. 1
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 472,000 cfs and with further qualification of the statement. Have available the pages from which the references on this are based. Staff Notes: Reference from US COE report. Additional context is needed to clarify statement. Clarify that tidal flow greatly exceeds stream flow. Additional citation would clarify.	**Open – applicant will revise application.**
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. Staff Notes: Sea level rise in 2.4.5. Section 2.4.12 states no evidence of significant gw subsidence in the area. Section 2.4.5.4 would be clearer if it was updated to include additional information to strengthen section by adding statements regarding subsidence, isostatic rebound.	**Open – applicant will revise application**
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. Staff Notes: Leading "0" missing. The applicant noted this. Section would be clearer if the section is revised.	**Open – applicant will revise application**
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. Staff notes: Clarification needed, the applicant will revise in next version.	**Open – applicant will revise application**
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.	**Open – applicant will revise application**

Serial No.	SSAR Section	Information Needs	Action
		Staff Notes: Record is not continuous, footnote would help clarify. An additional column with period of record would be useful.	
11	Table 2.4.1-4	Have available an SME who is knowledgeable about period of record used for other statistics in table. Staff Notes: Add time period to table for clarification.	RAI
12	Table 2.4.1-5	Have available an SME who is knowledgeable about gage datums and the conversion method used. Staff Notes: Conversion of datums not discussed. Additional discussion of conversion needed in text/footnote or other. Column “elevation” is unclear, rename to “gage datum elevation.”	RAI
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. Staff notes: See Resolution No. 12	Closed – based on RAI response to Serial No. 12
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 re-suspension during the design dam failures. Staff notes: The applicant used Stokes law. The conclusion of the analysis was that the sediment particles will drop out prior to reaching the site. The staff notes that a sediment model was not used. The applicant looked at closest channels and effects of deposition at the safety related intakes. RAI will be issued. Describe and support assumptions for sediment transport analysis. (References may support analysis or may require sed transport model).	RAI
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.	Closed – based on RAI response to serial no. 14

Serial No.	SSAR Section	Information Needs	Action
		Staff Notes: See response to No. 14	
16	**2.4.4**	The report indicates that the three New York reservoirs hold 68 % 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. Staff Notes: The applicant looked at various scenarios for breach of dams and verified the time for the flood wave to get to the site. RAI will be issued requesting additional discussion of the process used to eliminate the risk of flooding due to the failure of the nearby dams. The staff questioned whether time interval used to eliminate flood threat is not conservative enough and that the combined events should be considered. Combined floods should be added to the FSAR for clarity. Possible RAI - Additional RAI may request justification for dam breaches and conservatism of the scenarios.	**RAI**
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. Staff Notes: The applicant researched recent studies for sediment transport. Some recent references by Cook, Wong - See “references” in Section 2.4.5. The staff requested dredging information for HC maintenance. SAR may contain info. Applicant Action Item… The applicant will add discussion about references and other dredging maintenance information.	**Open - Pending applicant action**
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. Staff Notes: The staff will verify in its confirmatory analysis and the data provided in No. 1.	**No further action – staff will review**
19	**2.4.4**	Figure 2.4.4-1. Have available the digital Geographic Information System (GIS) data used to generate the figure. Staff Notes: RAI will be requested for this figure.	**Closed – RAI response in Serial No. 1.**

Serial No.	SSAR Section	Information Needs	Action
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 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. Staff Notes: Propagated up bay, tidal influence, added 500 year, added dam breach. Figure 2.4.2-7 – Revise reference to PMF on figure. Applicant action item to clarify process for selecting dam breach combinations.	**Open – applicant will revise SAR**.
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/. Staff Notes: FSAR does not reference the online address. Applicant action item. Will add on line reference to SAR.	**No further action required at this time**.
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. Staff Notes: Coastal Engineering Manual pdfs should be added to electronic reading room.	**No further action required at this time.**
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. Staff Notes: Clarify table header. "City" is unclear look at original source for headings.	**Open – Applicant will update SAR**
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). Staff Notes: Terms were used interchangeably and should be clarified in next version of application.	**Open – Applicant will update SAR**
25	**2.4.7.1**	To support findings of historic ice jams, reference to USACE CRREL Ice Jam Database is needed. Staff Notes: Ref 2.4.7-15. The staff will attempt to access and verify data.	**No further action required at this time**.

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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. Staff Notes: Conversion process for datum not clear. Additional details should be included in FSAR. 1904 gage height + 7.77 ft NGVD +22.8 = 30.57ft NGVD converted to 29.6 ft. NAVD	RAI response in Serial No. 12
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 Staff Notes: Ice jam database discussed general area not specific to the Trenton, NJ area. FSAR suggests that the rise occurred at Trenton. Either clarify or remove statement or add specific data.	Open – Applicant will revise SAR
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. Staff notes: Datum is NAVD. The staff will research with USGS.	No further action at this time.
29	2.4.7.1	Have available source of meteorological data for the PSEG Site. Staff Notes: Met tower data on site. No reference specifically available. PSEG met data available on site. Source may be available under annual REMPs report. FSAR will be updated to reflect the reference.	Open – Applicant will revise SAR and update reading room
30	2.4.7.1	Have available the USGS streamflow gaging station numbers for stations listed in the text. Staff Notes: Station numbers available in text, recommended revision of FSAR for clarity. Stations are listed Table 2.4.7-1.	Open – Applicant will Revise SAR
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. Staff Notes: Resolved, see discussion in 2.4.11.3.3.	No further action required at this time.

Serial No.	SSAR Section	Information Needs	Action
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. Staff Notes: Reference figure 2.4.2-7. Clarification in 2.4.7-1 (paragraph). Resolved.	No further action at this time.
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? Staff Notes; April spring flow data were used at input variable and base flow. The applicant reviewed USGS data, April had highest mean discharge See explanation - page 2.4-105. Other months (march and may) average flows are lower. Using April is conservative choice. Resolved	No further action at this time.
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. Staff Notes: See Figure 2.4.6-1 to reference slope (reference 2.4.6-11 and Figure 2.4.1-1) Resolved	No further action at this time.
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. Staff notes: Frazil ice and other protection measures will be addressed during COL phase. The staff will identify COL Action item. Resolved	No further action at this time
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 Staff notes: Period of record should be the same. Typo in FSAR. Applicant will revise. Record should indicate 1998 thru 2004/2005.	Open – Applicant will revise SAR
37	Ref 2.4.7-7	URL for reference leads to a blank web page; updated or new URL is needed. Staff Notes:	No further action at this time

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		Correct reference: Http://tidesandcurrents.noaa.gov/data_menu.shtml?stn=8551910%20Reedy%20Point,%20DE&type=Historic+Tide+Data Select date 1/1/96 thru 2/10/96 The staff will verify. Resolved	
38	**Ref. 2.4.7-29**	Have available an SME who is knowledgeable on which dataset was accessed for use in the analysis. Staff Notes: DEM data will satisfy request. See resolution to No 5. Resolved.	**RAI issued under Serial No. 5**
39	**Ref. 2.4.7-4**	URL listed for this reference does not work, try http://www.natice.noaa.gov/index.htm. Verification of URL is needed. Staff Notes: Updated URL is http://www.natice.noaa.gov/ Applicant to revise 2.4.7-4 Resolved	**No further action at this time.**
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. Staff Notes: Reference response to No. 26. Resolved	**RAI response under Serial Nos. 12 and 26.**
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. Staff Notes: The header does reference USGS streamflow gaging stations. The applicant will update table. Resolved	**Open – Applicant will revise SAR**
42	**Table 2.4.7-2**	Have available an SME who is knowledgeable on the definition of the term thickness code. Staff Notes: Refers back WMO code for describing sea ice an referred to "egg code." Information held in an "egg" Additional reference needed for term thickness code. The applicant will add footnote and more specific reference to table. http://www.natice.noaa.gov/egg_code/index.html	**Open – Applicant will revise SAR**

Serial No.	SSAR Section	Information Needs	Action
43	**2.4.11**	Have available an SME who is knowledgeable about channel depth or provide figure or elevation of thalweg near plant site. Staff Notes: See Figure 2.4.3-7 cross section at RM 52 No cross reference in this section. Applicant action item – add reference.	**Open – Applicant will revise SAR**
44	**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. Staff Notes: See resolution No. 10	**RAI response under Serial Nos. 10 and 11**
45	**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. Staff Notes: ANS 2.8 rational used in reverse, 22-year specified in ANS 2.8. ANS 2.13 referenced in introduction for ANS 2.8. RAI will be issued requesting additional details for methodology used.	**RAI**
46	**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. Staff Notes: Reference section 2.4.5.1.1 (pg 2.4-70) for discussion of maximum winds and PMH Staff will review section 2.4.5. Suggest applicant update application to reference information in 2.4.5 for clarity. Add duration of hurricane wind and the length of time in excess of 50 knots over the bay.	**Open – Applicant will revise SAR**
47	**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. Staff Notes: See response No.10	**RAI under Serial No. 10**
48	**2.4.11.2.1**	Have available an SME who is knowledgeable on length of record from Lewes gage used for model boundary. Staff Notes: See response No 10	**RAI under Serial No. 10**

Serial No.	SSAR Section	Information Needs	Action
49	2.4.12.1.1 / 2	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. Staff Notes: Clarify thickness and stratigraphic elevation of geologic units to top of Vincetown within the proposed extent of the power block.	No further action at this time.
50	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. Staff Notes: The staff to review modeling calc package contains info on site specific parameters (reading room). Identify site specific data and call out.	Open item – applicant will revise application.
51	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. Staff Notes: Explanation not required.	No further action at this time.
52	2.4.12.1.1 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. Staff Notes: Clarify explanation of local versus regional depth to groundwater.	Open item – applicant will revise application.
53	2.4.12.1.1	Have available an SME who is knowledgeable about potential future uses of groundwater in the region. Staff Notes: Explanation not required.	No further action at this time.
54	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). Staff Notes: Explanation not required.	No further action at this time.

Serial No.	SSAR Section	Information Needs	Action
55	2.4.12.1.2.2 through 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). Staff Notes: See Serial No. 50.	RAI under Serial No. 50.
57	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. Staff Notes: Clarify conceptual understanding of tidal influences on groundwater levels in the power block area.	No further action at this time.
58	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 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. Staff Notes: Clarify disagreement between rates (second statement is correct).	Open item – applicant will revise application.
59	2.4.12.4.1.1	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. Staff Notes: Bring forward discussion of model calibration and parameter sensitivity analysis, and conservatism incorporated into dewatering model simulations. Clarify storm water recharge component of dewatering does not significantly impact the dewatering simulations.	RAI
60	2.4.12.4.1.	Have available an SME who is knowledgeable about the hydraulic properties of the construction fill.	No further action at this time.

Serial No.	SSAR Section	Information Needs	Action
		Staff Notes: Discussion not required.	
61	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). Staff Notes: Clarify dewatering model development, structure and incorporation of site specific parameters. Clarify dewatering model is distinct and separate from the previous Dames & Moore groundwater supply model.	RAI
62	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. Staff Notes: Clarify development of horizontal and vertical flow velocity calculations utilizing site specific porosity information.	RAI (to include type of porosity specified in Table 2.4.12-1)
63	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. Staff Notes: Explanation not required.	No further action at this time.
64	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. Staff Notes: Explanation not required.	No further action at this time.
65	2.4.12.3.2	Have available an SME who is knowledgeable on: (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 (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.	RAI

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		Staff Notes: Clarify how the modeling by Dames and Moore was conservative and remains applicable.	
66	**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. Staff Notes: Covered in Serial No. 66.	**RAI under Serial No. 66.**
67	**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. Discussion: Explanation not required (Section 2.4.12.4.1.5 refers to additional COLA investigations for model dewatering estimates).	**No further action at this time.**
68	**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. Staff Notes: Deferred to Serial No. 60.	**RAI under Serial No. 60.**
69	**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. Staff Notes: Reference Section 2.5.4.6.3 discussion in Section 2.4.12.4.1.4.	**No further action at this time.**
70	**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. Staff Notes: Clarify the anomalous groundwater elevation values for the 2005 data in Table 2.4.12-6.	**Open item – applicant will revise application.**

Serial No.	SSAR Section	Information Needs	Action
71	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. Staff Notes: Clarify rationale for determining predominant flow direction.	RAI
72	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. Staff Notes: Clarify conceptualization of the shallow groundwater flow system.	RAI
73	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. Staff Notes: Clarify conservatism of receptor location.	RAI
74	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. Staff Notes: Clarify the methodology used to estimate the source term bounding concentrations and consistency with Branch Technical Position (BTP) 11-6 and other applicable guidance.	RAI
75	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. Staff Notes: Clarify impact of dredging on shallow groundwater flow regime.	RAI
76	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.	RAI

Serial No.	SSAR Section	Information Needs	Action
		Staff Notes: Clarify discussion on construction fill, alluvium and release scenario.	
77	**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. Staff Notes: Clarify conservatism in determining groundwater velocities used for transport.	**RAI**
78	**2.4.13.1.4**	Have available an SME who is knowledgeable regarding the characterization of the postulated release volume. Staff Notes: Clarify derivation of concentrations and release volumes.	**RAI**
79	**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. Staff Notes: Clarify branching in radionuclide decay.	**RAI**
80	**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 Alluvium and not the shallower fill deposits and if a lower velocity assumption in the Alluvium is justified. Staff Notes: Refer to Serial No. 77.	**RAI under Serial No. 77.**
81	**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). Staff Notes: Clarify discussion of migration scenarios for radionuclide migration analyses, assumptions and conservatism incorporated in the analyses.	**RAI**
82	**2.4.13.1.7**	Have available an SME who is knowledgeable about: (1) Details of groundwater flux determinations (2) The methods of analysis, results and tabular summaries (Tables 2.4.13-3 and 2.4.13-5) (3) Dilution factor derivations (4) The specific factor by which the concentrations of each radionuclide would be lessened due	**Subpart 1 and 5, RAI under Serial Nos. 76 and 77. Subpart 2 RAI under Serial No. 82.**

Serial No.	SSAR Section	Information Needs	Action
		to the retardation (5) The determination of a tidally-influenced mixing zone Staff Notes: (1) Refer to Serial Nos. 76 and 77. (2) Refer to Serial No. 82. (3) Clarify groundwater flux and dilution due to Delaware River. (4) Clarify level of conservatism incorporated into the analyses. Correct typographical error Section 2.4.13.1.8, paragraph 2, "concentrations significantly **below**..." Should read, concentrations significantly **above**…." (5) Refer to Serial Nos. 76 and 77.	**Subpart 3 and 4 RAIs.**
83	**2.4.13.1.8**	Have available an SME who is knowledgeable about: (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. (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. (3) Justification of utilizing 2/3 of the entire Delaware River flow to estimate maximum dilution concentrations. (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. Staff Notes: (1), (2), (3) and (4) refer to Serial Nos. 82 and 83.	**RAI under Serial Nos. 82 and 83.**
84	**2.4.13.1.9**	Have available an SME who is knowledgeable about the following: (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. Staff Notes: Clarify rationale for potential migration directions Vincentown flow.	**RAI covering all subparts. Include correction to Table 2.4.12-8 Footnote (b).**

Serial No.	SSAR Section	Information Needs	Action
		(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. Clarify assumptions used for discussion of release in Vincentown formation. (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. Clarify alternative pathway description for migration through the Vincentown to the Delaware River. (4) Why the analysis for the Alluvium is considered more conservative than for the Vincentown and if this conclusion based on the nominal travel times. Refer to subpart (3) above. (5) In more detail the statement that the rate of induced downward migration would slow in the event of a release. Clarify the factors that would slow downward migration. (6) How dilution of radionuclide concentrations in a pumping well to less than detectable levels is compliant with requirements. Clarify conservative assumptions in the downward and then horizontal migration in the PRM Formation.	
85	**2.4.13.1.10**	Have available an SME who is knowledgeable about the potential for easterly migration in the Alluvium and the Vincentown. <u>Staff Notes</u>: Refer to Serial Nos. 72, 73, 76, 77 and 85, (1).	**RAI under Serial Nos. 72, 73, 76, 77, and 85.**
86	**2.4.12/13**	Have available the following calculation packages: • Digital copies of groundwater flow model input and output files in native formats with explanations of data and formats.	**RAI**

Serial No.	SSAR Section	Information Needs	Action
		• Digital copies of files used for radionuclide transport analysis in native formats with explanations of data and formats. • Digital copies of input and output files used for the aquifer test analysis in native formats with explanations of data and formats. • ~~Digital copies of laboratory distribution coefficient analysis results and a map showing site locations of samples submitted for analysis.~~	
87	**2.4.5**	Have available an elevation map that shows the topography at the new plant location. If the elevation is referenced to NGVD of 1929, have available a subject matter expert (SME) who is knowledgeable about the conversion method used to reference elevations to NAVD of 1988. Staff Notes: The applicant will provide elevation map as a digital file in TIN format. All data converted to NAVD88 using CORPSCON.	**Resolved pending receipt of DEM**
88	**2.4.5.1**	Have available an SME who is knowledgeable about how the PMH wind field represents the PMWS at the new plant location. Staff Notes: The applicant provides clarification of method to develop PMWS and discussion of the methods to compare PMWS and PMH (Section 2.4.5.1.1)	**Resolved based on audit discussion**
89	**2.4.5.1**	Have available the NOAA data that provides the following meteorological parameters for the PMH: – Central pressure, p0 = 26.65 inches of mercury [in. of Mercury (Hg)]. – Pressure drop, Δp = 3.5 in. of Hg. – Radius of maximum winds, R = from 11 to 28 nautical miles (NM). – Forward speed, T = from 26 to 42 knots (kt). – Coefficient related to density of air, K = 68 (when parameters are in units of in. of Hg and kt) – Track direction, from 138 degrees (moving northwest). Staff Notes: The applicant will clarify the discussion of the procedure to develop the PMH parameters from NWS 23; possibly with an additional table.	**Resolved, applicant may clarify discussion in revised report**
90	**2.4.5.1**	Have available PMH track direction and bathymetric contours of the continental shelf offshore of the mouth of Delaware Bay. Staff Notes: The applicant will clarify the discussion; possibly with an additional figure. Review of provided bathymetry map (reading room) shows alignment of offshore contours and transects applied in evaluation (perpendicular to offshore contours). Text cites Ref 2.4.5-20 (NOAA resource	**Resolved based on audit discussion**

Serial No.	SSAR Section	Information Needs	Action
		management map).	
91	**2.4.5.1**	Have available the material that shows PMH track direction is within the range of directions that NOAA specifies for the PMH at the mouth of Delaware Bay. Staff Notes: The applicant will include statement that 138 degree (Track Direction) results in the PMH angle based on NWS 23.	**Resolved, applicant may clarify discussion in revised report**
92	**2.4.5.1**	Have calculations available that shows, based on selected PMH parameters, the maximum winds range from 128 to 135 kt. Have available a SME who is knowledgeable about the computations of maximum winds and inflow angle. Staff Notes: The applicant will provide table that documents results to develop range of wind speeds based on PMH parameters.	**Open Item - Applicant will provide table of wind speeds developed for PMH parameter sets**
93	**2.4.5.1**	Have available an SME that is knowledgeable about the reason for selected values for R and T used to calculate the maximum storm surge at the open coast, specifically R (11, 20, and 28 NM) and T (26, 34, and 42 kt). Staff Notes: See response to No. 90. Middle value in range taken as mid-point of range between high and low values from NWS 23 charts at appropriate mile marker.	**Resolved based on audit discussion**
94	**2.4.5.1**	Have available the computations that show the surge at the mouth of Delaware Bay increases with R and T. Have modeling results available that shows the maximum surge at the coast consistently resulted from the PMH with high R and T. Staff Notes: The applicant will clarify the discussion; possibly with an additional table. Review of provided maximum surge results table (reading room) shows increasing surge for increasing R and T parameter values. Forward speed parameter values have minimal effect on surge level (radius to maximum winds value induces more change in maximum surge)	**Resolved, applicant may clarify discussion in revised report**
95	**2.4.5.1**	Have available material that shows the speed of propagation of the tide in Delaware Bay is approximately 14 kt. Have available a SME who is knowledgeable about speed of propagation of the tide in Delaware Bay.	**Resolved, based on discussion and new data presented. Applicant may clarify discussion in revised**

Serial No.	SSAR Section	Information Needs	Action
		Staff Notes: The applicant will provide additional information to demonstrate efforts to substantiate 14 kt estimate given the date of references provided. Information provided as a statement of general conditions. Review of more recent data shows 17 kt speed of propagation in bay. Importantly, measurements and HEC-RAS model capture amplification of tide level as tide moves up the bay.	**report**
96	**2.4.5.1**	Have available sample computations that illustrates that a PMH with a high forward speed (42 kt) produces the highest surge at the mouth of Delaware Bay does not produce the highest storm surge at the new plant location. Have available a SME who is knowledgeable about surge estimation in the mouth Delaware Bay and in Delaware Bay. Staff Notes: See response to No. 90 and No. 95; applicant will provide table to demonstrate surge developed for different PMH parameter variations.	**Open Item - Applicant will provide table of surge values developed for PMH parameter sets at open coast**
97	**2.4.5.1**	Have available an SME who is knowledgeable about the analysis that shows that the PMH with R = 28 NM, and T = 26 kt produces the maximum surge at the new plant location and who can show analysis results that are consistent with Bretschneider's evaluation. Staff Notes: See response to No. 90 and No. 95; applicant will provide table to demonstrate surge developed for different PMH parameter variations.	**Open Item - Applicant will provide table of surge values developed for PMH parameter sets at project site**
98	**2.4.5.1**	Have available a SME who is knowledgeable about the establishment of the tide phase in relation to the development of the storm surge such that the 10 % exceedence high tide coincides with the peak storm surge at the new plant location. Make available a SME knowledgeable about determination of the 10 % exceedence high tide at the site. Staff Notes: See response to No. 112 on method to develop timing for 10% exceedence high tide. ANS 2.8, Section 7.3.1.1.1 provides guidance for methodology to develop 10% high tide at Lewes and Reedy Point. Linear interpolation applied to develop 10% value at the project site (based on ANS 2.8, or RG 1.59).	**Resolved, based on audit discussion**

Serial No.	SSAR Section	Information Needs	Action
99	**2.4.5.1**	Have available an SME who is knowledgeable about the calculation of the maximum sustained winds over the ocean (128 kt); the maximum winds over Delaware Bay (126 kt), and maximum winds at the new plant location (116 kt). Staff Notes: NWS 23 procedure applied to develop variation of wind speed along transect through bay. Once storm makes landfall, storm decreases in strength with result of weaker wind field at project site than at mouth of bay.	**Open Item - Pending NRC review of calculations with NWS 23 methods**
100	**2.4.5.1**	Have material available that supports the assumption that winds in Delaware Bay can be assumed in steady state as winds are more uniform (because Delaware Bay is less extensive in area than the continental shelf). Provide direction of wind applied in analysis. Staff Notes: The applicant states that change in scale from offshore calculations (scale of hundreds of miles) requires unsteady winds. Inside the bay and estuary smaller length scales apply and winds do not vary significantly from mouth of bay to the head of the bay. Bodine method applied variable wind directions, wind setup calculations applied constant wind direction (along main axis of bay). The applicant will provide wind direction applied in wind setup calculations.	**Resolved; based on audit discussion**
101	**2.4.5.1**	Have available an SME to discuss wind drag coefficients provided in the Bodine model. Staff Notes: The applicant states that as a sensitivity test Bodine models were executed with default wind stress coefficients (not in calculation package). Approximately 5% change to default model results versus model results with modified wind stress coefficients (based on Ref 2.4.5-4, -26, -7). The applicant developed a conservative value 3.0*10-6 based on references and other models (SLOSH uses 3.0*10-6).	**Open Item - Pending NRC review of values recently applied in other studies**
102	**2.4.5.1.1**	Have available the data and analysis procedure for the 31-year record (1978 through 2008) of wind speed and direction data from Dover, DE (11 miles west of the center of Delaware Bay). Have available the location of the Dover Station. Dover station data from National Climatic Data Center; data should be publically available. Figure 2.4.5-1 shows location.	**Resolved, based on audit discussion**
103	**2.4.5.1.1**	Have available the analysis that shows that 4 hour average winds parallel to the long axis of Delaware Bay did not exceed 35 mph (30 kt) at Dover. Staff Notes: The applicant provided additional clarification of methods to develop 4-hr wind speed analysis and	**Resolved, based on audit discussion**

Serial No.	SSAR Section	Information Needs	Action
		summary of results.	
104	**2.4.5.2.1**	Make available an SME that is knowledgeable about the validation of the storm surge model used to determine the PMH surge. Make available an SME that is knowledgeable about the selection of the Chesapeake-Potomac hurricane of August 1933 as the storm to validate storm surge model. Provide information on datum for 1933 hurricane post-storm water level measurements and the associated uncertainty. Staff Notes: Bret. report (Ref 2.4.5-3) provides data applied for validation of 1933 hurricane (hydrographs). 1933 hurricane produced the second highest surge at Philadelphia. Discussed reasons for selection of 1933 hurricane; track better replicates PMH track and landfall location.	**Open item -Pending NRC review of Bret. report discussion of measured post-storm data**
105	**2.4.5.2.2**	Make available an SME who is knowledgeable about storm surge propagation in Delaware Bay. Specifically, make available a SME who can discuss how the geometry and hydraulics of the estuary control the propagation of the surge. Staff Notes: HEC-RAS applies time-varying input taken from offshore surge model to propagate time-varying surge through Delaware Bay.	**Open Item -Pending NRC review of HEC-RAS model inputs and model setup**
106	**2.4.5.2.2**	Make available an SME that is knowledgeable about the justification for selecting discharge of the Delaware River at Trenton and discharge of tributaries downstream of Trenton as the upstream boundary conditions input into the HEC-RAS model. Staff Notes: The applicant will check other sections of the report that discuss HEC-RAS model development and upstream tributary selection. The applicant states that all named tributaries from the National Hydrographic Dataset (USGS data set) applied in HEC-HMS model.	**Open Item - Pending NRC review of HEC-RAS model inputs and model setup**
107	**2.4.5.2.2**	Make available an SME that is knowledgeable about the combination of HEC-RAS surge, which includes the 10 % exceedence high tide, and Kamphuis wind setup to determine the PMH surge still water level at the new plant location. Have available all wind setup model of Kamphuis data inputs and outputs files. Have available an SME who is knowledgeable about wind setup model of Kamphuis model validation and application, specifically how the wind setup model of Kamphuis calculated effects on water levels at the new plant of wind blowing over Delaware Bay. Staff Notes: The applicant states the longest fetch line was developed for the site to the mouth of the bay,	**Open Item - Pending NRC review of overall methods and analysis of wind setup based with variable cross-section width**

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		determined wind at center of Delaware Bay (MM 24; approximately on fetch line), used NWS 23 to determine wind speed and direction at center of Delaware Bay, water levels from HEC-RAS, applied incremental stepping procedure to leverage water depth at different transects, (leads to delta depth as move up each transect), done for time period before and after maximum HEC-RAS surge (every half-hour) Variable width of Delaware Bay and influence on wind setup not considered to this point.	
108	**2.4.5.2.2**	Have available an SME who is knowledgeable about HEC-RAS model application, specifically how the HEC-RAS model calculated the storm surge propagation through Delaware Bay to the new plant location. Have available all HEC-RAS model data inputs and outputs files. Have available an SME who is knowledgeable about HEC-RAS model setup, calibration/verification, and application. Make available an SME that is knowledgeable about the ability of the HEC-RAS model (a one-dimensional model) to simulate surge propagation in Delaware Bay (a two-dimensional body of water). Staff Notes: Question addressed during group sessions Tuesday afternoon. The applicant will provide HEC-RAS input files. The applicant states that several references discuss validity of one-dimensional models to capture surge and tide propagation in Delaware River estuary.	**Open Item - Pending NRC review of HEC-RAS model inputs and model setup**
109	**2.4.5.2.2**	Make available an SME who is knowledgeable in demonstrating that not accounting for flow perpendicular to the primary longitudinal axis of the Delaware Bay and estuary does not have a significant effect on HEC-RAS model's ability to simulate either the tide or storm surge at the new plant. Staff Notes: Two Journal of Geophysical Research articles cited in text (2.4.5-36 and -37) along with Bretschneider reference (2.4.5-3) that provide information on tide and surge propagation being mainly along longitudinal axis of bay and estuary. JGR articles use observational techniques to document cross-bay effects, but results indicate minimal influence compared to longitudinal effects.	**Open Item - Pending NRC review of JGR articles and Bret. reference**
110	**2.4.5.2.2**	Make available an SME who is knowledgeable in demonstrating that an assumption of steady state response to varying winds is conservative because the bay does not respond to the winds instantaneously. Specifically, make available an SME who is knowledgeable in estimating storm surge elevation using steady and instantaneous response of bay water to wind condition. Staff Notes: Discussion focuses on specific geometry for this site with wider opening at bay-mouth and narrow	**Resolved, based on audit discussion**

Serial No.	SSAR Section	Information Needs	Action
		cross-channel dimension at project site. Steady-state wind approaches are accepted as providing conservative estimate since winds assumed constant during entire analysis. Steady state wind value applied (for each 30-minute time "step") is taken in the middle of bay and represents the best approximation of an average wind speed along the entire wind setup transect.	
111	**2.4.5.2.2.2**	Have available all Bodine storm surge model data inputs and outputs files, executables, and source code. Have available an SME who is knowledgeable about Bodine storm surge model setup, calibration/verification, and application. Have available an SME who is knowledgeable about Bodine storm surge model application, specifically how the Bodine storm surge model calculated storm surge at the open coast. Make available the Bodine calculations that result in a maximum surge elevation of 20.9 ft. NAVD at the mouth of Delaware Bay. Make available an SME who is knowledgeable about the method of making the 10 % exceedence high tide at the new plant coincide with the peak storm surge. Staff Notes: The applicant can provide input data values applied. The applicant developed Excel application to apply Bodine methodology and equations and demonstrated that their model reproduced Bodine Fortran code results. Inputs, depth with distance from shore, storm track location (must be appropriate distance for equations to be valid), PMH storm parameters. Only produces water surfaces elevations along that bathymetry transect. The applicant developed 20.9 ft based on permutations of PMH wind parameters as the maximum surge at the mouth of the Bay, but occurs at a different time step than maximum surge at project site when including wind setup (Table 2.4.5-1 provides details). The applicant states that Bodine model executed with tide levels at different phases (adjusted phase for tide at mouth of the bay) such that 10% exceedence tide peaked a project site with peak of water level from HEC-RAS and wind setup. Additional question about boundary condition at mouth of Delaware Bay in the Bodine model (Codell). The applicant believes that the boundary condition applied by Bodine is a no flow boundary condition, but will confirm and provide additional clarification.	**Open Item - pending NRC review of Bodine model inputs and review of source code and possible model execution.**
112	**2.4.5.2.2.2**	Have available an SME who is knowledgeable about SLOSH model setup, calibration/verification, and application. Make available a SME who is knowledgeable about using the SLOSH Display Program to estimate the highest surge elevation at the mouth of Delaware Bay and accounting for the 10 % exceedence high tide. The applicant states that SLOSH display program results applied. The source code was not available for the applicant to run at time of analysis. No model setup, calibration/verification performed by the applicant. SLOSH display program information does not provide enough information on storm parameters applied to determine if they are similar to PMH values applied in	**Resolved, based on audit discussion**

Serial No.	SSAR Section	Information Needs	Action
		Bodine simulation.	
113	**2.4.5.2.2.2**	Make available an SME who is knowledgeable about illustrating the Bodine method produces a more conservative result than SLOSH, and can specifically simulate the response to the PMH. Staff Notes: The applicant discusses that the Bodine results are more conservative than the SLOSH Display Program (not exactly the same storm). Provides some verification of model approach (Bodine, HEC-RAS, Wind Setup), but unknown SLOSH storm parameters.	**Open Item - Pending NRC review of SLOSH application with PMH storm parameters**
114	**2.4.5.2.2.3**	Have available an SME who is knowledgeable about the HEC-RAS model version used for surge propagation in Delaware Bay. Old HEC-RAS versions have been superseded by Version 4.1 released in January 2010. Have available an SME who is knowledgeable about how the simulations may have been effected by the latest revised versions of HEC-RAS. Staff Notes: The applicant reviewed HEC-RAC model upgrades since analysis completed and found that upgrades would not have affected results. No HEC-RAS simulations completed with newest codes.	**Open Item - Pending NRC review of HEC-RAS upgrades and possible implications**
115	**2.4.5.2.2.3**	Have available an SME to discuss HEC-RAS model calibration procedure, statistics, and results. Staff Notes: The applicant states that calibration procedure occurred for normal tides up to Trenton and included replication of tidal signal (amplitude and phase) Aug 2006 input (relatively standard flow for this period) at Lewes (mouth of Bay) with comparison at Reedy Point, Philly, and Newbold, PA. Determined that it was necessary to use Manning N at low end of reported by TR 55 and Chow within Delaware Bay to match tidal signal measurements. Mainly visual comparison of modeled versus measured tidal amplitudes and phases applied to select “calibrated” model. Next, up-river components added to model. Reading room review of measured and modeled hydrographs shows good fit with high tide amplitude and phase and stage discharge relationship at Trenton.	**Open Item - Pending NRC review of HEC-RAS model inputs and setup**.
116	**2.4.5.2.2.3**	Have available an SME who is knowledgeable about Hydrologic Engineering Center-Hydrologic Modeling System (HEC-HMS) application for the Delaware River at Trenton and its major tributaries downstream of Trenton. In addition, have available an SME who is knowledgeable about estimating discharges from HEC-HMS.	**Resolved, based on audit discussion**

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		Staff Notes: The applicant states that all named tributaries from the National Hydrographic Dataset (USGS data set) applied in HEC-HMS model. HEC-HMS model setup to capture runoff from entire basin that would affect surge levels at project site. Much studied watershed that has many references and prior models and studies.	
117	**2.4.5.2.2.3**	Have available an SME who is knowledgeable about historical rainfall event conservatively represents the effects of hurricane-associated precipitation. Specifically, have available an SME who is knowledgeable in illustrating that the June 2006 historical rainfall event that produced a basin average rainfall of 6 inches in the Delaware River Basin conservatively represents the hurricane-associated precipitation. Staff Notes: The applicant states that the National Hurricane Center website provides document on inland flooding related to hurricanes, provides simplified procedure to estimate rainfall from a hurricane. PMH hurricane rainfall at project site based on document is around 3.3 inches. June 2006 event had basin wide average of over 6 inches, so this provides a conservative estimate of hurricane rainfall in study area. ANS 2.8 9.2.2 states PMH should account for hurricane-induced precipitation, not the PMP or other parameter. The applied 6 inch rainfall event is approximately equal to 25 year flood (not used to select, but provides a reference level). Additional question on influence of rainfall on surge level at site. The applicant states that including rainfall event only increases surge levels at site by less than one foot.	**Open Item- Pending NRC review of discharge quantities and surge estimates**
118	**2.4.5.2.2.3**	Have available an SME who is knowledgeable about the addition of the wind setup to the HEC-RAS water level. Have available an SME who is knowledgeable about the type (steady or time-dependent) HEC-RAS model run. Staff Notes: The applicant states that HEC-RAS model is time-dependent. Wind setup results determined at specific distances along transect from mouth of bay to project site based on HEC-RAS results and water depth at specific location, incremental wind setup values are determined moving up the transect to the project site. Wind speed determined at center of bay and applied as constant in space (varies at each time step) along transect.	**Open Item - Pending NRC analysis of wind setup in bay.**
119	~~**2.4.5.2.2.3**~~ 2.4.5.3.1	Have available an SME who is knowledgeable about estimation of winds at the new plant location in accordance with NOAA guidelines. The applicant states that winds at site developed from NWS 23 with no correction for overland flow (analysis showed negligible effect). Determined wind speeds at site for wave runup	**Resolved, based on audit discussion**

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		calculations versus determined at center of bay for wind setup calculations.	
121	**~~2.4.5.2.2.3~~ 2.4.5.3.1**	Have available an SME who is knowledgeable in estimating wind vectors averaged over time consistent with the fetch and duration limitations and estimation of the significant wave height and period using the straight line fetch and the friction velocity. Staff Notes: The applicant states that winds at site determined at a specific time (wind speed and direction). Iterative approach, get wave height, period at that location, but then check to see if sufficient duration and fetch to have that wave developed. If takes 3 hours to develop that wave height and period, then must find 3 hour wind speed and look at effects on fetch. Try to find worst case (highest sustained winds in combination with duration and fetch) at project site. Discuss that applicant developed wave run-up analysis with waves moving from east/southeast near the project site over inundated marsh areas. This analysis is based on applicant's assessment that wind directions at the time of the maximum surge would create waves along this fetch transect. The applicant did not evaluate wave run-up conditions for waves generated within Delaware Bay/Estuary and moving to the northwest in open water areas. Plots of wind vectors at time around maximum surge conditions at site would help understand appropriate fetch transects; applicant will provide plots of wind vectors at time near maximum surge conditions. At critical time, 13.4 km of fetch, winds were 53.6 m/s.	**Open Item - Pending NRC analysis of wind vectors at time near maximum surge and resulting wave conditions near the site**
122	**2.4.5.3.1**	Have available an SME who is knowledgeable in the design of rip rap around the site. Provide a cross-section showing the elevation and extent of the rip rap. Staff Notes: The applicant provides diagram that rip rap will extend about 25 ft in elevation from existing grade to approximately 37 ft. Figure 2.5.4.5-2.	**Resolved, based on audit discussion and review of design figure**
123	**2.4.5.3.2**	Have available an SME who is knowledgeable in estimating wave runup at the new plant. Specifically, more information needed on the methods to develop the fetch for the runup calculation and the equations applied. Staff Notes: See No. 122; additional discussion of equation to calculate wave run up with reference 2.4.5-6 listed (d'Angremond and van Roode). Discuss CEM methods applied for wave run up calculation (Hunt's equation), but Ref 2.4.5-6 applied for rip rap coefficient. NRC must check CEM equations	**Open Item - See No. 122, pending NRC review of CEM equations for runup**

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		based on provided input parameter values.	
124	**2.4.5.4**	Have data available that shows the monthly sea level trend based on monthly mean sea level data from 1956 through 2006 with an upper 95 % confidence limit. Staff Notes: Data obtained from NOAA sources. Discuss that reference to relative sea level change (including land changes) may strengthen section. The applicant reviewed IPCC estimates and found Section 2.4.5.4 estimate (based on Reedy Point data) is more conservative than IPCC study (this not mentioned in text, but next revision may contain reference to comparison with IPCC data).	**Resolved, based on audit discussion**
125	**2.4.5.6**	Have available an SME who is knowledgeable in explaining how the HEC-RAS model's simulation of the PMH surge shows that velocities throughout Delaware Bay exceed 4.9 ft/sec; while velocities in the river channel near the new plant exceed 8 ft/sec. Staff Notes: The applicant provides additional information on determination of current velocities from HEC-RAS model. Transect averaged values (flow rate divided by cross-section). Averages taken in Delaware Bay vicinity and also near project site. Values are peak values at any time during simulation of PMH, not only at peak surge. Dick Codell asks about structures that would be protected from erosion. The applicant states that this depends on design selected; certain designs could require erosion protection for intake for plant. Page 2.4-78 states safety related SSC will be protected against erosion that could affect the integrity of those facilities.	**Resolved, based on discussion during audit**
126	**2.4.5.6**	Have available an SME who is knowledgeable in explaining how the HEC-RAS model's output velocity at a cross section can account for potential sediment transport variation across the bay width and river channel width. Staff Notes: The applicant responds that modeling done with HEC-RAS cannot capture differences in flow field and induced erosion across the channel width. Because of this, the applicant states they made conservative estimates of erosion and deposition.	**Resolved, based on discussion during audit**
127	**2.4.5.6**	Have available an SME who is knowledgeable in estimation of net deposition immediately around the intake structure.	**Open Item - Pending NRC review of additional references**

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		Staff Notes: Approached developed applied estimates of suspended sediment in similar type estuaries during hurricanes with deposition near the project site. This analysis results in approximately 2 inches of deposition near the project intake. The approach assumed a uniform deposition pattern across the channel (not piling up in certain areas).	
128	**2.4.5.7**	Have available an SME who is knowledgeable in estimation oscillation period of the various modes of seiche propagating along the length of the Delaware Estuary. Staff Notes: Review of JGR journal articles specific to Delaware Bay will provide basis for statements made in this section. NRC must review these sources.	**Open Item,pending NRC review of JGR articles specific to Delaware Bay**
129	**2.4.5.7**	Have available data from researchers that observed water level fluctuations in Delaware Bay have lower frequency than tides, which are semidiurnal (indicating 12-hour periods). Staff Notes: Review of JGR journal articles specific to Delaware Bay will provide basis for statements made in this section. NRC must review these sources.	**Open Item -Pending NRC review of JGR articles specific to Delaware Bay**
130	**2.4.5.7**	Have available data from the observations that indicates the atmospheric forcing, associated with seiche motion in Delaware Bay, occurs with longer periods (more than 3 days) than the natural period of oscillation of the Delaware Estuary (30 hrs. or less). Staff Notes: Review of JGR journal articles specific to Delaware Bay will provide basis for statements made in this section. NRC must review these sources.	**Open Item - pending NRC review of JGR articles specific to Delaware Bay**
131	**2.4.6.1 Historical**	1918 Puerto Rico Tsunami (SSAR 2.4.6.3) • Provide an SME to clarify 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 the a landslide likely contributed to the tsunami. Staff Notes: The applicant will clarify the location of 1918 earthquake source.	**RAI**

Serial No.	SSAR Section	Information Needs	Action
132	2.4.6.1 Historical	Paleotsunami deposits (Missing from SSAR) • Provide an SME to discuss 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 where applicable. Additionally, indicate 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, indicate how they are distinguished from storm wash-over deposits. Staff Notes: Related information presented in 2.5.1. No references to paleotsunamis have been found in existing literature, and no evidence of tsunami has been found in site borings. The applicant will refer to section 2.5.1 and related conclusions in 2.4.6.	RAI
133	2.4.6.2 PMT	Local Slope Stability (SSAR 2.4.6.2 1st Paragraph) • Provide an SME to discuss evaluation of the stability of local slopes. The applicant states "...the occurrence of locally-generated waves due to subaerial or submarine landslide events are unlikely. Figure 2.4.6.1 shows that the slope s 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. The 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). Provide 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: provide evidence to support this contention. Staff Notes: The applicant will reference related work in 2.5.5. Updated figure has been provided showing maximum slope angle of 0.3 degrees. Updated figure will be provided in a future revision.	RAI
134	2.4.6.2 PMT	Other Regional Landslide Sources (Missing from SSAR) • Provide an SME to discuss 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.) Staff Notes: The applicant will provide background on additional landslide sources which might impact the site, as well as a discussion of how the Currituck was chosen as the primary landslide tsunami source	RAI

Serial No.	SSAR Section	Information Needs	Action
		on the continental shelf.	
135	2.4.6.2 PMT	Activity of Offshore Portugal Seismic Zone (SSAR 2.4.6.2 2nd Paragraph) • Provide an SME to 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. Staff Notes: The applicant will clarify language in the revised text.	RAI
136	2.4.6.4 Tsunami Analysis	Verification of Model (SSAR 2.4.6.4 1st Paragraph) • Provide an SME to clarify whether the applicant ran simulations and compared their results with results using a different test source than the ones described in the SSAR. Provide results and figures of the verification experiment. Staff Notes: The applicant provided appropriate test output comparison data.	Resolved
137	2.4.6.4 Tsunami Analysis	Appropriateness of Shallow Water Wave Models (SSAR 2.4.6.4.1) • Provide an SME to indicate discuss 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. Staff Notes: The applicant will include NUREG/CR-6966 reference. The applicant will add physics-based discussion on possible limitations of MOST model for this application.	RAI
138	2.4.6.4 Tsunami Analysis	Water Levels for Bottom Friction Experiment (SSAR 2.4.6.4.1 and 2.4.6.4.5) • Provide an SME to resolve 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 Staff Notes: The applicant will add reference to section presenting 10% exceedence tidal levels, and repeat tidal values when presenting runup/rundown in 2.4.6.4.5.	RAI
139	2.4.6.4 Tsunami Analysis	Input Parameters and Results for all Water Level Models (SSAR 2.4.6.2) • Provide all input parameters to the MOST model for each of the cases selected. Provide results of all model runs conducted in the form of representative time series and wave amplitude maps within and offshore of Delaware Bay.	RAI

Serial No.	SSAR Section	Information Needs	Action
		Staff Notes: Input files provided. The applicant will add images of initial conditions and snapshots of the wave field in time in a revised version of the text.	
140	2.4.6.4 Tsunami Analysis	Determination of Simulation Time (SSAR 2.4.6.4.4) • Provide an SME to clarify 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, justify 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. Do seiches or other oscillations within the Delaware Bay develop that enhance the water levels at the site? Staff Notes: The applicant provided results of a long-time Currituck simulation, out to 40 hours, showing no evidence of seiche. The applicant will add a statement of such in the revised text.	RAI
142	2.4.6.4 Tsunami Analysis	Landslide Initial Conditions (SSAR 2.4.6.4.5 and 2.4.6.4.6) • Provide an SME to detail the equations used to specify the landslide tsunami initial conditions. Provide all input parameters to those equations and discuss with respect to their conservativeness. Staff Notes: The applicant will add discussion of conservativeness of the TOPICS method of determining initial conditions for the Currituck and the N-wave for the Canary Islands.	RAI
143	2.4.6.4 Tsunami Analysis	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) • Provide an SME to justify 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. Staff Notes: The applicant will provide additional simulation results for a case or cases with a finer resolution, to test the numerical effect of high frequency filtering. Provide results in a reading room.	RAI
144	2.4.6.4 Tsunami	Effects of Sea-Level Rise (Missing from SSAR) • Provide an SME to explain whether the effects of long-term sea-level rise were included in the water-level calculations for tsunamis. If so, provide the values estimated for long-term	Resolved

Serial No.	SSAR Section	Information Needs	Action
	Analysis	sea-level rise. If not, provide a justification for why sea-level rise is not included in the analysis. Staff Notes: The applicant added the sea-level rise to only the PMS, which is the DBF.	
145	**2.4.6.4 Tsunami Analysis**	Exceedance High Tide for La Palma and Hispaniola Sources (Missing from SSAR 2.4.6.4.6 and 2.4.6.4.7) • Provide an SME to explain whether 10% 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. Staff Notes: Tide levels are added to all sources.	**Resolved**
146	**2.4.6.4 Tsunami Analysis**	Hispaniola Earthquake Source Parameters (SSAR 2.4.6.4.7 2nd Paragraph) • Provide an SME to discuss how the Hispaniola earthquake source parameters listed in Table 2.4.6-2 were determined. Staff Notes: The applicant will add discussion on how the source parameters are derived.	**RAI**
147	**2.4.6.4 Tsunami Analysis**	Description of Refractive Redirection of Waves (SSAR 2.4.6.4.7, 3rd Paragraph) • Provide an SME to describe where the refractive effect that redirects waves away from Delaware Bay takes place. Provide results in the form of wave amplitude maps outside of Delaware Bay as discussed previously. Staff Notes: The applicant provided figures showing this effect.	**Resolved**
148	**2.4.6.7 Effects of Sediment Erosion and Deposition**	Erosion and Scour Effects on Intake Structure (Missing from SSAR 2.4.6.7) • Provide and SME to explain the expected effects of tsunami-related erosion with specific reference to intake structures within the plant envelope. Are the effects of 10% exeedance tidal currents considered in the analysis of erosion and scour? Provide an indication of the substrate where the intake structure would be located. Staff Notes: Intake not yet designed. Tsunami currents are less than regular tidal currents. Tsunami currents added to maximum tidal currents considerably less than PMS currents.	**Resolved**