Nuclear Development
244 Chestnut Street, Salem, NJ 08079

PSEG
Power LLC

ND-2012-0080
December 20, 2012

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

Subject: **PSEG Early Site Permit Application**
Docket No. 52-043
Response to Request for Additional Information, RAI No. 68, Accidental Releases of Radioactive Liquid Effluents in Ground and Surface Waters

References:
1) PSEG Power, LLC Letter No, ND-2012-0031 to USNRC, Submittal of Revision 1 of the Early Site Permit Application for the PSEG Site, dated May 21, 2012

2) RAI No. 68, SRP Section: 02.04.13 - Accidental Releases of Radioactive Liquid Effluents in Ground and Surface Waters, dated November 21, 2012 (eRAI 6645)

The purpose of this letter is to provide a response to the request for additional information (RAI) provided in Reference 2 above. This RAI addresses Accidental Releases of Radioactive Liquid Effluents in Ground and Surface Waters, as described in Subsection 2.4.13 of the Site Safety Analysis Report (SSAR), as submitted in Part 2 of the PSEG Site Early Site Permit Application (ESPA), Revision 1.

Enclosure 1 provides our response for RAI No. 68, Question No. 02.04.13-15. Our response to RAI No. 68, Question No. 02.04.13-15 will result in a revision to the SSAR. Enclosure 2 contains the revisions to SSAR Subsection 2.4.13. Enclosure 3 includes the new regulatory commitment established in this submittal.

If any additional information is needed, please contact David Robillard, PSEG Nuclear Development Licensing Engineer, at (856) 339-7914.

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NRO

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 20th day of December 2012.

Sincerely,

James Mallon

James Mallon
Early Site Permit Manager
Nuclear Development
PSEG Power, LLC

Enclosure 1: Response to NRC Request for Additional Information, RAI No. 68, Question No. 02.04.13-15, SRP Subsection: 02.04.13 - Accidental Releases of Radioactive Liquid Effluents in Ground and Surface Waters
Enclosure 2: Proposed Revisions, Part 2 - Site Safety Analysis Report (SSAR), Subsection 2.4.13 - Accidental Releases of Radioactive Liquid Effluents in Ground and Surface Waters
Enclosure 3: Summary of Regulatory Commitments

cc: USNRC Project Manager, Division of New Reactor Licensing, PSEG Site (w/enclosures)
USNRC Environmental Project Manager, Division of New Reactor Licensing (w/enclosures)
USNRC Region I, Regional Administrator (w/enclosures)

PSEG Letter ND-2012-0080, dated December 20, 2012

ENCLOSURE 1

Response to RAI No. 68

Question No. 02.04.13-15, SRP Subsection: 02.04.13 – Accidental Releases of Radioactive Liquid Effluents in Ground and Surface Waters

Response to RAI No. 68, Question No. 02.04.13-15:

In Reference 2, the NRC staff asked PSEG for information regarding the Accidental Releases of Radioactive Liquid Effluents into Groundwater and Surface Waters as described in Subsection 2.4.13 of the Site Safety Analysis Report. The specific request for Question No. 02.04.13-15 was:

> *As a result of a comparative review of Subsections 2.4.12 and 2.4.13 of the Site Safety Analysis Report (SSAR) (Application Revision 1), the staff requests that the applicant demonstrate how the groundwater gradients used for the transport analysis in Subsection 2.4.13 are conservative and consistent with those gradients and velocities which would result from predicted groundwater levels in the area of the power block of 6-10 ft (1.8 – 3 m) NAVD as indicated in Subsection 2.4.12 of the SSAR.*
>
> *Specifically, the staff is concerned that the groundwater elevations used to calculate the hydraulic gradient for an easterly release towards Fishing Creek (pages 2.4-209 and 2.4-210), and a westerly release towards the Delaware River (page 2.4-150 and Table 2.4.12-5, and pages 2.4-207 and 2.4-208), in the SSAR Rev 1 are inconsistent with the groundwater elevation assumed for the structural analysis and post construction modeling, 6 -10 ft (1.8 - 3 m) NAVD, presented in the SSAR Rev 1 (pages 2.4-164, 2.4-167, and 2.5-306).*

PSEG Response to NRC RAI:

The 6-10 ft. NAVD groundwater elevations referenced in the RAI arise from evaluation of groundwater behavior after construction to estimate possible hydrostatic pressures. A conservative modeling approach was applied based on a scenario in which:

1. a relatively impermeable soil retention barrier installed for construction purposes is left in place with a top elevation of 5 feet NAVD,
2. recharge from precipitation is relatively high (8 inches per year) over a large portion of the developed site within the power block footprint, and
3. a tidal influence of about 4 feet is experienced through a hydraulic connection with the Vincentown formation.

With respect to accidental releases that occur after the new plant is in operation, the groundwater levels and hydraulic gradients used to support the radionuclide transport analysis in Subsection 2.4.13.1.7 are different than those derived from the conservative approach for post-construction phase scenarios.

PSEG has evaluated the potential impact that increased water levels and hydraulic gradients following construction may have on accidental release of radionuclides to groundwater. The evaluation is based on groundwater modeling output for the conservative scenario in the design basis for hydrostatic loading described in SSAR Subsection 2.4.12.5. In that design basis, groundwater mounding occurs within a permanent soil retention barrier. In this evaluation for response to the RAI question, the effect of hydraulic gradients outside the soil retention barrier, which are greater than those used in the radionuclide transport analysis presented in Subsection 2.4.13.1.7 (Transport with Advection, Radioactive Decay and Dilution - Cases 2, 4 and 6), is considered.

The assumptions for hydrostatic loading pertain to conditions within the low permeability soil retention barrier, which will be constructed to support dewatering and excavation activities during the construction phase. The extent of the soil retention barrier is based on a conservative bounding condition assumption because the final reactor technology and required footprint of the development has not yet been determined. The final design will include features to divert, intercept, or otherwise prevent most potential storm water infiltration, thus reducing the height of potential groundwater elevation increase within the soil retention barrier. Additionally, the final design will have a smaller confined footprint inside the soil retention barrier than that considered in the accidental release analysis, which will result in a greater distance and travel time for pathways to the Delaware River and Fishing Creek.

Using the above conservative approach to estimating post-construction groundwater levels within the soil retention barrier produces an apparent increase in hydraulic gradient between the barrier and surface water bodies to the west (Delaware River) and east (Fishing Creek) as shown in the groundwater flow modeling run for the post-construction scenario (Reference Calculation 2251-ESP-GW-002). The increase is largely due to the inclusion of a high recharge rate (8 in. per yr.) within the post-construction soil power block area causing an overtopping of the soil retention barrier. The increase in gradient resulting from the conservative scenario evaluated in the groundwater model is not expected to occur in final design because the design of a permanent retention barrier will consider potential for overtopping and include features to minimize such effects. Post-construction hydraulic gradients in the alluvium, both to the west and to the east, are expected to be relatively unchanged from existing conditions.

In the accidental release analysis to the west (Delaware River) presented in Subsection 2.4.13.1.7 and based on Calculation 2251-ESP-GW-003, a conservative flow rate is assumed, and that assumption is additionally enhanced by the assumptions of no retardation effects, a short distance to the river to the west, no limiting effects of a sea wall at the river's edge, and discharge directly to the river at the river's edge rather than, as likely, further out in the Delaware River with greater mixing and dilution potential.

Similarly, for potential migration to the east, the release path length is very long. As a result, only a minimal amount of added dilution and mixing at Fishing Creek is needed to achieve the unity rule. Increasing the level of conservatism in the assumptions already inherent in the accidental release scenario provides an even greater conservative estimate for radionuclide transport in this direction.

With respect to an accidental release to the east, the steep portion of a potential increase in gradient is limited to approximately the first 400 feet of the total length of the estimated 4200-foot long pathway to Fishing Creek. The original analysis for this pathway showed that a groundwater discharge of 0.53 cubic feet per day was needed to meet the unity rule. If the length of the pathway were assumed to be shortened to 3800 feet (release placed at 400 feet east of the power block), the water level in the model output is roughly equivalent to the maximum used in the original calculation. The results at the end of the pathway show that the amount of groundwater discharge to Fishing Creek needed to attain the unity rule is equivalent to an additional 1.59 cubic feet per day (2.12 cubic feet per day for the 3,800-foot long pathway versus 0.53 cubic feet per day for the 4,200-foot long pathway). The additional width of discharging groundwater bracketing the hypothetical accidental release plume reaching Fishing Creek to attain the unity rule through dilution increases only to an estimated 24 feet on either side of the plume (from an estimated 9 feet on either side). There are no barriers in the subsurface conditions that prevent achieving this increased groundwater discharge, so the unity rule is easily met.

If dilution from adjacent groundwater discharge at Fishing Creek is discounted entirely, an equivalent dilution of 2.12 cubic feet per day is available from Fishing Creek flow. This amount of flow is expected to be only a small fraction of the tidally-induced flow in Fishing Creek as described in Subsection 2.4.13.1.7.

For a westerly release, the groundwater model for the post-construction scenario shows a gradient for the west flow path of 0.007 ft/ft. For comparison, the accidental release calculations show a maximum hydraulic gradient of 0.00235 ft/ft as cited in SSAR Subsection 2.4.13.1.3. Thus, the potential increase in hydraulic gradient over the full distance from the accidental release site to the Delaware River is approximately three times the maximum considered in the accidental release calculations. The accidental release calculation shows that mixing with only 112 cubic feet per second of flow in the Delaware River (about 0.03 percent of the available flow rate) is sufficient to meet the unity rule. Even if the ground water flow rate from a potential accidental release is tripled (due to the tripled hydraulic gradient), the required increase in river flow rate required to reach unity would still be well below (<0.2 percent) the minimum anticipated river flow rate.

In either of the cases described above, if an increase in groundwater elevation inside the soil retention barrier were to be realized, as postulated in the conservative scenario conducted to estimate maximum changes in hydraulic pressure within the power block, the conclusions resulting from the reasonable and conservative assumptions in the accidental release calculations are not significantly changed. Potential impacts of the postulated accidental release do not result in an exceedance of the unity rule in the receiving body upon mixing.

The analysis of the potential effects of a hypothetical release and of potential hydrostatic pressures experienced at the PSEG Site will be revised after selection of a reactor technology, the specification of the extent and location of the power block development, and the design of any soil retention barrier, should one be employed and/or left in place. These revisions will be evaluated during the COLA stage, and will also be further refined based on additional hydrogeologic data to be gathered to support these revisions and the final design.

SSAR Subsection 2.4.13 will be updated to include examples, as presented above, showing that potential post-construction increases in hydraulic gradient will not significantly change the conclusions of potential impact to the receiving surface water bodies as a result of an accidental release to groundwater.

Associated PSEG Site ESP Application Revisions:

SSAR Subsection 2.4.13 will be updated as described in Enclosure 2 of this document.

PSEG Letter ND-2012-0080, dated December 20, 2012

ENCLOSURE 2

Proposed Revisions
Part 2 - Site Safety Analysis Report (SSAR)

Section 2.4.13 - Accidental Releases of Radioactive liquid Effluents in Ground and Surface Waters

Marked-up Pages
2.4-216
2.4-217

Insert A (new subsection)

2.4.13.1.9

with river water) to again discharge to surface-water. This additional dilution effect can be significant in lowering concentrations at the point of discharge.

~~2.4.13.1.8~~ Comparison with 10 CFR Part 20

For the average and maximum estimated groundwater velocities in the Alluvium aquifer (Cases 1, 3 and 5), the conservative analysis conducted above indicates that most of the radionuclides released remain under consideration relative to the 10 CFR Part 20 criteria. The results indicate that the concentrations reaching the Delaware River or Fishing Creek could be at levels where the ratio of concentration to ECL is greater than one percent and a total of these ratios for all constituents in the mixture is greater than 1 (see Tables 2.4.13-2, 2.4.13-4 and 2.4.13-6). Concentrations could still remain above the ECL at the point of discharge, but the receiving water dilution factors (Cases 2 and 4) reduce the exposure concentration to several orders of magnitude below the ECL (Tables 2.4.13-3, 2.4.13-5 and 2.4.13-7). The Delaware River and Fishing Creek, in the vicinity of the PSEG Site, are not sources of drinking water due to salinity. In addition, the Alluvium and Vincentown aquifers are also not potable water supplies due to elevated salinity. The nearest off-site public water supply wells are within the Mount Laurel-Wenonah aquifer and are located approximately 3.5 miles across the river in Delaware. These wells would not be impacted by a release to the Alluvium or the Vincentown aquifers.

Based on the sum of the fractions and without dilution, the unity rule is exceeded. However, a more refined analysis taking credit for retardation would result in only tritium reaching the Delaware River at concentrations significantly above the ECL. With dilution alone, and without any contribution from retardation, the resulting sum of the fractions would also be significantly less than 1 for all radionuclides. The amount of dilution that would take place at the edge of each receiving water body cannot be easily quantified. However, the very low rates of discharge of the maximum estimated rate of the hypothetical release, not considering other attenuation factors such as dispersion and retardation, requires only mixing within a river flow of 112 cfs (less than 0.03 percent of the low end of the available tidal flow, as cited above) to meet a sum of ratios of less than 1 for a release along the west side of the power block. Under similar assumptions (no dispersion or retardation) a flow of only 0.53 cubic feet per day in Fishing Creek would be needed to achieve the unity rule for a release at the northeast edge of the power block.

2.4.13.1.10

~~2.4.13.1.9~~ Conclusions

The above discussion presents a conservative analysis of the potential effects of the accidental release of liquid radioactive waste to groundwater in two independent locations within the power block. For a release along the western edge of the power block, a westerly migration path to the Delaware River is considered. For a release along the northeast edge of the power block, a northeasterly migration pathway to Fishing Creek is assessed. Each release does not take into account dispersion and retardation of the radionuclides. The analysis for the west flow path, a shorter pathway, indicates that most of the radionuclide releases considered in this hypothetical scenario could reach the potential receptor (at the point of discharge to the Delaware River) at concentrations above 10 CFR Part 20 ECLs. If retardation effects are included, all radionuclides, except for tritium, would likely be present at the discharge location at activities less than one percent of their respective ECLs. The Delaware River is tidal in the vicinity of the site, and the ebb and flow of the tidally-influenced estuary offers several orders of magnitude of

Insert B

dilution to the effluent release. Considering this dilution effect, all radionuclides are within the limits of 10 CFR Part 20.

The analysis of the northeast flow path indicates that without any consideration for the effects of dispersion, retardation, or dilution, all but one radionuclide would be present at the discharge point (Fishing Creek) below their respective ECLs. The calculated ECL ratio (1.38) for all radionuclides is slightly over the target ECL ratio of 1.00. Considering the effect of a small amount of flow contribution for dilution from Fishing Creek (0.53 cubic feet per day or more) all radionuclides are within the limits of 10 CFR Part 20 for this flow path.

In addition to the conservative assumptions of maximum estimated groundwater velocity, minimum travel path length, and no attenuation due to dilution and dispersion, or retardation along the migration pathway, further conservatism is inherent in the analysis. Additional conservative factors not assumed in calculating estimated concentrations at the river point of discharge include:

1) That a construction soil retention barrier, which could act as a seepage cutoff, may remain in place, and a bulkhead, constructed along the river's edge, will decrease groundwater flux rates for the westerly migration pathway,

2) Improved site surface drainage may decrease infiltration and flow through the Alluvium in the vicinity of the expansion,

3) The shallow aquifers are not usable as potable water sources,

4) There are no public water supply wells within 3.5 miles of the facility (the nearest being across the river in Delaware), and

5) Spill containment will be provided for tanks where release of radionuclides to groundwater could potentially occur.

2.4.13.2 Surface-Water

There are no potable surface-water bodies downgradient of the PSEG Site. Although the final plant design and specific layout have not been determined, any outdoor tanks that contain radionuclides will have secondary containment to ensure that a catastrophic release does not result in the release of liquid effluent directly to the surface-water. There will also be controlled release points for systems that could be in contact with radioactive liquids to prevent any potential releases from being discharged directly to surface waters.

2.4.13.3 References

2.4.13-1 Dames & Moore, "Final Report Study of Groundwater Conditions and Future Water-Supply Alternatives Salem/Hope Creek Generating Station, Artificial Island, Salem County, New Jersey," PSEG, July 15, 1988.

2.4.13-2 Harleman, D.R.F., "One-Dimensional Models," in "Estuarine Modeling: An Assessment, Capabilities and Limitations for Resource Management and Pollution

RAI No. 68, Insert A

2.4.13.1.8 Potential Effects from Increased Hydraulic Gradients (Mounding)

As described in Subsection 2.4.12, groundwater mounding in the power block area following construction is possible due to changes in grade elevation and placement of fill to support construction. However, under a conservative scenario, the unity rule is still met with increases in hydraulic gradients that are depicted in modeling output both on the east and west side of the power block.

Potential effects on post-construction groundwater gradients in the alluvium are depicted on Figure 2.4.12-28 under a conservative modeling scenario to develop estimates for maximum hydrostatic pressures inside a soil retention barrier. To the east of the power block, the steep portion of a potential increase in gradient is limited to approximately the first 400 feet of the total length of the estimated 4,200-foot long release pathway to Fishing Creek. If the length of the pathway were assumed to be shortened to 3,800 feet, the additional width of discharging groundwater bracketing the hypothetical accidental release plume reaching Fishing Creek to attain the unity rule through dilution would increase to about 24 feet on either side of the plume (from an estimated 9 feet on either side as described in Subsection 2.4.13.1.7). The amount of groundwater discharge to Fishing Creek needed to attain the unity rule is equivalent to an additional 1.59 cubic feet per day (2.12 cubic feet per day for the 3,800-foot long pathway versus 0.53 cubic feet per day for the 4,200-foot long pathway).

If dilution from adjacent groundwater discharge at Fishing Creek is discounted entirely, an equivalent dilution of 2.12 cubic feet per day is available from Fishing Creek flow. This amount of flow is expected to be only a small fraction of the tidally-induced flow in Fishing Creek as described in Subsection 2.4.13.1.7.

For a westerly release, the groundwater model for the post-construction scenario shows a gradient for the west flow path of 0.007 ft/ft. For comparison, the accidental release calculations show a maximum hydraulic gradient of 0.00235 ft/ft as cited in SSAR Subsection 2.4.13.1.3. Thus, the potential increase in hydraulic gradient over the full distance from the accidental release site to the Delaware River is approximately three times the maximum considered in the accidental release calculations. The accidental release calculation shows that mixing with only 112 cubic feet per second of flow in the Delaware River (about 0.03 percent of the available flow rate) is sufficient to meet the unity rule. Even if the ground water flow rate from a potential accidental release is tripled (due to the tripled hydraulic gradient), the required increase in river flow rate required to reach unity would still be well below (<0.2 percent) the minimum anticipated river flow rate.

In summary, if an increase in hydraulic gradient were to materialize for each release pathway (east and west sides), as suggested in the conservative scenario conducted to estimate maximum changes in hydraulic pressure within the power block, an unmitigated release does not result in an exceedance of the unity rule in the receiving body upon mixing.

RAI No. 68, Insert B

Increased hydraulic gradients or mounding in the alluvium unit, which may occur following construction, are expected to result in only a limited increase in radionuclide concentrations at the discharge point that meets the unity rule, when taking into account a relatively small amount of dilution for each transport pathway.

PSEG Letter ND-2012-0080, dated December 20, 2012

ENCLOSURE 3

Summary of Regulatory Commitments

ENCLOSURE 3

SUMMARY OF REGULATORY COMMITMENTS

The following table identifies commitments made in this document. (Any other actions discussed in the submittal represent intended or planned actions. They are described to the NRC for the NRC's information and are not regulatory commitments.)

COMMITMENT	COMMITTED DATE	COMMITMENT TYPE	
		ONE-TIME ACTION (Yes/No)	Programmatic (Yes/No)
PSEG will revise SSAR Subsection 2.4.13 to incorporate the changes in Enclosure 2 in response to NRC RAI No. 68, Question 02.04.13-15.	This revision will be included in a future update of the PSEG ESP application.	Yes	No