Nuclear Development
244 Chestnut Street, Salem, NJ 08079

PSEG
Power LLC

ND-2012-0021
March 23, 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. 52, Evaluation of Potential Accidents

References: 1) PSEG Power, LLC letter to USNRC, Application for Early Site Permit for the PSEG Site, dated May 25, 2010

2) RAI No. 52, SRP Section: 02.02.03 – Evaluation of Potential Accidents, dated February 23, 2012 (eRAI 6285)

The purpose of this letter is to respond to the request for additional information (RAI) identified in Reference 2 above. This RAI addresses Evaluation of Potential Accidents, as described in Subsection 2.2.3 of the Site Safety Analysis Report (SSAR), as submitted in Part 2 of the PSEG Site Early Site Permit Application, Revision 0.

Enclosure 1 provides our response for RAI No. 52, Question No. 02.02.03-5. Enclosure 2 includes the revisions to SSAR Section 2.2 resulting from our response to RAI No. 52, Question No. 02.02.03-5. Enclosure 3 includes the new regulatory commitments established in this submittal.

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

D079
NRE

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 23rd day of March, 2012.

Sincerely,

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

Enclosure 1: Response to NRC Request for Additional Information, RAI No. 52, Question No. 02.02.03-5, SRP Section: 2.2.3 – Evaluation of Potential Accidents

Enclosure 2: Proposed Revisions, Part 2 – Site Safety Analysis Report (SSAR), Section 2.2 - Identification of Potential Hazards

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 Site and Environmental Reviews (w/enclosures)
USNRC Region I, Regional Administrator (w/enclosures)

PSEG Letter ND-2012-0021, dated March 23, 2012

ENCLOSURE 1

RESPONSE to RAI No. 52

QUESTION No. 02.02.03-5

Response to RAI No. 52, Question 02.02.03-5:

In Reference 2, the NRC staff asked PSEG for information regarding the Evaluation of Potential Accidents, as described in Subsection 2.2.3 of the Site Safety Analysis Report. The specific request for Question 02.02.03-5 was:

> *RS-002 and RG 1.206 provide guidance regarding the information that is needed to ensure that the potential hazards in the site vicinity are identified and evaluated in order to meet the siting criteria in 10 CFR 100.20 and 10 CFR 100.21.*
>
> *The applicant performed an evaluation of explosions in SSAR Section 2.2.3.2.2, and flammable vapor cloud explosions in SSAR Section 2.2.3.2.3, and presented the results in SSAR Tables 2.2-18 and 2.2-19, respectively.*
>
> *a) The hydrogen considered in the analyses is not listed either in SSAR Table 2.2-2a or 2.2-2b. SSAR Table 2.2-3 indicates the location of hydrogen storage as "facility wide;" however, SSAR Tables 2.2-18 and 2.2-19 provide a distance to safety-related buildings of 0.44 miles for hydrogen. Please provide clarification regarding hydrogen storage on the site and its relationship to the distance to safety-related structures provided in SSAR Tables 2.2-18 and 2.2-19.*
>
> *b) The applicant calculated a safe distance of 0.24 mile for the hydrogen vapor cloud explosion; however, staff confirmatory analysis for the hydrogen vapor cloud explosion resulted in a higher value than that of 0.24 mile. Please provide the assumptions, data, and methodology used in calculating the minimum safe distance of 0.24 mile to conclude that it is within the distance of the applicant-identified safety related buildings of 0.44 mile.*
>
> *The staff notes that for propane, the applicant calculated a safe distance due to a flammable vapor cloud explosion of 0.814 mile, while the staff confirmatory analysis calculated a safe distance of 0.31 mile. However, the staff notes that for propane, both calculated distances do not exceed the distance of 3 miles to safety related buildings.*

PSEG Response to NRC RAI:

a) The information in SSAR Table 2.2-2a and 2.2-2b is derived from the Salem/ Hope Creek "Requirements for Compliance with Discharge Prevention, Containment, and Countermeasure (DPCC) Regulations" filing to the State of New Jersey provided in Reference 2.2-25. Hydrogen is not considered a hazard by the State of New Jersey for the purposes of the DPCC filing. The information in SSAR Table 2.2-3 is derived from the Salem/ Hope Creek "Community Right-to-Know" information provided in Reference 2.2-15. The Right-to-Know information combines all hydrogen storage at the Salem/Hope Creek site and lists the location of hydrogen as "Facility Wide'. SSAR Table 2.2-3 was not updated to account for the actual location of hydrogen. Hydrogen is evaluated in SSAR Subsection 2.2.3 and SSAR Tables 2.2-18 and 2.2-19 with the actual location and closest approach distances. Hydrogen is stored in 120,000 cu. ft. hydrogen trailer tubes at two locations south of the Hope Creek Turbine/Administration Building.

SSAR Table 2.2-3 will be revised to identify the specific location and size of the hydrogen trailer tubes. SSAR Subsection 2.2.3 and SSAR Tables 2.2-18 and 2.2-19 contain the correct location of the hydrogen trailer tubes and the correct distance from the tubes to the power block of the new plant.

b) From SSAR Subsection 2.2.3.2.3, an air dispersion model based on the hand calculation methods and equations in Regulatory Guide 1.78, Evaluating the Habitability of a Nuclear Power Plant Control Room During a Postulated Hazardous Chemical Release, Rev. 1, and NUREG-0570, Toxic Vapor Concentration in the Control Room Following a Postulated Accidental Release, is used in this analysis. The model created for this analysis uses the computer program Mathcad to perform the calculations.

The Mathcad model is used to determine the distance that the vapor cloud can travel before the concentration is less than the lower explosive limit (LEL). This distance is referred to as the "LEL distance". The potential methods to calculate the LEL distance are presented in SSAR Subsection 2.2.3.2.3. The method that is selected for each chemical is dependent on the release type (liquid spill evaporation, lighter than air gas release, sub-cooled liquid boil-off, etc.). In the case of hydrogen, a gas much lighter than air, the model determines the farthest distance away from the release point where the vapor cloud concentration is above the LEL at a location with a potential ignition source. For the hydrogen analysis, any building is considered an ignition source. If the plume rises above the top of the building, a detonation explosion cannot be supported. The farthest LEL distance is then considered to be the center point of the explosion. It is then assumed that the explosive mass is the total mass of hydrogen in the 120,000 cu. ft. on-site trainer tubes (608.4 lbs).

There are three types of inputs needed for the hydrogen flammable vapor cloud explosion analysis. The chemical property inputs that are needed are the molecular weight and the LEL. The weather inputs needed are the wind speed, atmospheric pressure and temperature, and the Pasquill atmospheric stability class. The site inputs needed are the storage tank size for the chemical, the height of the tallest structure in the vicinity of the site, and the distance from the storage tank to the nearest PSEG safety related building.

For this analysis, the weather inputs used are selected based on the 5% worst case weather criterion in Regulatory Guide 1.78, Rev. 1. The temperature used in this analysis is 80.8 °F. The atmospheric pressure used in this analysis is 14.7 psia. The Pasquill stability class used in this analysis is Class G.

A different way to perform this analysis is to use the computer program ALOHA instead of the hand calculations in Mathcad. The Mathcad model is selected because it can be more tailored to the specific hazard and site characteristics. For example, ALOHA does not have the option to select Class G. Class F is the most conservative stability class available in ALOHA. Class G is a more conservative selection of stability class than Class F.

The release is then modeled using the vapor dispersion methodology from Regulatory Guide 1.78, Rev. 1, and NUREG-0570 (SSAR Subsection 2.2.3.2.3) and the plume rise methodology from the book "Prediction of Hazards of Spills of Anhydrous Ammonia on Water." If the flammable vapor cloud rises above all site structures it is both unconfined and not near any ignition sources, and will therefore not detonate. Use of plume rise is supported in NUREG-0014, Safety Evaluation Report Related to Construction of Hartsville Nuclear Plants (SSAR Subsection 2.2.3.2.3). The plume rise methodology calculates the plume height as a function of the mass release rate of the gas, the molecular weight of the gas, the wind speed, the Pasquill atmospheric stability class, and the air temperature and pressure. The equation for the steady state plume rise height is:

$$\Delta h_{max} = \frac{\dot{m}^{1/3}}{U^{1/3}} \times C \times G \times W$$

Where: $\dot{m}$ - Mass release rate from the source (lb/s)
U - Wind speed (ft/s)
C - A constant related to the ambient conditions (3.528 at 80.8°F and 14.7 psi)
G - A constant related to the gas released (8.934 for hydrogen)
W - A constant related to the stability class (2.727 for Class G)

This equation shows that as the mass release rate increases, the height of the vapor cloud increases. For large release rates, the plume will rise above all site structures and would not explode. The methodology in NUREG-0570 uses a Gaussian dispersion equation that is also based on the mass release rate. As the mass rate increases, the horizontal distance from the release point to where the concentration reaches the LEL increases. In order to maximize the LEL distance, the mass release rate is iterated to find the balance between the rise height and the LEL distance. A mass release rate of 11.1 pounds per second is determined to be the worst case release rate.

The supporting calculation determines that the LEL distance is 0.13 miles. At a distance of 0.13 miles, the maximum possible concentration of hydrogen at the height of any plant structure is 3.69%, which is less than the 4% LEL for hydrogen. The radius of the explosion is 0.11 miles, for a total minimum safe distance of 0.24 miles.

For propane, the LEL distance is much greater because propane is heavier than air and does not rise. Therefore, the plume of propane can travel much farther before dispersing below the LEL. The supporting calculation determines that the LEL distance is 0.673 miles and the radius of the explosion is 0.141 miles, for a total minimum safe distance of 0.814 miles. Note: If the computer program ALOHA is used for the analysis of propane, ALOHA, by default, uses a dense gas dispersion method instead of the Gaussian dispersion method. The dense gas model typically gives much less conservative results for LEL distance. For this analysis, the Gaussian dispersion method is used to be consistent with NUREG-0570 and Reg. Guide 1.145, Atmospheric Dispersion Model for Potential Accident Consequence Assessments at Nuclear Power Plants, Rev. 1. The propane analysis also uses a receptor elevation (the elevation of the plume when the plume reaches the site) of 0 consistent with recommendations for heavier than air gases in NUREG-0570.

Associated PSEG Site ESP Application Revisions:

SSAR Table 2.2-3 will be updated as specified in Enclosure 2 of this document.

PSEG Letter ND-2012-0021, dated March 23, 2012

ENCLOSURE 2

Proposed Revisions

Part 2 – Site Safety Analysis Report (SSAR)
Section 2.2 – Identification of Potential Hazards

<u>Marked-up Page</u>
Table 2.2-3

Table 2.2-3
SGS and HCGS Right-to-Know Chemical Storage

Chemical	Container Type	Location	Max Daily Inventory Pounds
Ammonium Hydroxide	Stainless Steel	Facility Wide	9999
Tetrafluoroethane	Cylinder	Facility Wide	99,999
Acetone	Bottles/ Jugs (glass)	Facility Wide	499
Carbon Dioxide	Cylinder	Salem Gas Bottle Storage	999
Dichlorodifluoromethane	Cylinder	Material Center	9999
Difluoroethane	Cylinder	Material Center	24,999
Ethylbenzene	Other	Material Center	99
Hydrazine	Stainless Steel	Facility Wide	9999
Hydrogen	Cylinder	~~Facility Wide~~ South of the Hope Creek Turbine/ Admin. Building [a]	~~9999~~ 120,000 cu. ft. [a]
Methoxypropylamine	Tote Bin	Facility	24,999
Monochloropentafluoroethane	Cylinder	Salem Gas Bottle Storage	99,999
Nitrogen	Cylinder	Facility Wide	24,999
Toluene	Can	Material Center	99
N-Butyl Acetate	Other	Material Center	499
Trichlorofluoromethane	Steel Drum	Material Center	999
Xylene	Can	Material Center	9999

Reference 2.2-15

a) The location and storage conditions of the hydrogen were identified using site drawings and a walkdown conducted by on-site PSEG employees separate from Reference 2.2-15

PSEG Letter ND-2012-0021, dated March 23, 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 Section 2.2 to incorporate the changes in Enclosure 2 in response to NRC RAI No. 52, Question 02.02.03-5.	This revision will be included in a future update of the PSEG ESP application.	Yes	No