Nuclear Development
244 Chestnut Street, Salem, NJ 08079

PSEG
Power LLC

ND-2012-0027
April 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. 55, 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. 55, SRP Section: 02.02.03 – Evaluation of Potential Accidents, dated February 23, 2012 (eRAI 6289)

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. 55, Question No. 02.02.03-4. Enclosure 2 includes the revisions to SSAR Subsection 2.2.3 resulting from our response to RAI No. 55, Question No. 02.02.03-4. 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
NRD

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

Sincerely,

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

Enclosure 1: Response to NRC Request for Additional Information, RAI No. 55, Question No. 02.02.03-4, SRP Section: 2.2.3 – Evaluation of Potential Accidents
Enclosure 2: Proposed Revisions, Part 2 – Site Safety Analysis Report (SSAR), Section 2.2.3 - Evaluation of Potential Accidents
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-2012-0027, dated April 23, 2012

ENCLOSURE 1

RESPONSE to RAI No. 55

QUESTION No. 02.02.03-4

Response to RAI No. 55, Question 02.02.03-4:

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 02.02.03-4 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.*
>
> *In SSAR Section 2.2.3.2.3, the applicant addresses potential flammable vapor cloud explosions due to chemicals transported by vessels on the Delaware River. The applicant evaluated this by performing probabilistic analysis which consisted of determining allowable trips for each of the chemicals (SSAR Table 2.2-14) and comparing the allowable trips against the estimated trips of that chemical (SSAR Table 2.2-15). The applicant concluded by stating, "For each chemical, the total number of allowable trips is greater than the estimated number of trips; therefore, none of these chemicals pose a threat greater than 10^{-6} hazards per year."*
>
> *Based on the acceptance criteria of NUREG-0800, the staff considers that the aggregate probability of hazard should be determined, based on realistic data and assumptions, to be 10^{-6} or less per year, as opposed to the applicant's assessment of discrete individual chemical trips each having a probability of 10^{-6} or less per year. The assessment of the hazard probability should include solid explosives transport also. Therefore, the applicant is requested to revise the calculations to determine the total probability of explosive hazard from flammable vapor clouds due to all chemicals and solid explosives transported by vessels on the Delaware River.*

PSEG Response to NRC RAI:

The acceptance criteria from the Standard Review Plan NUREG-0800, Rev. 3, Section 2.2.3 (pg. 2.2.3-3 and 2.2.3-4) states:

> The identification of design-basis events resulting from the presence of hazardous materials or activities in the vicinity of the plant ... is acceptable if all postulated types of accidents are included for which the expected rate of occurrence of potential exposures resulting radiological dose in excess of the 10 CFR 50.34(a)(1) as it relates to the requirements of 10 CFR Part 100 is estimated to exceed the NRC staff objective of an order of magnitude of 10^{-7} per year.
>
> If data are not available to make an accurate estimate of the event probability, ... an expected rate of occurrence of potential exposures resulting radiological dose in excess of the 10 CFR 50.34(a)(1) as relates to the requirements of 10 CFR

Part 100, by an order of magnitude of 10^{-6} per year is acceptable if, when combined with reasonable qualitative arguments, the realistic probability can be shown to be lower.

The Standard Review Plan (Section 2.2.3) provides a hypothetical example where each potential chemical explosive hazard frequency is aggregated for a total explosive hazard frequency.

The probability analysis for explosive chemical hazards uses the following equations (SSAR Subsection 2.2.3.2.1):

$$R_{haz} = P_{spill} \cdot R_{accident} \cdot P_{weather} \cdot D_{trip} \qquad \text{(SSAR Equation 2.2-2)}$$

$$T_{allowable} = 10^{-6} / \Sigma R_{haz} \qquad \text{(SSAR Equation 2.2-3)}$$

Where:
- R_{haz} = Rate of hazards per vessel trip near the PSEG site (hazardous conditions at the site/trip)
- P_{spill} = Probability of the spill, dependent on the amount released (spills/accident)
- $R_{accident}$ = Rate of vessel accidents (accidents/vessel mi.)
- $P_{weather}$ = Adverse wind direction probability (hazardous conditions at the site/spill)
- D_{trip} = Hazardous trip length, the total number of mi. that a vessel travels past the PSEG Site each trip where an accident would result in a hazardous condition (vessel mi./trip)
- $T_{allowable}$ = Allowable number of trips (trips/year)
- 10^{-6} = Total allowable number of hazards per year as specified in RG 1.91

The result of these two equations is the maximum number of allowable trips of each individual chemical hazard (e.g., all vessels of propane on the Delaware River) where the frequency of the individual chemical hazard is less than 10^{-6} hazards per year.

The final step in the probability analysis is to determine the actual number of trips of the vessels in the vicinity of the PSEG Site. Exact shipment data was not available from the U.S. Army Corps of Engineers or from the U.S. Coast Guard. Instead, the data available from these sources provided the yearly tonnage, average tonnage, and minimum tonnage for each type of chemical. To estimate the number of shipments that went past the PSEG site, the total tonnage was divided by a conservative average tonnage. A lower average tonnage maximizes the total number of trips. A conservatively low value was selected as the average vessel tonnage to be used in this analysis (SSAR Table 2.2-15). The total tonnage is then divided by this conservatively low average vessel tonnage, providing a value for the maximum total number of vessel trips past the PSEG site.

The results of the probability analysis are shown in SSAR Tables 2.2-14 and 2.2-15. The results are combined in the table below. The total probability of an explosion at the site also includes the probability of a solid explosion. Therefore, "Solid Explosives" and "Ammonium Nitrate" are included in the sum. The sum of the frequency of all individual explosion hazards in the table below is 2.31 x 10^{-6} hazards per year.

Frequency of each chemical explosion hazard

Chemical	Allowable Number of Trips	Estimated Number of Trips	Frequency (haz/year)
Propane	397	129	3.25E-07
Gasoline	3,753	1,012	2.70E-07
Benzene	9,131	449	4.92E-08
Ammonia	4,629	176	3.80E-08
Naphtha	3,753	732	1.95E-07
Methane	708	399	5.64E-07
Acetone	3,753	1,378	3.67E-07
Vinyl Chloride	520	97	1.87E-07
Solid Explosives	888	2	2.25E-09
Ammonium Nitrate	888	282	3.18E-07

As stated above, the Standard Review Plan requires that the aggregate frequency of a radiological release to the public is less than 10^{-6} per year if arguments show that the analysis is conservative. To determine the probability of a radiological release to the public, two additional conditional probabilities must be included.

$$\sum_{\text{hazards}} \mathrm{H_f} \times \mathrm{CCDP} \times \mathrm{CRRP} < 10^{-6} \text{ per year}$$

Where: H_f = chemical hazard frequency (events per year)
CCDP = conditional core damage probability given an event
CRRP = conditional radiological release probability given core damage

These conditional probabilities are dependent on specific reactor technologies and are not known at this time. This hazard will be further evaluated at COL when the PSEG reactor technology is finalized. However, based on existing data, an order of magnitude estimate can be established. The conditional core damage probability was previously evaluated for small aircraft hazards. The four reactor technology vendors were contacted for the CCDP for the small aircraft analysis. The responses from the vendors are presented in the response to RAI No. 40 (eRAI 6145) and in the table below. The highest reported CCDP is 0.318%. Using a CCDP of 0.318%, the total frequency of core damage due to all explosions near the PSEG site is 7.35×10^{-9} core damages per year. Even if the number of shipments of each of the chemicals listed in the table above were equal to the allowable number of trips, each chemical would have a hazard frequency of 1×10^{-6} hazards per year. The total hazard frequency of all the chemicals would be 1×10^{-5} hazards per year, which would result in a core damage frequency of 3.18×10^{-8} core damages per year. This demonstrates that there is a large amount of margin available when the CCDP is applied to the hazard frequency. The conditional release to the public following core damage has not been quantified, but it would further reduce the total frequency of an unacceptable condition.

Conditional core damage probability for each of the proposed reactor technologies for PSEG

Reactor Technology	CCDP
AP1000	5.85E-08
ABWR	3.18E-03
US-APWR	2.2E-03
U.S. EPR	8.8E-08

In summary, this analysis is acceptable because the frequency of a radiological release is less than 10^{-6} releases per year and the analysis is conservative. A total core damage frequency due to explosions of 7.35×10^{-9} core damages per year is representative and is based on core damage frequency data for small aircraft hazards. This is well below the NUREG-0800 requirements that the frequency of releases to the public is less than 10^{-6} releases per year. In addition, as stated in SSAR Subsection 2.2.3.2.6, there are many conservatisms built into the analysis, including:

- The spill size for each case is the maximum in the range of spill sizes. For instance, a spill of 51,000 gal. is modeled as a spill of 322,000 gal. of chemical since the applicable range is 50,000 gal. to 322,000 gal. (SSAR Table 2.2-12).

- The estimated number of trips of each chemical is high since the estimated ship cargo sizes are biased low.

- Storage conditions for chemicals are selected in order to maximize the release rate, which would maximize the concentration at the PSEG Site. Many chemicals that would typically be stored or transported as liquids are modeled as gases (e.g., propane, methane).

- For vessels, bounding chemicals are selected for each commodity category (e.g., propane is modeled for "Unknown NEC" where NEC is the shipping acronym for Not Elsewhere Classified). While there may have been a commodity as hazardous as propane that is classified as "Unknown NEC", it is very unlikely that all trips classified as "Unknown NEC" are as hazardous as propane.

An additional conservatism will be included in the SSAR (see Enclosure 2).

- It is very likely that a chemical vapor cloud explosion would occur near the vessel following a massive release. The vessel provides many ignition sources. This would consume the flammable vapor before the vapor reaches the PSEG site. Therefore, a vapor cloud explosion at the site is much less likely than modeled here.

Associated PSEG Site ESP Application Revisions:

SSAR Subsection 2.2.3 will be revised to clarify the acceptance criteria and to add the aggregated probability discussion. Tables 2.2-14 and 2.2-15 will be revised to document the aggregate probability.

Enclosure 2 includes a markup of the proposed SSAR revisions.

PSEG Letter ND-2012-0027, dated April 23, 2012

ENCLOSURE 2

Proposed Revisions

Part 2 – Site Safety Analysis Report (SSAR)
Subsection 2.2.3.2 – Evaluation of Potential Accidents

<u>Marked-up Pages</u>
2.2-8
2.2-9
2.2-14
2.2-16
2.2-19
2.2-20
2.2-40
2.2-41

- Chemical releases that could result in an explosion, flammable vapor cloud (delayed ignition), toxicity hazard, or fires
- Collisions with cooling water intake structure
- Liquid spills that could be drawn into the cooling water intake structure
- Radiological hazards

These hazard categories are discussed in the following subsections.

2.2.3.2 Effects of Design-Basis Events

The chemical hazards are analyzed at the following locations (for this section, chemicals refer to all materials that could result in explosive, flammable, or toxic hazards to the PSEG Site, including, but not limited to, ammonia, gasoline, propane, and other fuel storage):

- Nearby transportation routes such as local roads in both New Jersey and Delaware
- River vessel traffic on the Delaware River
- Nearby chemical and fuel storage facilities (in Lower Alloways Creek (LAC) Township Buildings or Port Penn Sewage Treatment Plant)
- Chemical storage at Salem and Hope Creek (S/HC)

On-site chemical storage for the new plant is not included in the ESPA and is analyzed for the combined license application (COLA) when the new plant reactor technology is selected.

ADD: "Per the Standard Review Plan, NUREG-0800 Section 2.2.3, if the total aggregated frequency of a hazardous condition is greater than 10^{-6} hazards per year, then it must be shown that the probability of a radiological release to the public is less than 10^{-7} releases per year or 10^{-6} releases per year if arguments are made to show the analysis is conservative."

2.2.3.2.1 Probabilistic Analysis Methods

A probabilistic analysis is used to determine the frequency of hazards due to chemicals that are transported on the Delaware River. This method is used to determine the threat due to solid explosions, vapor cloud ignition explosions and toxic vapor clouds. This method is consistent with RG 1.70, RG 1.78, *Evaluating the Habitability of a Nuclear Power Plant Control Room During a Postulated Hazardous Chemical Release*, December 2001, RG 1.91, *Evaluations of Explosions Postulated to Occur on Transportation Routes Near Nuclear Power Plants*, February 1978, and NUREG-0800 Section 2.2.3. These references state that a chemical is hazardous to the new plant if the probability of a hazardous event is greater than 10^{-7} hazards per year or 10^{-6} hazards per year if arguments are made to show that the analysis is conservative.

The probability analysis is based on Equation 2 in RG 1.91, but is modified to more accurately represent the analyzed situation. Equation 2 in RG 1.91 is (note that for the following discussion, "shipment" refers to known vessels on the Delaware River such as shipment size, and "trip" refers to a hypothetical vessel containing the chemical being analyzed):

$r = n \cdot f \cdot s$ (Equation 2.2-1)

Where:
- r = exposure rate in hazards per year (i.e., rate of a hazardous event)
- n = explosion rate for the substance and transportation mode in question in explosions per mile (mi.)
- f = frequency of trips for the substance in question in trips per year
- s = exposure distance in mi. (i.e., mi. of transportation route within the standoff distance)

For the purposes of this analysis, the previous equation is modified to account for additional features. The equation used to determine the frequency of vessel hazards is:

$R_{haz} = P_{spill} \cdot R_{accident} \cdot P_{weather} \cdot D_{trip}$ (Equation 2.2-2)

Where:
- R_{haz} = Rate of hazards per vessel trip near the PSEG Site (hazardous conditions at the site/trip)
- P_{spill} = Probability of a spill, dependent on amount released (spills/accident)
- $R_{accident}$ = Rate of vessel accidents (accidents/vessel mi.)
- $P_{weather}$ = Adverse wind direction probability (hazardous conditions at the site/spill)
- D_{trip} = Hazardous trip length, the total number of mi. that a vessel travels past the PSEG Site each trip where an accident would result in a hazardous condition (vessel mi/trip)

The total number of allowable trips is calculated using Equation 2.2-3:

$T_{allowable} = 10^{-6} / \Sigma R_{haz}$ (Equation 2.2-3)

Where:
- $T_{allowable}$ = Allowable number of trips (trips/year)
- 10^{-6} = Total allowable number of hazards per year as specified in RG 1.91

The hazard rate is split into several different cases. Each case is a combination of weather conditions (i.e., Pasquill Stability Class and wind speed) and spill size. For each combination of Pasquill Stability Class and spill size, Equation 2.2-2 is used to determine the rate of a hazard for that combination. The total rate of a hazard for a single vessel trip of a chemical is the sum of each of the hazard rates for each case.

ADD INSERT A

<u>Hazardous Trip Length (D_{trip})</u>

The total number of miles that the vessel travels near the new plant where a spill would result in a hazardous condition (the hazardous trip length) is calculated deterministically using the methods presented in RG 1.78 for toxicity or flammable vapor cloud analyses, or using the methods presented in RG 1.91 for explosion analyses. The trip length is dependent on the standoff distance for each case. The standoff distance is the smallest distance the release can be from the PSEG Site without the site experiencing a hazardous condition. The standoff distance is dependent on the chemical, the stability class, the wind speed and the amount of chemical released. The relationship between the standoff distance, the trip length, and the wind direction is shown in Figure 2.2-3. For example, within a 2 mi. standoff distance, there is 4.3 mi. of navigable channel between south and north-northwest of the PSEG Site.

RAI No. 55, Question 02.02.03-4 INSERT A:

To determine the total probability of a radiological release to the public, the sum of all the individual explosive hazard frequencies is multiplied by the conditional core damage probability given an explosion and by the conditional radiological release probability given core damage, as shown in Equation 2.2-3a.

$$\sum_{\text{hazards}} H_f \times \text{CCDP} \times \text{CRRP} < 10^{-6} \text{ per year} \quad \text{(Equation 2.2-3a)}$$

Where: H_f = chemical hazard frequency (events per year)
CCDP = conditional core damage probability given an event
CRRP = conditional radiological release probability given core damage

crowded harbor, and the Texas City Disaster occurred during unloading. The Delaware River is very wide near the new plant and there are no large docks within 5 mi. Both of these explosions are estimated to be on the order of 2500 tons of solid explosive.

A probability analysis similar to the one presented in Subsection 2.2.3.2.1 is used to determine the number of allowable trips of solid explosive. The number of allowable solid explosive trips is 888 trips. The total allowable tonnage of solid explosives is therefore 523,032 tons (888 trips x 589 tons) per year. From the USACE data (Reference 2.2-28), the largest total annual amount of "explosives" or "ordinance" that is transported on the Delaware River in any year between 2003 and 2007 is 610 tons per year, and the largest total annual amount of "ammonium nitrate" or other fertilizers is 165,412 tons per year. The total amount of solid explosive is much less than the acceptable amount of solid explosive, therefore solid explosives are not a hazard to the PSEG Site.

ADD: "In addition to the above analysis, the frequency of a solid explosion affecting the site is included in the aggregate explosion frequency used to assess the rate of radiological releases to the public. This assessment is presented in Subsection 2.2.3.2.6."

<u>Roadways</u>

The only chemical tr
delivery truck to the

2.2.3.2.3 Flammable Vapor Clouds

Flammable gases in the liquid or gaseous state can form an unconfined vapor cloud that could drift toward the plant before ignition occurs. When a flammable chemical is released into the atmosphere and forms a vapor cloud it disperses as it travels downwind. The parts of the cloud where the concentration is within the flammable range, between the lower and upper flammability limits, can burn if the cloud encounters an ignition source. The speed at which the flame front moves through the cloud determines whether it is a deflagration or a detonation. If the cloud burns fast enough to create a detonation an explosive force is generated.

Potentially hazardous materials on the Delaware River are identified in Table 2.2-16. Hazardous materials transported on nearby roads or at nearby facilities, and SGS and HCGS, are identified in Table 2.2-17. These chemicals are evaluated to ascertain which hazardous materials have the potential to form a flammable vapor cloud or vapor cloud explosion. For those chemicals with an identified flammability range, an air dispersion model based on the methods and equations in RG 1.78 and NUREG-0570, *Toxic Vapor Concentration in the Control Room Following a Postulated Accidental Release,* is used to determine the distance that the vapor cloud can travel before the concentration is less than the LEL. This distance (called the LEL distance) is used in three ways. First, if the LEL distance is greater than the distance to a safety-related building, then the cloud is flammable at the PSEG Site and is hazardous. Second, if it can be shown that there are no ignition sources within the LEL distance, then that vapor cloud does not explode. Third, if there are potential ignition sources (i.e., buildings or other man made objects), the LEL distance is used as the center of an explosion of the chemical vapor. All of the mass of chemical between the release point and the LEL distance is modeled in an explosion centered at the LEL distance. This maximizes the explosive energy and minimizes the distance between the center of the explosion and safety-related buildings.

Conservative assumptions are used in the analyses with regard to meteorological inputs and identified scenarios. The following meteorological conditions are used as inputs to the model: Pasquill Stability Class G (very stable), with a wind speed of 2.84 miles per hour (mph); ambient

Nearby Facilities

The only off-site chemicals identified for further analysis for a stationary explosion are a tank of gasoline and a tank of propane at the LAC Township Buildings, over 3 mi. away. For both tanks, the safe distances are much less than the actual distance. The safe distance for the 6000 gal. gasoline tank is 0.239 mi., and the safe distance for the propane tank is 0.814 mi.

Vessels on the Delaware River

Based on reports from the MEDRB (Reference 2.2-22) and from the USACE (Reference 2.2-28), several chemicals are identified as the bounding chemicals that are transported along the Delaware River. These chemicals are propane, gasoline, benzene, alcohols (methanol, ethanol), carboxylic acids, ammonia, naphtha & solvents, methane, acetone and vinyl chloride. The closest point that vessel traffic approaches the new plant is 0.9 mi.

A vapor cloud of alcohols has a standoff distance of less than 0.9 mi., and is therefore not a hazard to the PSEG Site. The hazardous carboxylic acids (acetic acid, formic acid, and benzoic acid) have vapor pressures lower than their lower flammable limits. Therefore, carboxylic acids do not support a flammable vapor cloud. The rest of the chemicals identified as being transported on the Delaware River are analyzed using the probabilistic analysis presented in Subsection 2.2.3.2.1.

The vessels of gasoline, benzene, ammonia, naphtha, methane, acetone and vinyl chloride are analyzed in the same method as the propane analysis that is presented in Subsection 2.2.3.2.1. The table of total allowable trips is shown in Table 2.2-14 and the table of estimated number of trips is shown in Table 2.2-15. For each chemical, the total number of allowable trips is greater than the estimated number of trips; therefore, none of these chemicals pose a threat greater than 10^{-6} hazards per year.

ADD: "The frequency of each individual chemical vapor cloud explosion affecting the site is included in the aggregated explosion frequency used to assess the rate of radiological releases to the public. This assessment is presented in Subsection 2.2.3.2.6."

Roadways

The only chemical ... delivery truck to the ...

2.2.3.2.4 Toxic Chemicals

Toxic chemical hazards are considered for facilities and activities in the vicinity of the PSEG Site. These hazards include chemicals that are processed, stored, used, or transported near the PSEG site. NRC RG 1.78, Revision 1, *Evaluating the Habitability of a Nuclear Power Plant Control Room During a Postulated Hazardous Chemical Release*, requires evaluation of control room habitability after a postulated external release of hazardous chemicals from mobile or stationary sources, off-site or on-site. PSEG has not selected a reactor technology. Control room characteristics (i.e., the control room volume and outside air infiltration and circulation rates) are unknown. Therefore, chemicals that lead to concentrations above the Immediately Dangerous to Life and Health (IDLH) at the power block boundary will be evaluated during the development of the COLA.

Hazardous materials potentially on the Delaware River are identified in Table 2.2-16. Hazardous materials transported on nearby roads or at nearby facilities, and SGS and HCGS, are identified

concrete wall of a building heats up by 8.2°F as a result of this fire. This is less than the 200°F allowable temperature rise and therefore, the fire is not a hazard to the new plant.
The BLEVE fireball of propane from a vessel on the Delaware River is modeled as being a complete fireball of 5000 tons of propane based on the largest explosion data detailed in Subsection 2.2.3.2.2. The fireball would last for 42 sec. and causes a peak heat load of 22.3 kW/m^2. The surface of a concrete wall of a building heats up by 174°F as a result of this fireball. This is less than the 200°F allowable, however, it is a very high temperature increase and very high heat load. Therefore, further evaluation of the likelihood of a propane vessel BLEVE is provided.

INSERT: "The total aggregated frequency of an explosion, both due to solid explosives and vapor cloud explosions, that adversely affects the PSEG site is 2.31 x 10^{-6} hazards per year which is greater than 10^{-6}. From Equation 2.2-3a, the probability of a release to the public includes the conditional core damage probability (CCDP) given an explosion at the site. The conditional probability is unknown at this time and will be evaluated at COL when a reactor technology is selected. However, based on existing data, an order of magnitude estimate can be established. The CCDP was previously evaluated for small aircraft hazards. The four reactor technology vendors were contacted for the CCDP for the small aircraft analysis. The highest reported CCDP is 0.318%. The frequency of core damage due to chemical explosions with a CCDP of 0.318% is 7.35 x 10^{-9}, which is over two orders of magnitude less than the 10^{-6} acceptance criteria in NUREG-0800."

database, there have been no other explosions or fires within an order of magnitude of 5000 tons. Therefore, the frequency of a fireball on the order of 5000 tons of chemical is very low.

2.2.3.2.6 Conclusions

Based on the analyses presented in Subsections 2.2.3.2.1 through 2.2.3.2.5, there are no chemical hazards that are design-basis events, provided:

- A review of the supporting calculations for these sections will be performed following technology selection.
- The HCGS 6000 gal. tank of gasoline and the delivery truck route to that tank, will be relocated.
- Chemicals identified for toxicity and control room habitability analysis will be performed for the COLA.

This conclusion is reached using the acceptance criterion for a probabilistic analysis. This analysis determines that the frequency is less than 10^{-6} hazards per year for each chemical. Several conservatisms are used in the probability analyses; the more significant conservatisms are listed here.

- The spill size for each case is the maximum in the range of spill sizes. For instance, a spill of 51,000 gal. is modeled as a spill of 322,000 gal. of chemical since the applicable range is 50,000 gal. to 322,000 gal. (Table 2.2-12).
- The estimated number of trips of each chemical is high since the estimated ship cargo sizes are biased low.

- Storage conditions for chemicals are selected in order to maximize the release rate, which would maximize the concentration at the PSEG Site. Many chemicals that would typically be stored or transported as liquids are modeled as gases (e.g., propane, methane).
- For vessels, bounding chemicals are selected for each commodity category (e.g., propane is modeled for "Unknown NEC" where NEC is the shipping acronym for Not Elsewhere Classified). While there may have been a commodity as hazardous as propane that is classified as "Unknown NEC", it is very unlikely that all trips classified as "Unknown NEC" are as hazardous as propane.

ADD NEW BULLET: "It is very likely that a chemical vapor cloud explosion would occur near the vessel following a massive release given that a vessel provides many ignition sources. This on or near-vessel explosion would consume the flammable vapor before the vapor reaches the PSEG site. Therefore, a vapor cloud explosion at the site is much less likely than modeled here."

2.2.3.3 ~~Collisions with~~ In

The cooling water intake str
navigable waterway. One of
safety-related intake structu
which considered the proba
material that could cause a
intake. This evaluation is de

Five factors are determined to yield the probability of the event of concern (a runaway barge striking the safety-related section of the intake structure and causing a fire or explosion). The factors and the basis for their determination are described below:

- Number of non-self propelled vessels that pass the site per year identified in Table 2.2-22. Conservatively, this is determined to be 2825 vessels based on the study of USACE statistics for years 2003 through 2007 (Reference 2.2-28).

- Proportion of traffic on the Delaware River having potentially flammable material listed in Table 2.2-6. This is determined to be 0.071 based on the summary of chemical shipment data USACE for the years 2003 through 2007 (Reference 2.2-28).

- Accident rate for non-self propelled vessels. This is determined to be $1.8x10^{-6}$ per year, as provided in NUREG/CR-6624.

- Proportion of accidents causing significant release of contents. This is determined to be 0.025, as provided in NUREG/CR-6624.

- Conditional probability that a runaway vessel strikes the intake of length L. This is calculated assuming that once a vessel becomes runaway, the angle at which it travels is uniformly distributed over all possible angles.

The probability is calculated using the values listed above, and the length of the safety-related section of the intake structure of 68 ft. The probability of a significant release is found to be $0.59x10^{-7}$per year. Since this probability is much smaller than the $1.0x10^{-7}$ per year threshold for a design basis event (Subsection 2.2.3.1), no further consideration of this hazard is necessary. There is an additional conservatism related to the fact that not every significant release causes a fire or explosion. The current calculation does not take credit for this fact and conservatively assumes the conditional probability of fire and explosion for a given release to be unity.

Table 2.2-14
Number of Allowable Trips of Chemical Hazards Past the PSEG Site Each Year Based on a Probabilistic Analysis for a Flammable Vapor Cloud ~~Hazard~~

Chemical	Allowable Number of Trips
Propane	397
Gasoline	3753
Benzene	9131
Ammonia	4629
Naphtha	3753
Methane	708
Acetone	3753
Vinyl Chloride	520

REPLACE WITH:
"and Solid
Explosive Hazards"

ADD:
"Solid Explosive | 888
Ammonium Nitrate | 888"

and the Frequency of each Explosive Hazard

Table 2.2-15
Estimated Number of Trips of Chemical Hazards Past the PSEG Site Each Year[(a)]

Chemical	Maximum Total Tons per Year (2003-2007 USACE)	USACE Average Shipment Tons (2003-07)	USACE Minimum Shipment Tons (2003-07)	Maritime Exchange Average Shipment Tons (2003-07)	Maritime Exchange Minimum Shipment Tons (2003-07)	Tons per Vessel Used in this Analysis	Estimated Number of Trips [(b)]	Allowable Number of Trips	Probability of Explosive Hazard per year (d)(e)
Propane	514,839	7238	2307	7592	1269	4000	129	397	3.25E-7
Gasoline	4,044,285	5062	614	14,922	10,400	4000	1012	3,753	2.70E-7
Benzene	358,551	10,424	823	5234	2351	800	449	9,131	4.92E-8
Ammonia	140,636	9035	4272	8109	829	800	176	4,629	3.80E-8
Naphtha	731,221	5375	1347	11,280	4527	1000	732	3,753	1.95E-7
Methane	398,585	1999	1999	N.A.	N.A.	1000	399	708	5.64E-7
Acetone	1,102,373	15,276	8815	7512	829	800	1378	3,753	3.67E-7
Vinyl Chloride	182,955	11,411	1922	N.A.	N.A.	1900	97	520	1.87E-7
Solid Explosives (c)	610	N.A.	N.A.	N.A.	N.A.	589	2	888	2.25E-9
Ammonium Nitrate (c)	165,412	N.A.	N.A.	N.A.	N.A.	589	282	888	3.18E-7

a) N.A. - Not Available
~~b) The estimated number of trips is rounded up for conservatism.~~
c) See Subsection 2.2.3.2.2 for a discussion of the shipment sizes of of solid explosives
d) Based on the estimated number of trips for each chemical
e) Total Aggregated Frequency of an Explosion adversely affecting the PSEG Site is 2.31E-6/year.

PSEG Letter ND-2012-0027, dated April 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 Subsection 2.2.3 to incorporate the changes in Enclosure 2 in response to NRC RAI No. 55, Question 02.02.03-4.	This revision will be included in a future update of the PSEG ESP application.	Yes	No