Nuclear Development
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PSEG
Power LLC

ND-2012-0039
July 19, 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. 43, Vibratory Ground Motion

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

2) RAI No. 43, SRP Section: 02.05.02 – Vibratory Ground Motion, dated December 12, 2011 (eRAI 6162)

3) PSEG Power, LLC Letter No. ND-2012-0002 to USNRC, Response to Request for Additional Information, RAI No. 43, Vibratory Ground Motion, dated January 10, 2012

4) PSEG Power, LLC Letter No. ND-2012-0006 to USNRC, Response to Request for Additional Information, RAI No. 43, Vibratory Ground Motion, dated January 25, 2012

5) PSEG Power, LLC Letter No. ND-2012-0009 to USNRC, Response to Request for Additional Information, RAI No. 43, Vibratory Ground Motion, dated February 9, 2012

6) PSEG Power, LLC Letter No. ND-2012-0018 to USNRC, Response to Request for Additional Information, RAI No. 43, Vibratory Ground Motion, dated March 15, 2012

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The purpose of this letter is to respond to the request for additional information (RAI) identified in Reference 2 above. This RAI addresses Vibratory Ground Motion, as described in Subsection 2.5.2 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. 43, Question No. 02.05.02-5, and supplemental responses to Questions 02.05.02-2, 02.05.02-4a, and 02.05.02.4b.

The response to RAI No. 43, Question Nos. 02.05.02-3, 02.05.02-6, 02.05.02-7 and 02.05.02-8 were provided in Reference 3. The response to RAI No. 43, Question No. 02.05.02-9 was provided in Reference 4. The response to RAI No. 43, Question No. 02.05.02-2 was provided in Reference 5. The response to RAI No. 43, Question Nos. 02.05.02-1 and 02.05.02-4 were provided in Reference 6.

PSEG will provide a supplemental response to RAI No. 43, Question 02.05.02-5 to provide a GMRS for the outcrop of the competent layer by October 5, 2012.

Enclosure 2 includes the revisions to SSAR Section 2.5 resulting from our response to RAI No. 43, Question No. 02.05.02-4. Enclosure 3 contains revised SSAR Figures 2.5.2-3 and 2.5.2-4. Enclosure 4 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.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 19th day of July, 2012.

Sincerely,

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

Enclosure 1: Response to NRC Request for Additional Information, RAI No. 43, Question No. 02.05.02-5, SRP Section: 2.5.2 – Vibratory Ground Motion
Enclosure 2: Proposed Revisions, Part 2 – Site Safety Analysis Report (SSAR), Section 2.5 – Geology, Seismology and Geotechnical Information
Enclosure 3: CD-ROM Containing Revised SSAR Figures 2.5.2-3 and 2.5.2-4
Enclosure 4: 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-2012-0039, dated July 19, 2012

ENCLOSURE 1

RESPONSE to RAI No. 43

QUESTION No.
02.05.02-5

Response to RAI No. 43, Question 02.05.02-5:

In Reference 2, the NRC staff asked PSEG for information regarding the Vibratory Ground Motion, as described in Subsection 2.5.2 of the Site Safety Analysis Report. The specific request for Question 02.05.02-5 was:

> *In compliance with 10 CFR 100.23 and in conformance to NUREG-0800, Standard Review Plan, Section 2.5.2, "Vibratory Ground Motion," and Regulatory Guide (RG) 1.208, "A Performance-Based Approach to Define the Site-Specific Earthquake Ground Motion," please assess the adequacy of the existing EPRI-SOG seismic source model in light of the August 23, 2011 M5.8 Mineral, Virginia earthquake. The earthquake was located in the Central Virginia Seismic Zone, which is modeled by all of the EPR-SOG ESTs except for the Law Engineering Team. Please review the adequacy of each of the ESTs source models that incorporate this earthquake (including the Law Engineering Team) in terms of the maximum magnitude probability distribution, source geometry, probability of activity, and seismicity rates. In addition, please address the impact on the GMRS and update the tectonic description of the Central Virginia Seismic Zone in SSAR Subsection 2.5.1.1.4.2.5.1.*

PSEG Response to NRC RAI:

The response to this RAI is divided into five sections.

- Section 1 – Response to Question 02.05.02-5. This section discusses the impact of the Mineral earthquake on the seismic source model used for the PSEG Site ESP. This section includes a review of the EPRI-SOG (Reference RAI-43-5-10) seismic zones potentially impacted by the Mineral earthquake, a discussion of potential updates to these seismic zones, and a discussion of sensitivity analyses conducted to illustrate the impact of the modified seismic zones on the PSEG Site ground motion.

- Section 2 – Supplemental response to RAI 43, Question 02.05.02-2. The original response to RAI 43, Question 02.05.02-2 (Reference RAI-43-5-19) addressed the potential impact of increasing the extent of the updated seismicity catalog (see SSAR Section 2.5.2.1.2) on the seismic source model used for the PSEG Site ESP. In that response a commitment was made to investigate the impact of the increased catalog extent on the seismic zones from three of the EPRI-SOG teams. This section describes modifications made to the seismic zones to account for the extended catalog and presents results of sensitivity analyses conducted to illustrate the impact of the modified seismic zones on the PSEG Site ground motion.

- Section 3 – Supplemental response to RAI 43, Question 02.05.02-4a. The original response to RAI 43, Question 02.05.02-4a, (Reference RAI-43-5-20) addressed the potential impact of recent data regarding the Charlevoix Seismic Zone (CSZ) and the St. Lawrence Rift (SLR) on the seismic source model used for the PSEG Site ESP. In that response a commitment was made to investigate the impact of the increased catalog extent on the seismic zones from five of the EPRI-SOG teams. This section describes modifications made to the seismic zones to account for recent data with respect to the SLR and the CSZ and presents results of sensitivity analyses conducted to illustrate the impact of the modified seismic zones on the PSEG Site ground motion.

- Section 4 – Supplemental response to RAI 43, Question 02.05.02-4b. The original response to RAI 43, Question 02.05.02-4b, (Reference RAI-43-5-20) addressed the potential impact of post-EPRI-SOG publications regarding seismicity within the New England area. This section describes modifications made to the seismic zones to account for the more recent publications and presents results of sensitivity analyses conducted to illustrate the impact of the modified seismic zones on the PSEG Site ground motion.

- Section 5 – Cumulative Impact. This section presents the cumulative impact of the four previous sensitivity studies, and of that presented in the response to RAI 43, Question 02.05.02-1 with respect to the New Madrid Seismic Zone (NMSZ), on the PSEG Site ground motion.

Sections 1 through 4 present updated characterizations for some EPRI-SOG seismic zones for use in the above sensitivity analyses. Table RAI-43-5-1 summarizes these updates, and Table RAI-43-5-2 summarizes the modifications that were made to the original source model used for the PSEG Site ESPA for each of the sensitivity analyses described above.

SECTION 1 – RESPONSE TO RAI 43, QUESTION 02.05.02-5 (MINERAL EARTHQUAKE)

Seismic zones from each of the six EPRI-SOG teams within the region of the 23 August 2011 earthquake near Mineral, VA (referred to here as the Mineral earthquake) were examined to determine whether the seismic zones adequately characterized the occurrence of the Mineral earthquake. In particular, the zones were examined to determine if the maximum magnitude (Mmax), probability of activity (Pa) values, and/or geometry need to be updated to account for the Mineral earthquake.

The magnitude of the Mineral earthquake is compared to the lower-bound Mmax value for the respective zones to test if the Mmax distributions need to be updated. If the magnitude of the Mineral earthquake is greater than the lower-bound Mmax value, the Mmax distribution needs to be updated. A body-wave magnitude (mb) estimate of the magnitude of the Mineral earthquake is required to make this comparison. The mb magnitude of the Mineral earthquake is taken to be mb 5.9 for the comparisons described in this response, based on an mb 5.9 magnitude as reported for the Mineral

earthquake in the National Earthquake Information Center (NEIC) Preliminary Determinations of Epicenters Weekly Listing (PDE-W) catalog (Reference RAI-43-5-18). Adopting this magnitude is consistent with the original EPRI-SOG methodology that preferred using direct measurements of body-wave magnitude over conversions from other magnitude scales to describe the magnitude of earthquakes. This methodology is outlined on page 3-6 of Volume 1, Part 1 of the EPRI-SOG documentation (Reference RAI-43-5-10), page 4-8 of Volume 1, Part 2 of the EPRI-SOG documentation (Reference RAI-43-5-10), and page 3-2 of the EQHAZARD Primer (Reference RAI-43-5-11).

The Mineral earthquake has been associated with the Central Virginia Seismic Zone (CVSZ) References RAI-43-5-3, RAI-43-5-4, RAI-43-5-8, RAI-43-5-14, RAI-43-5-15, RAI-43-5-16, RAI-43-5-22, RAI-43-5-23). The location of the earthquake is compared to the different geometries of the CVSZ from the EPRI-SOG model to determine whether the occurrence of the Mineral earthquake suggests the need to revise any of the EPRI-SOG seismic zones. In general, if the Mineral earthquake, and its associated aftershocks, is contained within the existing CVSZ geometries, there is no need to update the geometry of the zones. The location of the Mineral earthquake used to make these comparisons is 77.933° W 37.936° N, as reported by the NEIC in their PDE-W listing (Reference RAI-43-5-18). As there may be future studies that revise the location of the Mineral earthquake, it should be noted that the results presented here are insensitive to moderate changes (less than approximately 10 km, 6 mi.) in the location of the Mineral earthquake. The earthquake is approximately 10 km (6 mi.) or greater from the boundaries of the zone for all but one of the EPRI-SOG seismic zones relevant to the Mineral earthquake. The one exception is Bechtel Zone 17 where the Mineral earthquake is outside of the zone by less than 1 km (0.6 mi.). Bechtel Zone 17 is considered to contain the earthquake to ensure that the results of this sensitivity study are insensitive to moderate changes in the location of the Mineral earthquake, despite the fact that the earthquake has been mapped as just outside that zone. However, as discussed later, it is likely that the Mineral earthquake should not be associated with Bechtel Zone 17, so uncertainty in the earthquake location has no effective impact on Zone 17.

The general procedure followed to determine if Pa values need to be updated is to examine: (1) if the Pa of the zone is less than 1, and (2) whether there was an earthquake with mb ≥ 5.0 within the zone prior to the Mineral earthquake. The basis for this procedure is that the Pa values within the EPRI-SOG model essentially represent the probability that a zone is capable of generating an earthquake with a magnitude of mb ≥ 5.0. For zones where there were no earthquakes with mb ≥ 5.0 prior to the Mineral earthquake, the earthquake potentially motivates updating the Pa value.

Table RAI-43-5-3 lists all of the seismic zones that were examined as potentially impacted by the occurrence of the Mineral earthquake. These zones include all of the seismic zones that contained the Mineral earthquake, related dependent zones, and Bechtel Zone 17, which the Mineral earthquake occurs close to. Figures RAI-43-5-1 through RAI-43-5-6 show the locations of the zones relative to the PSEG Site, the

EPRI-SOG earthquake catalog (see SSAR Section 2.5.2.1.1), the updated earthquake catalog developed for the PSEG Site (see SSAR Section 2.5.2.1.2), the location of the Mineral earthquake (Reference RAI-43-5-18), and aftershocks of the Mineral earthquake identified by the St. Louis University Earthquake Center (Reference RAI-43-5-21).

The potential impact of the Mineral earthquake on the seismic zones for each team is discussed below.

<u>Bechtel</u>

The Mineral earthquake occurred within two seismic sources identified by the Bechtel team: Zone E and Zone BZ5 (Table RAI-43-5-3; Figure RAI-43-5-1). The NEIC PDE-W location for the Mineral earthquake (Reference RAI-43-5-18) is less than 1 km (0.6 mi) outside the boundary of Zone 17. To account for potential moderate uncertainty in the location of the earthquake, Zone 17 is also considered to encompass the Mineral earthquake.

Zone 17

Zone 17 was developed by the Bechtel team to represent the Stafford fault. As described in SSAR Section 2.5.1.1.4.2.5.6, there is no evidence that the Stafford fault has been active in the Quaternary. Since the occurrence of the Mineral earthquake, most researchers have attributed the Mineral earthquake to the CVSZ, and not a specific tectonic feature (e.g., the Stafford fault) (References RAI-43-5-3, RAI-43-5-4, RAI-43-5-8, RAI-43-5-14, RAI-43-5-15, RAI-43-5-16, RAI-43-5-22, RAI-43-5-23). Also, the identified traces of the Stafford Fault system (Reference RAI-43-5-17) occur in the northern-most region of Bechtel Zone 17, well north of the Mineral earthquake and its associated aftershocks (Figure RAI-43-5-1). While the above observations suggest that the Bechtel team would not have considered the Mineral earthquake to have an impact on Zone 17, it cannot be precluded that they would have considered the earthquake to have an impact on the Bechtel Stafford fault characterization. Therefore, the potential impact of the Mineral earthquake on Zone 17 is taken into account.

The lower-bound Mmax value for Zone 17 is mb 5.4 (Table RAI-43-5-3), so the Mmax distribution needs to be updated to account for the Mineral earthquake (mb 5.9). The Bechtel methodology for determining the Mmax distribution is outlined in the EPRI-SOG documentation (Reference RAI-43-5-10, Vol. 9, p. 6-20 to 6-23). The methodology, as relevant to Zone 17 and the Mineral earthquake, can be summarized as follows:

- The magnitude of the largest historical earthquake within a zone is taken as the lower-bound magnitude (e.g., mb 5.9);
- Two other Mmax values are determined by taking the lower-bound magnitude and adding 0.3 and 0.6 magnitude units, respectively (e.g., mb 6.2 and 6.5);
- The fourth Mmax value is taken as mb 6.6; and

- These four magnitude values are given weights of 0.1, 0.4, 0.4, and 0.1, respectively.

Applied to Zone 17 and the Mineral earthquake, this methodology gives an updated Mmax distribution of: 5.9 (0.1), 6.2 (0.4), 6.5 (0.4), and 6.6 (0.1) (Table RAI-43-5-1).

The Pa for Zone 17 is 0.1 (Table RAI-43-5-1), and the largest observed earthquake from the EPRI-SOG catalog within the zone (Mobs) is 3.38. Therefore, the Pa value should be updated.

Bechtel determined the Pa value of seismic zones by evaluating the probability of activity of tectonic features using what the EPRI-SOG teams referred to as a matrix of physical characteristics. The details of the methodology are presented within the Bechtel EPRI-SOG volume (Reference RAI-43-5-10, Vol. 9, p. 4-14 to 4-30), but a brief outline is presented below.

The basis for the Pa value of a given zone is the weight the team gave to the applicability of three characteristics for each seismic zone, where the sum of the weights for each characteristic is 1.0. The characteristics are:

- The zone's association with seismicity. This characteristic was evaluated for moderate to large earthquakes (mb ≥ 5.0), small earthquake only, and no seismicity.
- How favorably oriented are tectonic features within the zone relative to the dominant stress direction. This characteristic was described as either favorable or unfavorable.
- Whether the zone is associated with tectonic features that have a deep crustal expression. This characteristic was described as either yes or no.

The weights of these characteristics are then applied to the matrix of physical characteristics to develop a Pa value.

The Bechtel team evaluated the characteristics of Zone 17 as follows (weights in parentheses) (Reference RAI-43-5-10, Vol. 9, p. 4-42):

- Association with seismicity – moderate to large (0.0), small (0.1), none (0.9);
- Geometry – favorable (0.6), unfavorable (0.4); and
- Deep crustal association – yes (0.5), no (0.5).

Applying these evaluations to the matrix of physical characteristics gives a Pa of 0.042. The final Pa of the zone is 0.092 reflecting the 0.042 value plus an additional 0.05 probability that the zone is active, which the Bechtel team assigned to the zone based on their subjective evaluation of the potential activity of the Stafford fault (Reference RAI-43-5-10, Vol. 9, p. 4-42) (note that some of the EPRI-SOG documentation has rounded this Pa value to 0.1 as shown in Table RAI-43-5-1).

The occurrence of the Mineral earthquake requires updating the Pa evaluation for Zone 17 because the largest observed earthquake in the zone prior to the Mineral earthquake was Emb 3.38. Therefore, the weight that the zone is associated with moderate to large seismicity needs to be increased from the original value of 0.1. Because the Bechtel methodology does not provide enough information to determine how the occurrence of the Mineral earthquake would impact the evaluation of association with seismicity, we conservatively increased the association with moderate to large earthquakes to 1.0 and decreased the association with small earthquakes and no seismicity to 0. Applying these changes results in an updated Pa value of 0.60, including the additional 0.05 subjective probability originally defined by the Bechtel team (Table RAI-43-5-1).

Zone E

Zone E was developed by the Bechtel team to represent the CVSZ. The lower-bound Mmax value for Zone E is mb 5.4 (Table RAI-43-5-1), so the Mmax distribution needs to be updated to account for the Mineral earthquake. The Bechtel methodology for determining the Mmax distribution for Zone E is the same as described above for Zone 17. Applying this methodology to Zone E gives an updated Mmax distribution of: 5.9 (0.1), 6.2 (0.4), 6.5 (0.4), and 6.6 (0.1) (Table RAI-43-5-1).

The Pa for Zone E is 0.35 (Table RAI-43-5-1), and the largest observed earthquake from the EPRI-SOG catalog within the zone (Mobs) is 4.9. Therefore, the Pa value should be updated following the same procedure described above for Zone 17. The Bechtel team evaluated Zone E as follows (weights in parentheses) (Reference RAI-43-5-10, Vol. 9, p. 5-4 to 5-5):

- Association with seismicity – moderate to large (0.5), small (0.5), none (0.0);
- Geometry – favorable (0.5), unfavorable (0.5); and
- Deep crustal association – yes (0.5), no (0.5).

To account for the Mineral earthquake, the weight that the Zone E is associated with (moderate to large seismicity) needs to be increased from the original value of 0.35. Because the Bechtel methodology does not provide enough information to determine how the occurrence of the Mineral earthquake would impact the evaluation of association with seismicity, we conservatively increased the association with moderate to large earthquakes to 1.0 and decreased the association with small earthquakes and no seismicity to 0. Applying these changes results in an updated Pa value of 0.51 (Table RAI-43-5-1).

Zone BZ5

Zone BZ5 is the background zone for both Zones E and 17. The lower-bound Mmax value for Zone BZ5 is mb 5.7 (Table RAI-43-5-1). The Mmax distribution needs to be updated to account for the Mineral earthquake due to the following combined factors: (1) the lower-bound Mmax value is less than the magnitude of the Mineral earthquake; (2) the Pa values for zones 17 and E are less than 1.0; and (3) Zone 17 is mutually

exclusive with Zone E. Following the same methodology as described above for the Bechtel team, the updated Mmax distribution for Zone BZ5 is: 5.9 (0.1), 6.2 (0.4), 6.5 (0.4), and 6.6 (0.1) (Table RAI-43-5-1).

Sensitivity Scenarios

As described above, the Mineral earthquake occurs just outside of Zone 17, which represents the Bechtel team's interpretation of the Stafford fault. Even if the Mineral earthquake did occur within Zone 17, it is unlikely that the Bechtel team would interpret the Mineral earthquake as having occurred on the Stafford fault. Therefore, it is unlikely that the team would have updated their characterization of Zone 17 in response to the Mineral earthquake. Due to uncertainty in how the Bechtel team would have responded to the Mineral earthquake, and potential uncertainty in the location of the earthquake, two interpretations for how the Bechtel team would have responded to the Mineral earthquake were incorporated in the sensitivity study:

- Interpretation 1 – Update Zone 17 and BZ5 only (i.e., the interpretation that the Mineral earthquake is related to the Bechtel team's Stafford fault zone and not the CVSZ); and
- Interpretation 2 – Update Zone E and BZ5 only (i.e., the interpretation that the Mineral earthquake is related to the CVSZ and not the Bechtel team's Stafford fault zone).

Based on the currently available data regarding the Mineral earthquake (References RAI-43-5-3, RAI-43-5-4, RAI-43-5-8, RAI-43-5-14, RAI-43-5-15, RAI-43-5-16, RAI-43-5-22, RAI-43-5-23), interpretation 2 is heavily favored over interpretation 1. In the sensitivity scenarios presented within this response (Table RAI-43-5-2), interpretation 1 is included in Scenario 1, and interpretation 2 is included in Scenario 2.

Dames & Moore

The Mineral earthquake occurred within one seismic source identified by the Dames & Moore team, Zone 41, which is mutually exclusive with Zones 42, 43, and 46 (Table RAI-43-5-3; Figure RAI-43-5-2). However, Zone 41 was defined by Dames & Moore as a default zone (e.g., a background zone) for zones 42, 43, and 46. Zones 42, 43, and 46 represent the Newark Basin, the Ramapo fault, and the Dan River fault, respectively, tectonic features not related to the CVSZ. In contrast, the Mineral earthquake is considered by most researchers to be related to the CVSZ (References RAI-43-5-3, RAI-43-5-4, RAI-43-5-8, RAI-43-5-14, RAI-43-5-15, RAI-43-5-16, RAI-43-5-22, RAI-43-5-23). The Dames & Moore team did define a CVSZ (Zone 40), which they clearly intended to represent the region of high seismicity within central Virginia (Reference RAI-43-5-10, Vol. 6, p. B-31). Therefore, Zone 40 should be updated to account for the Mineral earthquake, and no changes should be made to Zones 41, 42, 43, or 46.

Zone 40

Because the Mineral earthquake occurs outside of Zone 40 and closer to the PSEG Site than the current boundary of Zone 40, the geometry of the zone should be updated to appropriately represent the location of the Mineral earthquake. Figure RAI-43-5-2 shows the original boundary of Zone 40, the location of the Mineral earthquake, and the location of aftershocks located by the St. Louis University Earthquake Center (Reference RAI-43-5-21). The geometry of Zone 40 is updated by extending the northern boundary of the zone northward to encompass the Mineral earthquake and the identified aftershocks. This is a reasonable and adequate modification of the Dames & Moore team's representation of the CVSZ because: (1) it mostly maintains the original geometry of the zone by only extending the northern boundary; and (2) it encompasses the seismicity related to the Mineral earthquake that is thought by most researchers to be associated with the CVSZ (References RAI-43-5-3, RAI-43-5-4, RAI-43-5-8, RAI-43-5-14, RAI-43-5-15, RAI-43-5-16, RAI-43-5-22, RAI-43-5-23).

It should be noted that extending the northern boundary of Zone 40 further north creates an overlap between Zone 40 and Zones 41 and 53 (see SSAR Figure 2.5.2-6) and thus a double counting of seismicity from this region of overlap. The overlap between the zones is relatively small, so Zones 41 and 53 are not modified to remove the overlap.

The lower-bound Mmax for Zone 40 (mb 6.6) is greater than the magnitude of the Mineral earthquake, and the Pa for Zone 40 is 1.0 (Table RAI-43-5-1). Therefore, there is no need to update either the Mmax or the Pa values for Zone 40.

<u>Law</u>

The Mineral earthquake occurred within two zones defined by the Law team: Zone 17 and Zone 217 (Table RAI-43-5-3; Figure RAI-43-5-3). Zone 17 is an expansive zone that extends along the eastern US from Alabama to Vermont, and Zone 217 is a background zone with the same geometry as Zone 17 (Figure RAI-43-5-3; SSAR Figure 2.5.2-7). The Law team did not define a seismic zone for the CVSZ. Based on the documentation of the Law team's methodology, they followed a strict tectonic feature approach to defining seismic zones, and they tended to not define seismic zones that did not have a potentially related tectonic feature (Reference RAI-43-5-10, Vol. 7, p. 5-2). The only exceptions the Law team made to this methodology are their characterizations of the seismic zones for Charleston and Ottawa (Reference RAI-43-5-10, Vol. 7, p. 5-7).

Despite the fact that the Law team did not define a zone representing the CVSZ, the occurrence of the Mineral earthquake does not motivate the revision of the Law team's seismic zone interpretation to include a CVSZ. This conclusion is based on the following observations:

- The CVSZ was an identified feature at the time of the EPRI-SOG study (as evident in the characterization of the seismic zone by other teams), and the Law team intentionally determined that defining a CVSZ did not fit within their methodology (i.e., they followed a strict approach of basing zones on tectonic features) (Reference RAI-43-5-10, Vol. 7, p. 5-2);
- Law's interpretation that the region of the CVSZ should not be defined as a unique zone was also present in the other teams' source characterizations that defined the Pa of their CVSZs as less than 1.0 (e.g., Bechtel, Weston, Woodward-Clyde);
- The Law interpretation of the region surrounding the CVSZ is only one of six interpretations that comprise the EPRI-SOG model.

Therefore, to account for the Mineral earthquake, only the Mmax and Pa values of Zones 17 and 217 need to be evaluated.

Zone 17

The lower-bound Mmax value for Zone 17 is mb 5.7 (Table RAI-43-5-1), so the Mmax distribution needs to be updated to take into account the Mineral earthquake. The Law methodology for defining Mmax was to estimate the Mmax using several different approaches (e.g., maximum observed earthquake, the magnitude with a 1000-yr return period, a series of estimates essentially based on empirical comparisons), and then define the final Mmax distribution based on the relative magnitude of the different estimates (Reference RAI-43-5-10, Vol. 7, p. 6-8 to 6-15). Following this methodology, the Law team defined the lower-bound Mmax value of mb 5.7 for Zone 17 based on the maximum observed earthquake within the zone, the 1897 Emb 5.7 Giles County earthquake in Virginia. Therefore, the lower-bound Mmax for Zone 17 should be increased to mb 5.9 to account for the Mineral earthquake. The updated Mmax distribution is then: mb 5.9 (0.2), 6.8 (0.8) (Table RAI-43-5-1).

Following a methodology similar to that used by the Bechtel team to define Pa values, the Law team developed Pa values by weighting the applicability of various characteristics for each seismic zone. The Law methodology is described in detail within their EPRI-SOG documentation (Reference RAI-43-5-10, Vol. 7, p. 4-1 to 4-10).

For Zone 17, Law evaluated two characteristics (Reference RAI-43-5-10, Vol. 7, p. 4-5 and A-14):

- Association with seismicity – moderate to large (0.6), small (0.2), none (0.2); and
- Geometry – favorable (0.6), unfavorable (0.4).

Applying these characteristics to the Law matrix of physical characteristics results in the Pa value for the zone of 0.62 (Table RAI-43-5-1).

The occurrence of the Mineral earthquake may require updating the Pa evaluation for Zone 17. The Law team assigned a 0.6 weight that moderate to large seismicity (i.e., mb ≥ 5.0) is associated with the zone. Prior to the Mineral earthquake, the largest earthquake within the zone that the Law team used in making this evaluation was the 1897 Emb 5.7 Giles County earthquake. It is not possible to determine how the Law team would have modified their 0.6 weight given the occurrence of the slightly larger (mb 5.9) Mineral earthquake. Due to this uncertainty, the weight that Zone 17 is associated with (moderate to large seismicity) is increased to 1.0, and the weights that the zone is either not associated with seismicity or is associated with small earthquakes only are set to 0. These changes are conservative, especially in light of the fact that the Law team already knew of an Emb 5.7 earthquake within the zone.

Applying these changes results in an updated Pa value of 0.85 (Table RAI-43-5-1).

Zone 217

Zone 217 has the same geometry as Zone 17 and is defined by the Law team as a background zone for Zone 17. Consistent with the alternate interpretation of the area encompassed by Zones 17, Zone 217 was originally defined to have a lower Mmax distribution than Zone 17 (Table RAI-43-5-3). The Mmax distribution for Zone 217 is mb 4.9 (0.5), 5.7 (0.5), so the Mmax distribution for the zone needs to be updated to account for the Mineral earthquake. However, the methodology used to develop the original Mmax distribution, and thus the updated Mmax distribution, is different from that used for Zone 17.

For Zone 217 the upper-bound Mmax value of mb 5.7 was based on Law's evaluation of the seismic activity within the zone (e.g., the 1897 Emb 5.7 Giles County earthquake) (Reference RAI-43-5-10, Vol. 7, p. 6-9 and 6-13). Now the maximum observed earthquake (Mineral earthquake, mb 5.9) is greater than that upper-bound evaluation made by Law. Therefore, it is reasonable to increase the upper-bound Mmax value based on seismic activity to the mb 5.9 magnitude of the Mineral earthquake. Based on Law's methodology for putting all of the weight on a single Mmax value if the magnitude of the maximum observed earthquake is equal to the upper-bound evaluation (Reference RAI-43-5-10, Vol. 7, p. 6-9 and 6-13), the Law methodology leads to a single-value Mmax distribution of mb 5.9 with a weight of 1.0. Therefore, the updated Mmax distribution for Zone 217 is mb 5.9 (1.0) (Table RAI-43-5-1).

The Law team Pa value for Zone 217 is 1.0 (Table RAI-43-5-1), so the Pa value does not need to be updated.

<u>Rondout</u>

The Mineral earthquake occurred within one zone defined by the Rondout team: Zone 29 (Table RAI-43-5-3; Figure RAI-43-5-4). Zone 29 has a lower-bound Mmax value of mb 6.6 and a Pa value of 1.0 (Table RAI-43-5-3). Therefore, there are no updates to Zone 29 required due to the occurrence of the Mineral earthquake.

Weston

The Mineral earthquake occurred within two primary zones defined by the Weston team (Zones 22 and 104) and a series of combination zones that incorporate Zone 104 (Table RAI-43-5-3; Figure RAI-43-5-5).

Zone 22

Zone 22 was defined by the Weston team to characterize the CVSZ. The lower-bound Mmax value for the zone is mb 5.4 (Table RAI-43-5-1), so the Mmax distribution needs to be updated. The Weston team methodology for determining the original Mmax distribution of Zone 22 was based on developing a cumulative probability of activity distribution for earthquakes, dependent on their mb magnitude, from Pa evaluations made at several magnitudes using matrices of physical characteristics (Reference RAI-43-5-10, Vol. 5, section 4). From this cumulative distribution, a discrete probability density function (PDF) describing the probability that a given Mmax value is appropriate for the source zone was determined. The final Mmax distribution was then calculated by truncating the PDF at the lowest magnitude of the discrete PDF that was greater than or equal to the largest observed earthquake within the zone and renormalizing the PDF.

For Zone 22, the updated Mmax distribution can be determined by truncating the original PDF for Zone 22 (Reference RAI-43-5-10, Vol. 5, C-65) at mb 6.0. This truncation magnitude ensures that the lower bound of the revised Mmax distribution is greater than the magnitude of the Mineral earthquake (mb 5.9). The resultant updated Mmax distribution for Zone 22 is then: 6.0 (0.81), 6.6 (0.19) (Table RAI-43-5-1).

Similar to the Bechtel team, the Weston team developed Pa values by weighting the applicability of various characteristics for each seismic zone and by defining a matrix of physical characteristics (Reference RAI-43-5-10, Vol. 5, p.4-1 to 4-9).

The Weston team evaluated three characteristics and gave these characteristics the following weights for Zone 22 (Reference RAI-43-5-10, Vol. 5, p. B-41):

- Association with seismicity – ≥ mb 5.0 (0.5), < mb 5.0 (0.5), none (0.0);
- Geometry – favorable (0.8), unfavorable (0.2); and
- Deep crustal association – deep with barrier (0.8), deep without barrier (0.2), shallow (0.0).

These weights, combined with Weston's matrix of physical characteristics, result in the original Pa value of 0.82 (Table RAI-43-5-1).

The occurrence of the Mineral earthquake requires updating the Pa evaluation for Zone 22 because the largest observed earthquake in the zone prior to the Mineral earthquake was less than 5.0 (Emb 4.9 in 1833). Therefore, the weight that the zone is associated with earthquakes of magnitudes greater than or equal to mb 5.0 needs to be increased from the original value of 0.5. Because the Weston team's methodology does not provide enough information to determine how the occurrence of the Mineral earthquake would impact the evaluation of association with seismicity, the association with moderate to large earthquakes is increased to 1.0 and a decrease in the association with small earthquakes and no seismicity to 0 is made as a conservative approach. Applying these changes results in an updated Pa value for Zone 22 of 0.91 (Table RAI-43-5-1).

Zone 104 and Related Combination Zones

The Mineral earthquake occurs within Zone 104, an extensive background zone. Following the EPRI-SOG methodology, instead of using Zone 104 for the PSEG Site, the appropriate combination zones incorporating Zone 104 and other contributing zones were used for the PSEG Site (see SSAR Table 2.5.2-7). Following the original implementation and methodology of the EPRI-SOG study, the Mmax values for all of the combination zones that are based on Zone 104 and contain the Mineral earthquake should be examined for potential updates. These are zones C21, C22, C25, C34, and C35 (Table RAI-43-5-3). However, Zones C25 and C35 do not need to be considered because they are defined to account for zone combinations that contain the Charleston seismic sources, and the EPRI-SOG characterizations of Charleston were replaced by an updated Charleston characterization for the PSEG Site (see SSAR Section 2.5.2.4.2.2.1).

The Weston team's documentation shows that the development of the Mmax distribution for Zones C21 and C22 is identical (i.e., same original Mmax PDF) (Reference RAI-43-5-10, Vol. 5, p. E-38 and E-40). The documentation does not provide the details of the Mmax distribution for Zone C34, but it is reasonable to assume it is identical to that of Zones C21 and C22 because the resultant original Mmax distribution is identical (see SSAR Table 2.5.2-7).

The lower-bound Mmax value for Zones C21, C22, and C34 is mb 5.4 (Table RAI-43-5-1), so the Mmax distribution needs to be updated to account for the Mineral earthquake. Weston used the same methodology for defining the Mmax distribution of these zones as for Zone 22 described above. Truncating the Mmax PDF at mb 6.0, as described above, results in the updated Mmax distribution for Zones C21, C22, and C34 of mb 6.0 (0.81), 6.6 (0.19) (Table RAI-43-5-1).

Zones C21, C22, and C34 are combination zones with no explicit Pa values, so there is no need to update the Pa values of Zones C21, C22, and C34 in response to the Mineral earthquake.

Woodward-Clyde

The Mineral earthquake occurs within two zones defined by the Woodward-Clyde team: Zones 26 and 27 (Table RAI-43-5-1; Figure RAI-43-5-6). Zone 28 does not contain the Mineral earthquake but is mutually exclusive with both Zones 26 and 27. Because the lower-bound Mmax values of both Zones 26 and 27 (mb 5.4 and mb 5.6, respectively) (Table 1) are less than the magnitude of the Mineral earthquake (mb 5.9) the Mmax distributions for both zones need to be updated.

Zone 26

To define the Mmax distribution for seismic zones, the Woodward-Clyde team estimated six Mmax PDFs for each zone using a range of different techniques and assumptions that they describe in detail within their documentation (i.e., maximum observed magnitude, features expression in the deep crust, dimensions of source, seismic flux, 1000-yr earthquake) (Reference RAI-43-5-10, Vol. 8, p. 6-15 to 6-21). Each of the six component Mmax distributions defined by the team were combined to create a composite distribution for the zone. This composite PDF was then truncated at or above the maximum observed magnitude and renormalized to generate the final Mmax values used in the EPRI-SOG model (Reference RAI-43-5-11, p. 4-4 to 4-5).

Two of the component distributions for each zone were based on two alternate hypotheses for interpreting the maximum observed earthquake within a zone (Mobs), and these two component distributions are the only distributions potentially impacted by the occurrence of the Mineral earthquake. These two alternate hypotheses were given half the weight of each of the other four Mmax PDFs when combining the component PDFs to generate the composite PDF (Reference RAI-43-5-10, Vol. 8, p. 6-21). The first Mobs hypothesis assumed that the Mmax value was close to Mobs, and the shape of the assumed PDF varied depending on whether Mobs was an instrumental magnitude or estimated from intensity measurements. The second Mobs hypothesis assumed that the Mmax value was greater than Mobs, and the assumed PDF did not vary depending on magnitude type.

To account for the Mineral earthquake, both of the original component PDFs based on Mobs (Reference RAI-43-5-10, Vol. 8, p. C-38) need to be updated using the methodology described above for an instrumental mb 5.9 earthquake (i.e., the two component PDFs need to be truncated at mb 5.9). Doing so results in the following updated Mmax distribution for Zone 26 (Table RAI-43-5-1):

Updated Mmax Distribution for Woodward-Clyde Zone 26

Mmax	Wt.
6.0	0.20
6.25	0.17
6.5	0.27
6.75	0.13
7.0	0.12
7.25	0.07
7.5	0.04

Zone 27

Woodward-Clyde used the same methodology to develop the Mmax distribution for Zone 27 as is described above for Zone 26. As with Zone 26, the largest observed earthquake within Zone 27 at the time of the EPRI-SOG study was an intensity based Emb 4.9 (i.e., Mobs is within the mb 5.0 bin). To account for the Mineral earthquake, both of the original component PDFs based on Mobs (Reference RAI-43-5-10, Vol. 8, p. C-38) need to be updated following the methodology described above for an instrumental mb 5.9 earthquake. Doing so results in the following updated Mmax distribution for Zone 27 (Table RAI-43-5-1):

Updated Mmax Distribution for Woodward-Clyde Zone 27

Mmax	Wt.
6.0	0.22
6.25	0.32
6.5	0.16
6.75	0.21
7.0	0.05
7.25	0.04

The Woodward-Clyde team followed a methodology similar to that of the Bechtel team in defining the Pa values for zones. However, the Woodward-Clyde team's documentation does not provide enough detail to determine how the Pa values derived for Zones 26, 27, and 28 were converted to the final Pa values used in the EPRI-SOG model. In particular, the Woodward-Clyde documentation illustrates the derivation of 0.488, 0.149, and 0.096 for Zones 26, 27, and 28, respectively (Reference RAI-43-5-10, Vol. 8, p. A-46 to A-51), but the final Pa values used for these zones in the EPRI-SOG model were 0.434, 0.474, and 0.092, respectively (Table RAI-43-5-3; (Reference RAI-43-5-11)). Apparently, the Pa values for these zones were modified when the zones were combined into a final model, but the Woodward-Clyde documentation does not provide enough detail to determine how these modifications were made and how the final model was constructed (Reference RAI-43-5-10, Vol. 8. p. B-13 to B-15). Therefore, several assumptions are made in determining how the Mineral earthquake impacts these zones.

Based on the mutually exclusive relationship between Zones 26, 27, and 28, the Woodward-Clyde team had three interpretations of the cause of seismicity within the region of the Mineral earthquake. Only two of these interpretations (Zones 26 and 27) actually contain the Mineral earthquake (Figure RAI-43-5-6), so it is reasonable, and conservative for the PSEG Site, to assume that the updated Pa value for Zone 28 should be set to 0. The original weights on the remaining two interpretations (Zones 26 and 27) were approximately equivalent (0.434 and 0.474, respectively), so it is reasonable to assume that the updated weights for these two zones should both be 0.5. This is reasonable because: (1) it preserves the original approximately equivalent weights, and (2) small differences in Pa values are unlikely to impact the PSEG Site because the zones overlap and are at similar distances to the PSEG Site.

Sensitivity Analysis for Mineral Earthquake (RAI 43, Question 02.05.02-5)

A sensitivity analysis was conducted to illustrate the impact of the updates to the EPRI-SOG model described above on the PSEG ground motions. The sensitivity analysis was conducted using the same source model as used for the PSEG Site ESPA (see SSAR Subsection 2.5.2.2.1) with the modifications described above. In particular, two different scenarios were investigated reflecting the uncertainty in how the Bechtel team would have treated the Mineral earthquake (see discussion above). Table RAI-43-5-2 lists the modifications for the two scenarios (Scenarios 1 and 2) developed for the Mineral Earthquake. Note that the new hazard values calculated for the Mineral earthquake scenarios do not use the CAV filter (see SSAR Section 2.5.2.4.3).

The Uniform Hazard Response Spectra (UHRS) values in SSAR Table 2.5.2-14 provide a base set of values for comparing results of sensitivity scenarios. A rock GMRS is calculated for the UHRS values using the methodology described in SSAR Subsection 2.5.2.6.1.1 which follows the guidance in RG 1.208. Table RAI-43-5-4, Table RAI-43-5-5, and Figure RAI-43-5-8 illustrate the impact of the Mineral earthquake sensitivity scenarios (Scenarios 1 and 2), as well as the other scenarios presented in Table RAI-43-5-2, through these comparisons, assuming rock site conditions for the ESPA and sensitivity scenario GMRS values.

Table RAI-43-5-4, Table RAI-43-5-5, and Figure RAI-43-5-8 demonstrate that:

- The Mineral earthquake has a very small impact on the rock GMRS values at the PSEG Site (e.g., largest increase over PSEG SSAR rock GMRS is 3.5% at 2.5 Hz); and
- There is no significant difference between the two Mineral earthquake scenarios with respect to the impact on the PSEG Site GMRS (e.g., the rock GMRS values are the same for the two scenarios to within 0.001 g).

Section 2 – Supplemental Response to RAI 43, Question 02.05.02-2 (Updated Catalog Extent)

The response to RAI 43, Question 02.05.02-2 (Reference RAI-43-5-19), identifies seismic zones for three EPRI-SOG teams as potentially needing to be updated to adequately characterize seismicity that has occurred since the original EPRI-SOG characterizations. The paragraphs below describe the updates for each of the three teams.

Law

As described in the response to RAI 43, Question 02.05.02-2 (Reference RAI-43-5-19), an mb 5.4 earthquake that occurred on 25 September 1998 in northwestern Pennsylvania is within Law Zone 112. The lower-bound Mmax for Zone 112 is mb 4.6 (Table RAI-43-5-1), so the Mmax distribution needs to be updated. As previously described, the Law methodology for defining Mmax was to estimate the Mmax using several different approaches (e.g., maximum observed earthquake, the magnitude with a 1000-yr return period, a series of estimates essentially based on empirical comparisons), and then define the final Mmax distribution based on the relative magnitude of the different estimates (Reference RAI-43-5-10, Vol. 7, p. 6-8 to 6-15). For Zone 112, Law defined the upper-bound Mmax value as mb 5.5 (Reference RAI-43-5-10, Vol. 7, p. 6-13), and estimated the 1000-yr earthquake magnitude to be mb 5.1 (Reference RAI-43-5-10, Vol. 7, p. 6-19). The updated estimate of Mmax from Mobs is now mb 5.4 reflecting the 1998 earthquake. Because the 1000-yr earthquake estimate is less than Mobs, it is not a credible Mmax value. The Law team does not provide guidance for how to weight Mmax estimates when the upper-bound magnitude is greater than the Mobs and the 1000-yr estimate is less than the Mobs (Reference RAI-43-5-10, Vol. 7, p. 6-14). Therefore, the weight they used for their 2-point scenario where the 1000-yr earthquake is not greater than Mobs (Reference RAI-43-5-10, Vol. 7, p. 6-14) is adopted because this is the closest scenario to the current situation. The updated Mmax distribution for Zone 112 is then: mb 5.4 [0.5], 5.5 [0.5] (Table RAI-43-5-1).

The response to RAI 43, Question 02.05.02-2 (Reference RAI-43-5-19) also identified an mb 5.3 earthquake that occurred on 20 April 2002 in northeastern New York. The earthquake occurs within Law Zone 9. The lower-bound Mmax value for the zone is mb 5.0 (Table RAI-43-5-1), so the Mmax distribution needs to be updated to take into account the 2002 earthquake. The upper-bound Mmax value of mb 7.4 was set based on the team's interpretation that the region was a well developed rift (Reference RAI-43-5-10, Vol. 7, p. 6-9 and 6-11). Based on the weights given to the other magnitudes, it can be determined that the 5.8 Mmax value is the 1000-yr earthquake estimate, and the 5.0 magnitude represents the maximum observed historical earthquake (an Emb 4.8 rounded up to 5.0). Therefore, to update the max distribution, the lower-bound magnitude should be increased to 5.3. The updated Mmax distribution for Zone 9 is then: mb 5.3 [0.2], 5.8 [0.5], and 7.4 [0.3] (Table RAI-43-5-1).

The Pa for Zone 9 is 0.89 (Table RAI-43-5-1), and, prior to the 2002 earthquake, the largest magnitude earthquake within the zone was an Emb 4.8. Therefore, the Pa value for the zone may need to be updated. The Law methodology for developing the Pa of Zone 9 is the same as described above for other Law zones. However, unlike the other zones discussed above, the Law team gave a 1.0 weight to the characteristic that Zone 9 was associated with moderate to large earthquakes and 0.0 weight to the characteristic that the zone was either associated with small earthquakes or no earthquakes. Therefore, there are no revisions to the Pa evaluation that can be made to account for the 2002 earthquake, and the current Pa value of 0.89 adequately describes the 2002 earthquake given the Law methodology.

Rondout

The response to RAI 43, Question 02.05.02-2 (Reference RAI-43-5-19) identified an mb 5.4 earthquake that occurred on 25 September 1998 in northwestern Pennsylvania. The earthquake occurred within two Rondout zones considered in the PSEG SSAR, Zones C07 and C02. The lower-bound Mmax values for both zones are mb 4.8 (Table RAI-43-5-1), so the Mmax values for both zones need to be updated. To determine Mmax values, the Rondout team assigned each source zone into one of four categories based on whether they thought the zone was a background zone or a zone capable of either great, large, or moderate earthquakes (Reference RAI-43-5-10, Vol. 10, p. 5-4 to 5-6). Because C07 and C02 are clearly background zones (they are comprised of Zone 50, an extensive background zone encompassing the Grenville crust not assigned to any tectonic features or other source zones; (Reference RAI-43-5-10, Vol. 10, p. B-19 to B-20)), the team assigned them to the background zone classification. The Rondout team decided upon an Mmax for background zones of mb 5.5, but gave a range of magnitudes from 4.8 to 5.8 to capture potential uncertainty. Because Zones C02 and C07 are clearly background zones, and because the mb 5.4 earthquake is less than the best-estimate Mmax value Rondout stated for background zones (mb 5.5), the most appropriate methodology for updating the Mmax values for the zones is to remove the lower-bound 4.8 from the Mmax distribution and add that 0.2 weight to the 5.5 value. The updated Mmax distribution for Zones C02 and C07 is then: 5.5 [0.8], 5.8 [0.2] (Table RAI-43-5-1).

Woodward-Clyde

The response to RAI 43, Question 02.05.02-2 (Reference RAI-43-5-19) also identified an mb 5.4 and an mb 5.1 earthquake that occurred on 6 March 2005 and 6 November 1997, respectively, in south-central Quebec. These earthquakes occurred within Zones 14 and 12. The response stated that these earthquakes may potentially require an update to the Pa value for Zone 14. However, the Woodward-Clyde team knew of numerous earthquakes with magnitudes greater than mb 5.0 that had occurred within Zone 14 (e.g., mb 5.7 in 1732, mb 5.7 in 1944, mb 5.9 in 1860, mb 6.1 in 1663, mb 6.3 in 1870, and mb 6.4 in 1925; Reference RAI-43-5-19). Based on the number of

earthquakes with magnitudes greater than or equal to mb 5.0, it appears unlikely that the more recent mb 5.4 and 5.1 earthquakes would have motivated the Woodward Clyde team to have updated the Pa value for Zone 14, so the Pa value of Zone 14 does not need to be updated.

Sensitivity Analyses for Updated Catalog Extent (RAI 43, Question 02.05.02-2)

A sensitivity analysis was conducted to illustrate the impact of the updates to the EPRI-SOG model described above on the PSEG ground motions. The sensitivity analysis was conducted using the same source model as used for the PSEG Site ESPA (see SSAR Subsection 2.5.2.2.1) with modifications described above. Table RAI-43-5-2 lists the modifications for the scenario (Scenario 3) developed for the response to RAI 43, Question 02.05.02-2. Note that the new hazard values calculated for this scenario do not use the CAV filter (see SSAR Section 2.5.2.4.3).

Table RAI-43-5-4, Table RAI-43-5-5, and Figure RAI-43-5-8 illustrate the impact of the updated catalog extent scenario (Scenario 3), as well as the other scenarios presented in Table RAI-43-5-2 and show that there is no impact on the PSEG Site rock GMRS from taking into account the impact of the updated catalog extent on the EPRI-SOG source model used for the PSEG Site.

SECTION 3 – SUPPLEMENTAL RESPONSE TO RAI 43, QUESTION 02.05.02-4A (CHARLEVOIX SEISMIC ZONE AND ST. LAWRENCE RIFT)

The response to RAI 43, Question 02.05.02-4a (Reference RAI-43-5-20), identifies specific seismic zones from five of the EPRI-SOG teams as potentially needing to be updated to adequately characterize more recent data and information regarding the Charlevoix Seismic Zone (CSZ) and St. Lawrence Rift (SLR) (Reference RAI-43-5-20). The paragraphs below describe the updates for each of those five teams.

Bechtel

The 1663 Charlevoix earthquake occurred within Bechtel Zone 3 representing the CSZ and Zone 2 representing the SLR. The EPRI-SOG study assigned this earthquake a magnitude of Emb 6.1 (References RAI-43-5-10, RAI-43-5-12). Ebel (Reference RAI-43-5-7) conducted a new analysis of the magnitude of the 1663 Charlevoix earthquake using records of chimney damage in Massachusetts, estimated dimensions of a potential rupture plane within the CSZ, and comparison to the 1811-1812 earthquake sequence in New Madrid. Based on these approaches, Ebel states in Reference RAI-43-5-7 that his best estimate of the magnitude of the 1663 Charlevoix earthquake is Mw 7.3 to 7.9 (mb 7.1 to 7.4). This magnitude is greater than the magnitude given to the earthquake in the EPRI-SOG study (mb 6.1) and by other researchers (Lamontagne et al., 2008). Instead of adopting Ebel (Reference RAI-43-5-7), a single-researcher's evaluation of the magnitude of the 1663 earthquake, the magnitude of the 1663 earthquake, as presented within the central and eastern US (CEUS) catalog developed as part of the EPRI CEUS study (Reference RAI-43-5-13), is adopted. Within the EPRI

CEUS catalog, the 1663 earthquake is given a magnitude of Mw 7.0 (mb 6.9). This magnitude is used instead of the magnitude of Reference RAI-43-5-7 because the EPRI CEUS magnitude: (1) was developed as part of a senior seismic hazard analysis committee (SSHAC) Level 3 study (Reference RAI-43-5-2) tasked with developing a seismicity catalog for the CEUS, and (2) the EPRI CEUS study interviewed Ebel and considered the magnitude estimates he presented in Reference RAI-43-5-7.

The mb 6.9 magnitude for the 1663 earthquake is greater than the lower-bound Mmax for Bechtel Zones 3 and 2 (Table RAI-43-5-1). Therefore, the Mmax distributions for Zones 3 and 2 need to be updated. Using the Bechtel team's methodology for developing Mmax values previously described in conjunction with the mb 5.9 magnitude for the Mineral earthquake, the updated Mmax distribution for Zones 3 and 2 is: 6.9 (0.2), 7.2 (0.4), 7.4 (0.4) (Table RAI-43-5-1). In this distribution, the 0.1 weight that would go to mb 6.6 was put on mb 6.9 because 6.6 is less than the magnitude of the 1663 earthquake.

The response to RAI 43, Question 02.05.02-1, identified the1988 Saguenay earthquake as having a magnitude of mb 6.2. As discussed in the response to RAI 02.05.02-4 (Reference RAI-43-5-20), the most likely update the Bechtel team would have made to their source characterizations to account for the Saguenay earthquake would have been to either: (1) define a new seismic zone representing the Saguenay graben, or (2) extend their SLR Seismic Zone (Zone 2) to include the Saguenay graben. Defining a new Saguenay graben source would have no impact on the PSEG Site given the considerable distance between the PSEG Site and the graben, so this discussion considers the impact of the Saguenay earthquake on Zone 2. Instead of updating the geometry of Zone 2 to encompass the Saguenay graben, the impact of the Saguenay earthquake is accounted for in the Pa value for the zone (the lower-bound Mmax value is greater than 6.2, so there is no need to update the Mmax distribution). This approach is adequate for this sensitivity study because expanding the zone is unlikely to increase the hazard at the PSEG Site (i.e., the expanded zone would be further from the site, and there is not a concentration of seismicity within the Saguenay graben to dramatically increase the seismicity rate).

The original Pa value of Zone 2 is 0.45 (Table RAI-43-5-1), and the zone contains eight earthquakes from the original EPRI-SOG catalog that have magnitudes greater than mb 5.0. One of these eight earthquakes (1931 Emb 5.4) also occurs outside of Zone 3, which is nested within Zone 2. Based on this seismicity, and other characteristics of the zone, the Bechtel team's evaluation led to the following tectonic feature assessments (weights in parentheses) (Reference RAI-43-5-10, Vol. 9, p. 4-31 to 32):

- Association with seismicity – moderate to large (0.7), small (0.3), none (0.0);
- Geometry – favorable (0.5), unfavorable (0.5); and
- Deep crustal association – yes (0.7), no (0.3).

It is unclear if the occurrence of the Saguenay earthquake would have motivated the Bechtel team to update the Pa value for Zone 2. This ambiguity is due to the fact that numerous earthquakes with magnitudes greater than Emb 5.0 occurred within the zone prior to the EPRI-SOG study, yet the Bechtel team still gave 0.3 weight to the zone being associated with small earthquakes. For this sensitivity study, the occurrence of the Saguenay earthquake is conservatively evaluated as though it would have led the team to increase the weight that the zone is associated with (moderate to large seismicity) to 1.0, and decrease the association with small earthquakes and no seismicity to 0. Applying these changes results in an updated Pa value of 0.55 (Table RAI-43-5-1).

Law

The 1663 Charlevoix earthquake also occurred within Law Zone 12 representing the CSZ. The lower-bound Mmax value for Zone 12 is mb 6.4 (Table RAI-43-5-1), so the Mmax distribution needs to be updated to account for the revised mb 6.9 magnitude used here for the 1663 earthquake. As previously described, the Law methodology for defining Mmax was to estimate the Mmax using several different approaches (e.g., maximum observed earthquake, the magnitude with a 1000-yr return period, a series of estimates essentially based on empirical comparisons), and then define the final Mmax distribution based on the relative magnitude of the different estimates (Reference RAI-43-5-10, Vol. 7, p. 6-8 to 6-15). For Zone 12, Law defined the upper-bound Mmax value as mb 7.4 based on the observation that the zone is associated with a well developed rift (Reference RAI-43-5-10, Vol. 7, p. 6-9 and 6-11). Based on the use of only two magnitude values in the Mmax distribution, the weights given to the two magnitudes (e.g., 0.8 weight given to the upper-bound magnitude) (Reference RAI-43-5-10, Vol. 7, p. 6-14), and the fact that Mobs within the zone is a 1925 Emb 6.4 earthquake, it is clear that the lower-bound Mmax value is based on an Mobs of 6.4. Therefore, to update the Mmax distribution of the zone, the lower-bound Mmax value for the zone needs to be updated to mb 6.9. The updated Mmax distribution for Zone 12 is then: 6.9 (0.2), 7.4 (0.8) (Table RAI-43-5-1).

The 1988 Saguenay earthquake also occurs within Law Zone 109. As described in the response to RAI 43, Question 02.05.02-4 (Reference RAI-43-5-20), this zone was explicitly drawn to include the Saguenay graben, so it is logical to update the zone to account for the Saguenay earthquake. The Pa for the zone is 1.0 and does not need to be updated. However, the Mmax distribution is defined using a single magnitude (mb 5.5) that is less than the magnitude of the Saguenay earthquake, so the Mmax distribution needs to be updated. Based on the single magnitude Mmax distribution, it appears that the Mmax for Zone 109 is based on the Mobs. Therefore, the updated Mmax distribution for Zone 109 should be a single magnitude set to the magnitude of the Saguenay earthquake: mb 6.2 (1.0) (Table RAI-43-5-1).

Rondout

Similar to the Bechtel team, the 1988 Saguenay earthquake also occurs within a large background zone defined by the Rondout team (Zone 50). As discussed in the response to RAI 43, Question 02.05.02-4 (Reference RAI-43-5-20), the most likely updates the Rondout team would have made to their source characterizations to account for the Saguenay earthquake would have been to either: (1) define a new seismic zone representing the Saguenay graben, or (2) extend their SLR Seismic Zone (Zone 39) to include the Saguenay graben. Defining a new Saguenay graben source would have no impact on the PSEG Site given the considerable distance between the PSEG Site and the graben, so this discussion considers the impact of the Saguenay earthquake on Zone 39. Instead of updating the geometry of Zone 39 to encompass the Saguenay graben, the impact of the Saguenay earthquake is accounted for on the Mmax distribution for the zone (the Pa value for the zone is 0.99, so there is no need to update it) (Table RAI-43-5-1). This approach is adequate for this sensitivity study because expanding the zone is unlikely to increase the hazard at the PSEG Site (i.e., the expanded zone would be further north from the site, and there is not a concentration of seismicity within the Saguenay graben to increase the seismicity rate within the expanded zone).

The lower-bound Mmax value for Zone 39 is mb 5.8 (Table RAI-43-5-1), so the Mmax distribution needs to be updated to account for the Saguenay earthquake. The Rondout team defined Mmax distributions based on classifying zones as being capable of generating great earthquakes, capable of generating large earthquakes, capable of generating moderate earthquakes, or as background zones. Zone 39 was originally classified as a zone capable of generating large earthquakes (Reference RAI-43-5-10, Vol. 10, p. C-4), but was given an Mmax distribution with lower magnitudes than other large earthquake zones (i.e., magnitudes between 5.8 and 6.8 versus 6.6 and 7.0). Therefore, to update the Mmax distribution of Zone 39, the Mmax distribution will be set to the higher of the two distributions used for zones capable of large earthquakes: mb 6.6 (0.3), 6.8 (0.6), 7.0 (0.1) (Table RAI-43-5-1).

Weston

The response to RAI 43, Question 02.05.02-4 (Reference RAI-43-5-20) describes the 1988 Saguenay earthquake as occurring within a zone that was used to calculate seismicity rates for the CSZ and it was not intended to be a seismic source. Therefore, the most likely updates the Weston team would have made to their source characterizations to account for the Saguenay earthquake would have been to either: (1) define a new seismic zone representing the Saguenay graben, or (2) extend their SLR Seismic Zone (Zone 4) to include the Saguenay graben. Defining a new Saguenay graben source would have no impact on the PSEG Site given the considerable distance between the PSEG Site and the graben, so this discussion considers the impact of the Saguenay earthquake on Zone 4.

The lower-bound Mmax value for Zone 4 is mb 5.4 (Table RAI-43-5-1), so the Mmax distribution needs to be updated to account for the Saguenay earthquake. As previously described, the Weston team's methodology for developing the original Mmax distribution was based on developing a cumulative probability of activity distribution for earthquakes based on their mb magnitude. From this cumulative distribution, a probability density function (PDF) describing the probability that a given Mmax value is appropriate for the seismic zone was determined (Reference RAI-43-5-10, Vol. 5, C-12). Developing an updated Mmax distribution entails truncating the PDF at a new magnitude and renormalizing the distribution. The truncation magnitude for the updated Mmax distribution is chosen as mb 6.6 to ensure that the lower bound of the revised Mmax distribution is greater than the magnitude of the Saguenay earthquake (mb 6.2). Truncating the original distribution at 6.6 results in the updated Mmax distribution for Zone 4 of 6.6 (0.65), 7.2 (0.35) (Table RAI-43-5-1).

<u>Woodward-Clyde</u>

The 1663 Charlevoix earthquake also occurred within Woodward-Clyde Zone 12 representing the CSZ. The lower-bound Mmax value for Zone 12 is mb 6.5 (Table RAI-43-5-1), so the Mmax distribution needs to be updated to account for the revised mb 6.9 magnitude used here for the 1663 earthquake. As previously described, the Woodward-Clyde methodology for developing Mmax distributions was to estimate the Mmax using several different approaches and then combine these component estimates into a single, composite Mmax distribution.

To account for the updated mb 6.9 magnitude for the 1663 earthquake, both of the original component PDFs based on Mobs (Reference RAI-43-5-10, Vol. 8, p. C-29) need to be updated following the methodology previously described above for an intensity-based mb 6.9 earthquake. Updating the component distributions, truncating the normalized composite PDF, and renormalizing the PDF results in an updated Mmax distribution for Zone 12 of 7.0 (0.4), 7.25 (0.23), 7.5 (0.29), 7.75 (0.09) (Table RAI-43-5-1).

As described in the response to RAI 43, Question 02.05.02-4 (Reference RAI-43-5-20), the 1988 Saguenay earthquake does not occur within any zones defined by the Woodward-Clyde team. Therefore, the most likely updates the Woodward-Clyde team would have made to their source characterizations to account for the Saguenay earthquake would have been to either: (1) define a new seismic zone representing the Saguenay graben, or (2) extend their SLR Seismic Zone (Zone 14) to include the Saguenay graben. Defining a new Saguenay graben source would have no impact on the PSEG Site given the considerable distance between the PSEG Site and the graben, so this discussion considers the impact of the Saguenay earthquake on Zone 14.

The lower-bound Mmax value for Zone 14 is mb 6.6 (Table RAI-43-5-1), so the Mmax distribution does not need to be updated to account for the Saguenay earthquake. As previously described in the section regarding RAI 43, Question 02.05.02-2 (Section 2), Zone 14 had numerous earthquakes with magnitudes greater than mb 5.0 (e.g., mb 5.7

in 1732, mb 5.7 in 1944, mb 5.9 in 1860, mb 6.1 in 1663, mb 6.3 in 1870, and mb 6.4 in 1925), yet the team defined the Pa value as 0.25. If the team were to have expanded Zone 14 to include the Saguenay earthquake, it is not possible to determine how the team would have changed their evaluation of the Pa value for the zone. However, in this case, it is reasonable to assume that the team would have increased the Pa value of Zone 14 to 1.0. This is because the region of the Saguenay earthquake has no source zones defined by the Woodward-Clyde team, so Zone 14 would be the only interpretation of the seismicity within the region of the Saguenay earthquake. Because the magnitude of the Saguenay earthquake is greater than or equal to mb 5.0, the Pa of Zone 14 then needs to be 1.0 for the Woodward-Clyde team's source characterizations to be a complete description of the observed seismicity. In contrast, all of the earthquakes within the EPRI-SOG catalog with magnitudes greater than or equal to mb 5.0 that occur within Zone 14 also occur within other zones that provide alternate interpretations of the seismicity within their respective regions (e.g., Zones 13 and 15), so the Pa of Zone 14 does not need to be 1.0 to adequately describe that seismicity. Therefore, the updated Pa for Zone 14 is then 1.0 (Table RAI-43-5-1). It should be noted that increasing the Pa of Zone 14 is conservative because it will result in double counting of some seismicity (i.e., the combined Pa values of some overlapping zones are greater than 1.0).

Sensitivity Analyses for CSZ and SLR (RAI 43, Question 02.05.02-4a)

A sensitivity analysis was conducted to illustrate the impact of the updates to the EPRI-SOG model described above on the PSEG ground motion. The sensitivity analysis was conducted using the same source model used for the PSEG Site ESPA (see SSAR Subsection 2.5.2.2.1) with the modifications described above. Table RAI-43-5-2 lists the modifications for the scenarios (Scenarios 4 and 5) developed for the response to RAI 43, Question 02.05.02-4a. The difference between the two scenarios is how the Saguenay earthquake is accounted for in the updates:

- Scenario 4 represents the interpretation that the teams would have updated their St. Lawrence Rift zones, where needed, to account for the Saguenay earthquake (instead of developing unique source zones for the Saguenay graben).
- Scenario 5 represents the interpretation that the teams would have developed unique source zones for the Saguenay graben instead of updating their St. Lawrence Rift zones (i.e., there is no impact of the Saguenay earthquake on the PSEG Site source model for most of the EPRI-SOG teams because the new sources are too far from the PSEG Site).

Note that the new hazard values calculated for these scenarios do not use the CAV filter (see SSAR Section 2.5.2.4.3).

Table RAI-43-5-4, Table RAI-43-5-5, and Figure RAI-43-5-8 illustrate the impact of the CSZ and SLR scenarios (Scenarios 4 and 5), as well as the other scenarios presented in Table RAI-43-5-2, Table RAI-43-5-4, Table RAI-43-5-5, and Figure RAI-43-5-8 demonstrate that:

- Accounting for new information with respect to the CSZ and SLR has a very small impact and only at low frequencies (e.g., largest increase over PSEG SSAR rock GMRS of 2.2% at 0.5 Hz)
- There is no significant difference between the two updated scenarios with respect to the impact on the PSEG Site GMRS (e.g., greatest difference in rock GMRS values is 0.0002 g at 0.5 Hz).

SECTION 4 – SUPPLEMENTAL RESPONSE TO RAI 43, QUESTION 02.05.02-4B (NEW ENGLAND EARTHQUAKES)

The response to RAI 43, Question 02.05.02-4b (Reference RAI-43-5-20), identifies specific seismic zones for three of the EPRI-SOG teams as potentially needing to be updated to adequately characterize more recent data and information regarding seismicity within the New England region. The bases for these updates are two earthquakes: the 11 June 1638 earthquake in central New Hampshire, and the 18 November 1755 Cape Ann earthquake off the coast of Massachusetts. The 1638 earthquake was not identified within the EPRI-SOG catalog, but Ebel (Reference RAI-43-5-5) describes the earthquake as having a magnitude of M_{Lg} 6.5 ± 0.5 (mb 6.5 ± 0.5). Instead of adopting the magnitude of Ebel (Reference RAI-43-5-5) for the 1638 earthquake, the Mw 5.3 (mb 5.7) magnitude of the earthquake as presented within the EPRI Central and Eastern United States Seismic Source Characterization (CEUS SSC) project seismicity catalog (Reference RAI-43-5-13) is adopted. This magnitude is preferred over the magnitude of Ebel (Reference RAI-43-5-5) because it was developed as part of the SSHAC Level 3 (Reference RAI-43-5-2) EPRI CEUS SSC project, as opposed to the magnitude of Reference RAI-43-5-5 that represents the opinion of a single researcher. Similarly, the 1755 earthquake is given a magnitude of Mw 6.1 (mb 6.3) in the EPRI CEUS SSC catalog (Reference RAI-43-5-13). This magnitude is adopted over those presented by Reference RAI-43-5-6 and Reference RAI-43-5-1. The locations of these earthquakes as presented within the EPRI CEUS SSC project (Figure RAI-43-5-7) are also adopted.

The following paragraphs describe the updates for each of the three teams identified in the response to RAI 43, Question 02.05.02-4b (Reference RAI-43-5-20).

Bechtel

Both the 1755 and 1638 earthquakes occur within Bechtel Zone BZ8. The lower-bound Mmax for the zone is 5.7, so the Mmax distribution needs to be updated to account for the mb 6.3 1755 earthquake. Following the same Bechtel methodology for developing Mmax distributions that was previously described, the updated Mmax distribution for Zone BZ8 is: 6.3 (0.1), 6.6 (0.5), 6.9 (0.4) (Table RAI-43-5-1).

Dames & Moore

The location of the 1638 earthquake, as reported by Reference RAI-43-5-5, places the earthquake within Zone 53, and the location of the earthquake, as reported by the EPRI CEUS SSC project (Reference RAI-43-5-13), places the earthquake within Zone 63 (Figure RAI-43-5-7). The magnitude from the EPRI CEUS SSC project is adopted; therefore, we also adopt the location from that project. The 1755 earthquake also occurs within Zone 63, so the larger mb 6.3 1755 earthquake becomes the basis for updating Zone 63.

The Dames & Moore team estimated Mmax values using two approaches: (1) they assumed that the Mmax was mb 7.2, and (2) they calculated the Mmax using the rate of observed seismicity (Reference RAI-43-5-10, Vol. 6, p. 6-4). For Zone 63, the rate-based Mmax value is mb 5.7 (Reference RAI-43-5-10, Vol. 6, p. 6-10), lower than the mb 6.3 magnitude of the 1755 earthquake. The Mmax distribution can then be updated by removing the rate-based Mmax interpretation and putting all of the weight on the assumed mb 7.2 value. The resultant updated Mmax distribution for Zone 63 is 7.2 (1.0) (Table RAI-43-5-1). It should be noted that because the Pa value of Zone 63 is less than 1.0, the Mmax distribution for Zone 62 (an alternate interpretation of seismicity within the region of Zone 53), is also updated to 7.2 (1.0). However, this update is not required for the PSEG Site because Zone 62 is over 450 km (280 mi.) from the site and was not considered in the SSAR.

Law

The response to RAI 43, Question 02.05.02-4b (Reference RAI-43-5-20), states that the 1638 earthquake occurs within Law Zone 102 and that the earthquake potentially warrants updating the Mmax distribution of the zone. This conclusion is based on the magnitude estimate and location of the earthquake presented by Ebel in Reference RAI-43-5-5. However, the location of the earthquake presented within the EPRI CEUS SSC project catalog (Reference RAI-43-5-13) places the earthquake within Zones C11 and C13 (Figure RAI-43-5-7). The lower-bound Mmax values for these zones are mb 6.8 (Reference RAI-43-5-11), so there is no need to update the Mmax of the zone to account for the 1638 earthquake.

Sensitivity Analyses for Updated New England Earthquakes (RAI 43, Question 02.05.02-4b)

A sensitivity analysis was conducted to determine the impact of the updates to the EPRI-SOG model described above on the PSEG ground motion. The sensitivity analysis was conducted using the same source model as used for the PSEG Site ESPA (see SSAR Subsection 2.5.2.2.1) with modifications described above. Table RAI-43-5-2 lists the modifications for the scenario (Scenario 6) developed for the response to RAI 43, Question 02.05.02-4b. Note that the new hazard values calculated for these scenarios do not use the CAV filter (see SSAR Section 2.5.2.4.3).

Table RAI-43-5-4, Table RAI-43-5-5, and Figure RAI-43-5-8 illustrate the impact of the New England earthquake scenario (Scenario 6), as well as the other scenarios presented in Table RAI-43-5-2.

Table RAI-43-5-4, Table RAI-43-5-5, and Figure RAI-43-5-8 demonstrate that accounting for new information with respect to New England earthquakes has a very small impact only at low frequencies (e.g., largest increase over PSEG SSAR rock GMRS of 0.1% at 1.0 and 0.5 Hz)

SECTION 5 – CUMULATIVE IMPACT OF SENSITIVITY STUDIES

Combining the impacts of the four sensitivity studies described above (Scenarios 1 through 6), and the study presented in the response to RAI 43, Question 02.05.02-1 (Reference RAI-43-5-20) with respect to the New Madrid Seismic Zone (NMSZ), (Scenario 7), illustrates the combined impact of the source model modifications on the PSEG Site. The combined sensitivity analysis is conducted using the same source model used for the PSEG Site ESPA (see SSAR Subsection 2.5.2.2.1) with modifications summarized in Table RAI-43-5-2 for Scenarios 8 and 9. The difference between Scenarios 8 and 9 is how the Saguenay earthquake is accounted for in the updates:

- Scenario 8 represents the interpretation that the teams would have updated their St. Lawrence Rift zones, where needed, to account for the Saguenay earthquake (instead of developing unique source zones for the Saguenay graben).
- Scenario 9 represents the interpretation that the teams would have developed unique source zones for the Saguenay graben instead of updating their St. Lawrence Rift zones (i.e., there is no impact from the Saguenay earthquake on the PSEG Site source model for most of the EPRI-SOG teams).

Both of these cumulative impact scenarios use the preferred interpretation of the Bechtel team's treatment of the Mineral earthquake (i.e., update Zone E and not Zone 17) and the preferred updated NMSZ renewal model (60-year plant life starting in June 2021) (see response to RAI 43, Question 02.05.02-1; Reference RAI-43-5-20).

Note that the new hazard values calculated for these scenarios do not use the CAV filter (see SSAR Section 2.5.2.4.3).

Table RAI-43-5-4, Table RAI-43-5-5, and Figure RAI-43-5-8 illustrate the results of the NMSZ impact (Scenario 7) and the cumulative impact scenarios (Scenarios 8 and 9), as well as the other scenarios presented in Table RAI-43-5-2, through comparing the hypothetical rock GMRS using the PSEG Site ESPA rock hazard to the rock GMRS for the different scenarios, assuming rock site conditions for the ESPA and sensitivity scenario GMRS values.

Table RAI-43-5-4, Table RAI-43-5-5, and Figure RAI-43-5-8 demonstrate that:

- The cumulative impact of the sensitivity scenarios is dominated by the inclusion of the NMSZ in the hazard calculations (e.g., compare Scenario 7, NMSZ, to Scenario 8, the cumulative scenario);
- The largest impact of the cumulative sensitivity analyses on the PSEG rock GMRS is at low frequencies (i.e., 1 Hz and 0.5 Hz), but the actual increase in ground motion is relatively small (e.g., less than 0.025g); and
- There is no significant difference between the two versions of the cumulative scenarios (e.g., the largest difference in the rock GMRS between Scenario 8 and 9 is 0.0001 at 1.0 and 0.5 Hz).

This response demonstrates that the net effect of the areas considered in RAI No. 43 Question Nos. 02.05.02-1, 02.05.02-4, and 02.05.02-5 is to increase the impact on the PSEG Site rock GMRS at low frequencies by a small numerical amount, but, due to already low GMRS values for the PSEG site, represent a large percentage increase. As a result of the sensitivity analyses presented in this response, a GMRS for the outcrop of the competent layer in accordance with RG 1.208 will be prepared using the dynamic profile discussed in SSAR Subsections 2.5.2.5 and 2.5.2.6. The modified GMRS will be presented in a supplement to this response.

Table RAI-43-5-1: Updated EPRI SOG Mmax and Pa Values

Team	Zone	Original Pa	Updated Pa (1)	Original Mmax (mb) [wt.]	Updated Mmax (mb) [wt.]	Other Updates
Bechtel	17 (Stafford Fault)	0.1	0.60	5.4 [0.1] 5.7 [0.4] 6.0 [0.4] 6.6 [0.1]	5.9 [0.1] 6.2 [0.4] 6.5 [0.4] 6.6 [0.1]	NA
	E (Central Virginia)	0.35	0.51	5.4 [0.1] 5.7 [0.4] 6.0 [0.4] 6.6 [0.1]	5.9 [0.1] 6.2 [0.4] 6.5 [0.4] 6.6 [0.1]	NA
	BZ5 (S. Appalachians)	1.0	NA	5.7 [0.1] 6.0 [0.4] 6.3 [0.4] 6.6 [0.1]	5.9 [0.1] 6.2 [0.4] 6.5 [0.4] 6.6 [0.1]	NA
	3 (Charlevoix – LaMalbaie)	0.8	NA	6.4 [0.1] 6.6 [0.1] 6.7 [0.4] 7.0 [0.4]	6.9 [0.2] 7.2 [0.4] 7.5 [0.4]	NA
	2 (St. Lawrence Rift)	0.45	0.55	6.4 [0.1] 6.6 [0.1] 6.7 [0.4] 7.0 [0.4]	6.9 [0.2] 7.2 [0.4] 7.5 [0.4]	NA
	BZ8 (N. Appalachians Region)	1.0	NA	5.7 [1.0] 6.0 [0.4] 6.3 [0.4] 6.6 [0.1]	6.3 [0.1] 6.6 [0.5] 6.9 [0.4]	NA
Dames & Moore	40 (Central Virginia)	1.0	NA	6.6 [0.8] 7.2 [0.2]	NA	Update geometry
	63 (Regional So. / Default for 62)	0.72	NA	5.7 [0.8] 7.2 [0.2]	7.2 [1.0]	NA
Law	17 (Eastern Basement	0.62	0.85	5.7 [0.2] 6.8 [0.8]	5.9 [0.2] 6.8 [0.8]	NA
	217 (Eastern Basement Background)	1.0	NA	4.9 [0.5] 5.7 [0.5]	5.9 [1.0]	NA
	112 (Ohio-PA Block)	1.0	NA	4.6 [0.2] 5.1 [0.5] 5.5 [0.3]	5.4 [0.5] 5.5 [0.5]	NA
	9 (St. Lawrence Rift)	0.89	NA	5.0 [0.2] 5.8 [0.5] 7.4 [0.3]	5.3 [0.2] 5.8 [0.5] 7.4 [0.3]	NA
	12 (Charlevoix – LaMalbaie)	1.0	NA	6.4 [0.2] 7.4 [0.8]	6.9 [0.2] 7.4 [0.8]	NA
	109 (St. Lawrence Lowlands)	1.0	NA	5.5 [1.0]	6.2 [1.0]	Not included in SSAR
Rondout	C02 (Background 50)	NA	NA	4.8 [0.2] 5.5 [0.6] 5.8 [0.2]	5.5 [0.8] 5.8 [0.2]	NA
	C07 ([50-02]+12)	NA	NA	4.8 [0.2] 5.5 [0.6] 5.8 [0.2]	5.5 [0.8] 5.8 [0.2]	NA
	39 (St. Lawrence	0.99	NA	5.8 [0.15] 6.5 [0.60]	6.6 [0.3] 6.8 [0.6]	NA

Team	Zone	Original Pa	Updated Pa (1)	Original Mmax (mb) [wt.]	Updated Mmax (mb) [wt.]	Other Updates
	Rift)			6.8 [0.25]	7.0 [0.1]	
Weston	22 (Central Virginia)	0.82	0.91	5.4 [0.19] 6.0 [0.65] 6.6 [0.16]	6.0 [0.81] 6.6 [0.19]	NA
	C21 (104-25), C22 (104-26), C25 (104-28BCDE), C34 (104-28BE-26), C35 (104-28BE-25)	NA	NA	5.4 [0.24] 6.0 [0.61] 6.6 [0.15]	C21, C22, C34: 6.0 [0.81] 6.6 [0.19] C25, C35: NA	NA
	4 (St. Lawrence Rift)	1.0	NA	5.4 [0.55] 6.0 [0.28] 6.6 [0.14] 7.2 [0.03]	6.6 [0.65] 7.2 [0.35]	NA
Woodward-Clyde	26 (Central VA Gravity Saddle)	0.434	0.5	5.4 [0.33] 6.5 [0.34] 7.0 [0.33]	6.00 [0.20] 6.25 [0.17] 6.50 [0.27] 6.75 [0.13] 7.00 [0.12] 7.25 [0.07] 7.50 [0.04]	NA
	27 (State Farm Complex)	0.474	0.5	5.6 [0.33] 6.3 [0.34] 6.9 [0.33]	6.00 [0.22] 6.25 [0.32] 6.50 [0.16] 6.75 [0.21] 7.00 [0.05] 7.25 [0.04]	NA
	28 (Richmond Basin)	0.092	0.0	5.3 [0.33] 6.0 [0.34] 7.2 [0.33]	NA	NA
	12 (Charlevoix)	0.894	NA	6.5 [0.33] 7.0 [0.34] 7.5 [0.33]	7.0 [0.40] 7.25 [0.23] 7.5 [0.29] 7.75 [0.09]	NA
	14 (St. Lawrence Rift)	0.25	1.0	6.6 [0.33] 6.8 [0.34] 7.3 [0.33]	NA	NA

(1) Values rounded to two decimal places.

Table RAI-43-5-2: Sensitivity Scenarios (Updated Parameters Shown in Table RAI-43-5-1)

Scenario [1]	EPRI-SOG Team[2]						Other[3]
	Bechtel	Dames & Moore	Law	Rondout	Weston	Woodward -Clyde	
Scenario 1 (02.05.02-5 v1)	17, BZ5	40	17, 217	None	22, C21, C22, C34	26, 27, 28	None
Scenario 2 (02.05.02-5 v2)	E, BZ5	40	17, 217	None	22, C21, C22, C34	26, 27, 28	None
Scenario 3 (02.05.02-2)	None	None	112, 9	C02, C07	None	None	None
Scenario 4 (02.05.02-4a v1)	2, 3	None	12, 109	39	4	12,14	None
Scenario 5 (02.05.02-4a v2)	3	None	12, 109	None	None	12	None
Scenario 6 (02.05.02-4b)	BZ8	63	None	None	None	None	None
Scenario 7 (02.05.02-1)	None	None	None	None	None	None	Use updated New Madrid (t = 60 years, start date = June 2021)
Scenario 8 (combined v1)	E, BZ5, 2, 3, BZ8	40, 63	17, 217, 112, 9, 12, 109	C02, C07, 39	22, C21, C22, C34, 4	26, 27, 28, 12, 14	Use updated New Madrid (t = 60 years, start date = June 2021)
Scenario 9 (combined v2)	E, BZ5, 3, BZ8	40, 63	17, 217, 112, 9, 12, 109	C02, C07	22, C21, C22, C34	26, 27, 28, 12	Use updated New Madrid (t = 60 years, start date = June 2021)

(1) The ( ) refers to the RAI 43 question being addressed by the scenario. The v1 and v2 refer to differing interpretations made as discussed in the text. The "combined" term refers to a combination of scenarios 1 through 7 with the Saguenay earthquake and two interpretations for that earthquake as described in the text.

(2) The different seismic zones updated for the EPRI-SOG teams are shown for each scenario. Table RAI-43-5-1 provides the updated parameters.

(3) Other information pertinent to the analysis.

Table RAI-43-5-3: EPRI-SOG Sources Relevant to the Mineral Earthquake

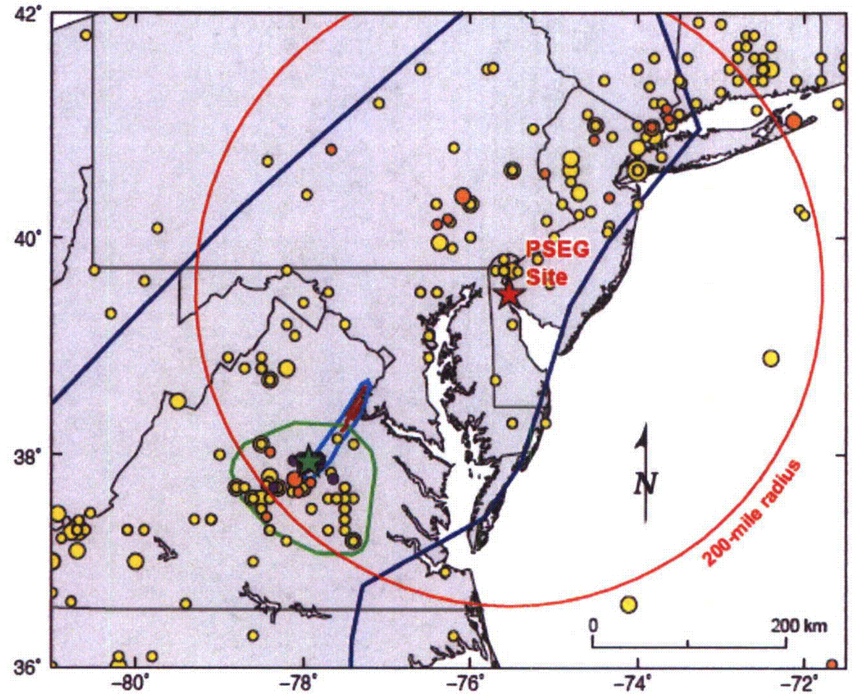
Team	Zone	Pa	Mmax (mb) [wt.]	Dependencies	Considered for PSEG	Contributed to Site Hazard
Bechtel	17 (Stafford Fault)	0.1	5.4 [0.1] 5.7 [0.4] 6.0 [0.4] 6.6 [0.1]	ME with all other sources (computational)	Yes	No
	E (Central Virginia)	0.35	5.4 [0.1] 5.7 [0.4] 6.0 [0.4] 6.6 [0.1]	None	Yes	Yes
	BZ5 (S. Appalachians)	1.0	5.7 [0.1] 6.0 [0.4] 6.3 [0.4] 6.6 [0.1]	Background for 17 and E	Yes	Yes
Dames & Moore	40 (Central Virginia)	1.0	6.6 [0.8] 7.2 [0.2]	None	Yes	Yes
	41 (Default for 42, 43, 46)	0.12	6.1 [0.8] 7.2 [0.2]	Mutually exclusive with 42, 43, 46	Yes	Yes
	42 (Newark G. Basin)	0.4	6.3 [0.75] 7.2 [0.25]	Mutually exclusive with 41, 43, 46	Yes	Yes
	43 (Ramapo Fault)	0.2	6.1 [0.75] 7.2 [0.25]	Mutually exclusive with 41, 42, 46	Yes	No
	46 (Dan R. Basin)	0.28	6.0 [0.75] 7.2 [0.25]	Mutually exclusive with 41, 42, 43	No	No
Law	17 (Eastern Basement	0.62	5.7 [0.2] 6.8 [0.8]	None	Yes	Yes
	217 (Eastern Basement Background)	1.0	4.9 [0.5] 5.7 [0.5]	None	No	No
Rondout	29 (Central VA Seismic Zone)	1.0	6.6 [0.3] 6.8 [0.6] 7.0 [0.1]	None	Yes	Yes
Weston	22 (Central Virginia)	0.82	5.4 [0.19] 6.0 [0.65] 6.6 [0.16]	None	Yes	Yes
	104 (S. Coastal Plain)	1.0	5.4 [0.24] 6.0 [0.61] 6.6 [0.15]	None	No (used combination zones)	No
	C21 (104-25), C22 (104-26), C25 (104-28BCDE), C34 (104-28BE-26), C35 (104-28BE-25)	NA	5.4 [0.24] 6.0 [0.61] 6.6 [0.15]	None	Yes: C21, C22, C34 No: C25, C35	Yes: C21, C22, C34 No: C25, C35
Woodward-Clyde	26 (Central VA Gravity Saddle)	0.434	5.4 [0.33] 6.5 [0.34] 7.0 [0.33]	Mutually exclusive with 27, 28	Yes	Yes
	27 (State Farm Complex)	0.474	5.6 [0.33] 6.3 [0.34] 6.9 [0.33]	Mutually exclusive with 26, 28	Yes	Yes
	28 (Richmond Basin)	0.092	5.3 [0.33] 6.0 [0.34] 7.2 [0.33]	Mutually exclusive with 26, 27	Yes	No

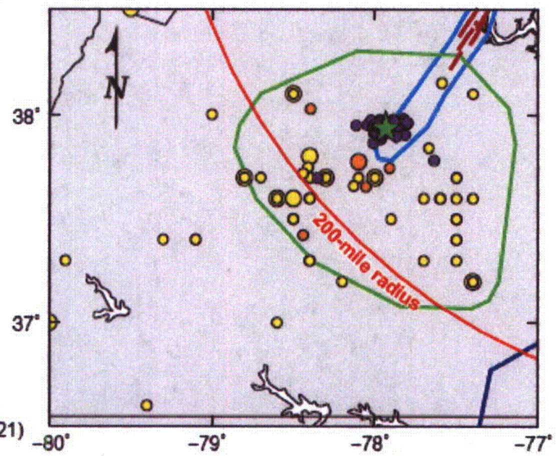
Table RAI-43-5-4: Rock GMRS values for sensitivity scenarios

Freq	PSEG SSAR	Rock GMRS (g) Sc. 1 (2.5.2-5 v1)	Sc. 2 (2.5.2-5 v2)	Sc. 3 (2.5.2-2)	Sc. 4 (2.5.2-4a v1)	Sc. 5 (2.5.2-4a v2)	Sc. 6 (2.5.2-4b)	Sc. 7 (2.5.2-1)	Sc. 8 (combined v1)	Sc. 9 (combined v2)
PGA	0.222	0.228	0.228	0.222	0.222	0.222	0.222	0.222	0.228	0.228
25 Hz	0.610	0.624	0.624	0.610	0.610	0.610	0.610	0.611	0.625	0.625
10 Hz	0.390	0.400	0.400	0.390	0.390	0.390	0.390	0.391	0.400	0.400
5 Hz	0.239	0.246	0.246	0.239	0.239	0.239	0.239	0.240	0.247	0.247
2.5 Hz	0.116	0.120	0.120	0.116	0.116	0.116	0.116	0.120	0.124	0.124
1 Hz	0.0432	0.0446	0.0446	0.0432	0.0436	0.0435	0.0432	0.0573	0.0586	0.0585
0.5 Hz	0.0272	0.0277	0.0277	0.0272	0.0278	0.0276	0.0272	0.0514	0.0519	0.0518

Table RAI-43-5-5: Percent increase in rock GMRS values over PSEG SSAR

Freq	PSEG SSAR	Percent increase in GMRS Sc. 1 (2.5.2-5 v1)	Sc. 2 (2.5.2-5 v2)	Sc. 3 (2.5.2-2)	Sc. 4 (2.5.2-4a v1)	Sc. 5 (2.5.2-4a v2)	Sc. 6 (2.5.2-4b)	Sc. 7 (2.5.2-1)	Sc. 8 (combined v1)	Sc. 9 (combined v2)
PGA	NA	2.4%	2.4%	0.0%	0.0%	0.0%	0.0%	0.0%	2.4%	2.4%
25 Hz	NA	2.3%	2.3%	0.0%	0.0%	0.0%	0.0%	0.0%	2.3%	2.3%
10 Hz	NA	2.4%	2.4%	0.0%	0.0%	0.0%	0.0%	0.1%	2.5%	2.5%
5 Hz	NA	2.7%	2.7%	0.0%	0.0%	0.0%	0.0%	0.4%	3.1%	3.1%
2.5 Hz	NA	3.4%	3.5%	0.0%	0.1%	0.1%	0.0%	4.1%	7.4%	7.4%
1 Hz	NA	3.3%	3.3%	0.0%	0.9%	0.7%	0.1%	32.7%	35.6%	35.4%
0.5 Hz	NA	1.9%	1.9%	0.0%	2.2%	1.7%	0.1%	89.3%	91.1%	90.9%





LEGEND

- Mineral earthquake (Reference RAI-43-5-18)
- Mineral earthquake aftershocks (Reference RAI-43-5-21)

EPRI-SOG seismicity (1627-1984)
(see SSAR Section 2.5.2.1.1)

Magnitude (Emb)
- 3.00 - 3.99
- 4.00 - 4.99
- 5.00 - 5.99
- 6.00 - 7.00

Update seismicity for PSEG site (1985-2009)
(see SSAR Section 2.5.2.1.2)

Magnitude (Emb)
- 3.00 - 3.99
- 4.00 - 4.99
- 5.00 - 5.99
- 6.00 - 7.00

EPRI-SOG seismic zones
- Zone BZ5
- Zone 17
- Zone E
- Stafford fault zone (Reference RAI-43-5-17)

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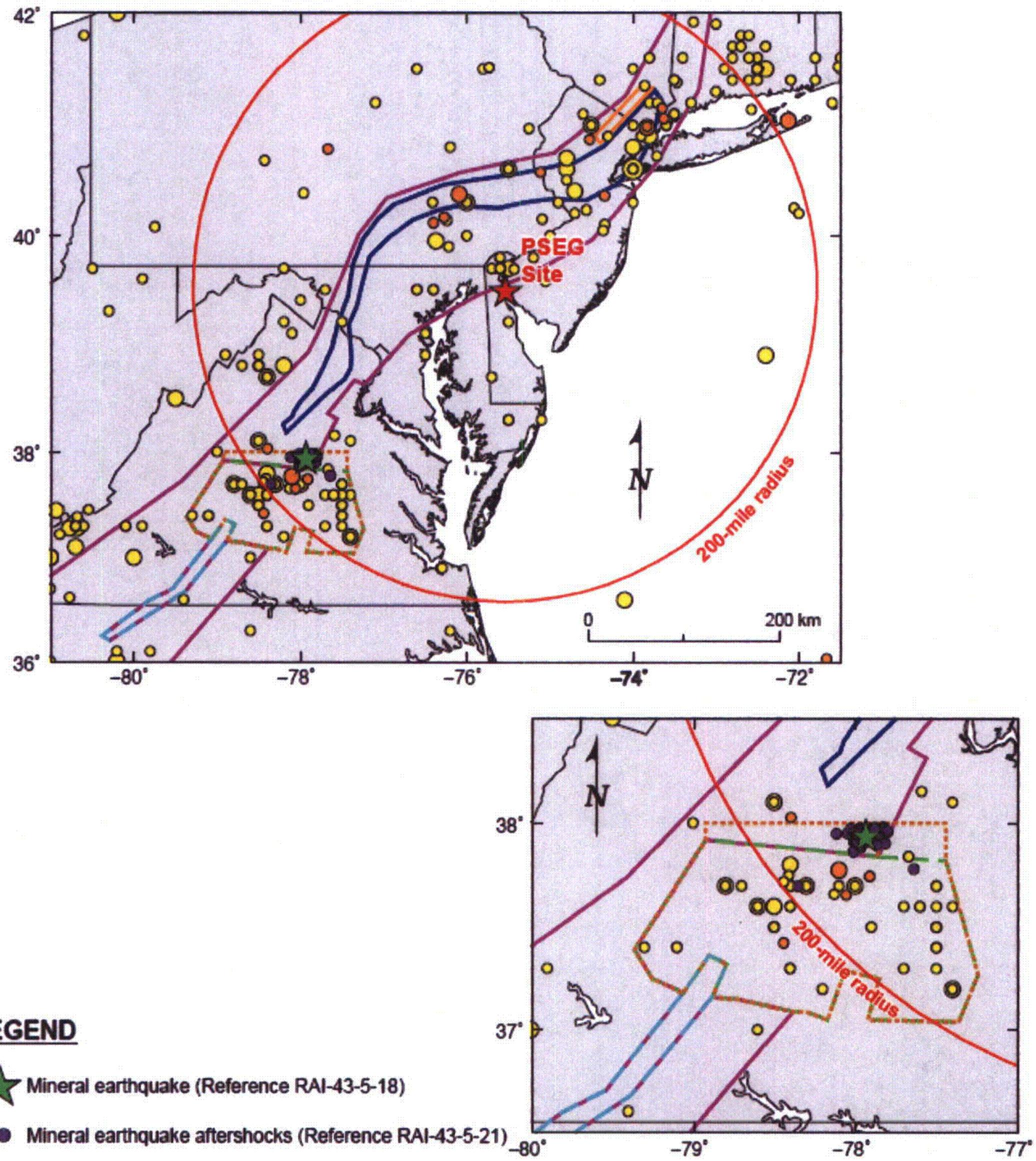
Selected Bechtel Seismic Zones and the Mineral Earthquake

FIGURE RAI-43-5-1

Rev 0



LEGEND

- Mineral earthquake (Reference RAI-43-5-18)
- Mineral earthquake aftershocks (Reference RAI-43-5-21)

EPRI-SOG seismicity (1627-1984)
(see SSAR Section 2.5.2.1.1)

Magnitude (Emb)
- 3.00 - 3.99
- 4.00 - 4.99
- 5.00 - 5.99
- 6.00 - 7.00

Update seismicity for PSEG site (1985-2009)
(see SSAR Section 2.5.2.1.2)

Magnitude (Emb)
- 3.00 - 3.99
- 4.00 - 4.99
- 5.00 - 5.99
- 6.00 - 7.00

EPRI-SOG seismic zones
- Zone 40
- Updated Zone 40
- Zone 41
- Zone 42
- Zone 43
- Zone 46

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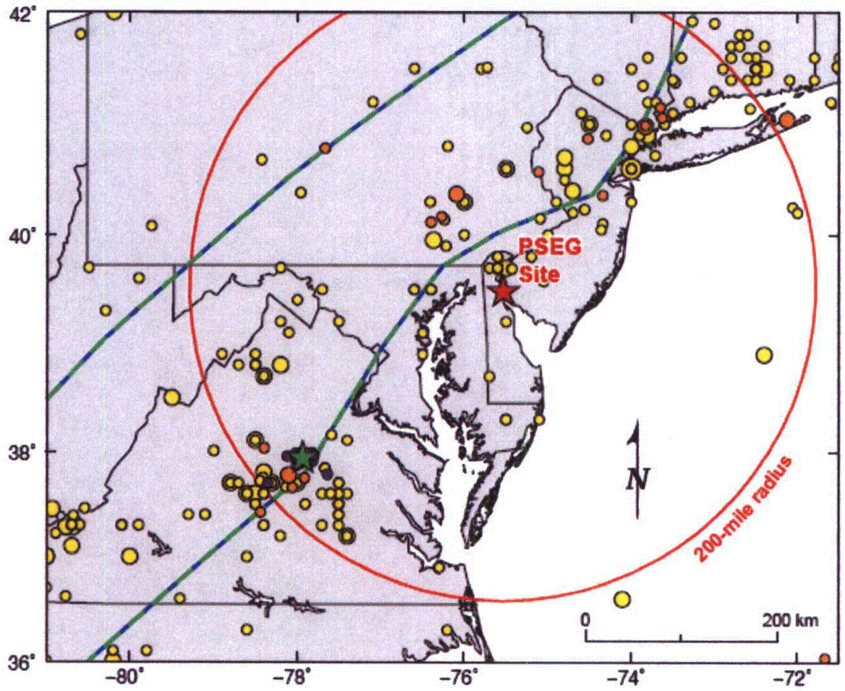
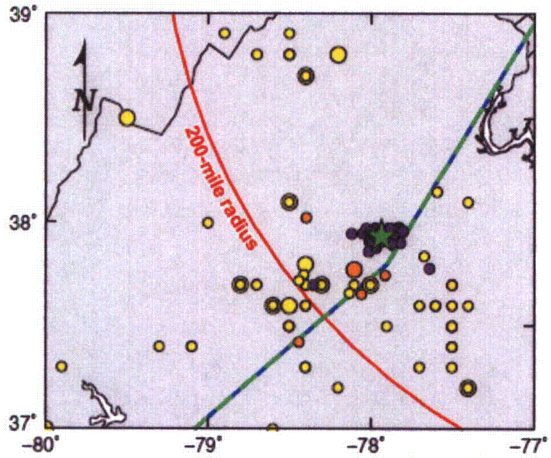
Selected Dames & Moore Seismic Zones and the Mineral Earthquake

FIGURE RAI-43-5-2

Rev 0





LEGEND

- Mineral earthquake (Reference RAI-43-5-18)
- Mineral earthquake aftershocks (Reference RAI-43-5-21)

EPRI-SOG seismicity (1627-1984)
(see SSAR Section 2.5.2.1.1)

Magnitude (Emb)

- 3.00 - 3.99
- 4.00 - 4.99
- 5.00 - 5.99
- 6.00 - 7.00

Update seismicity for PSEG site (1985-2009)
(see SSAR Section 2.5.2.1.2)

Magnitude (Emb)

- 3.00 - 3.99
- 4.00 - 4.99
- 5.00 - 5.99
- 6.00 - 7.00

EPRI-SOG seismic zones

- Zone 17
- Zone 217

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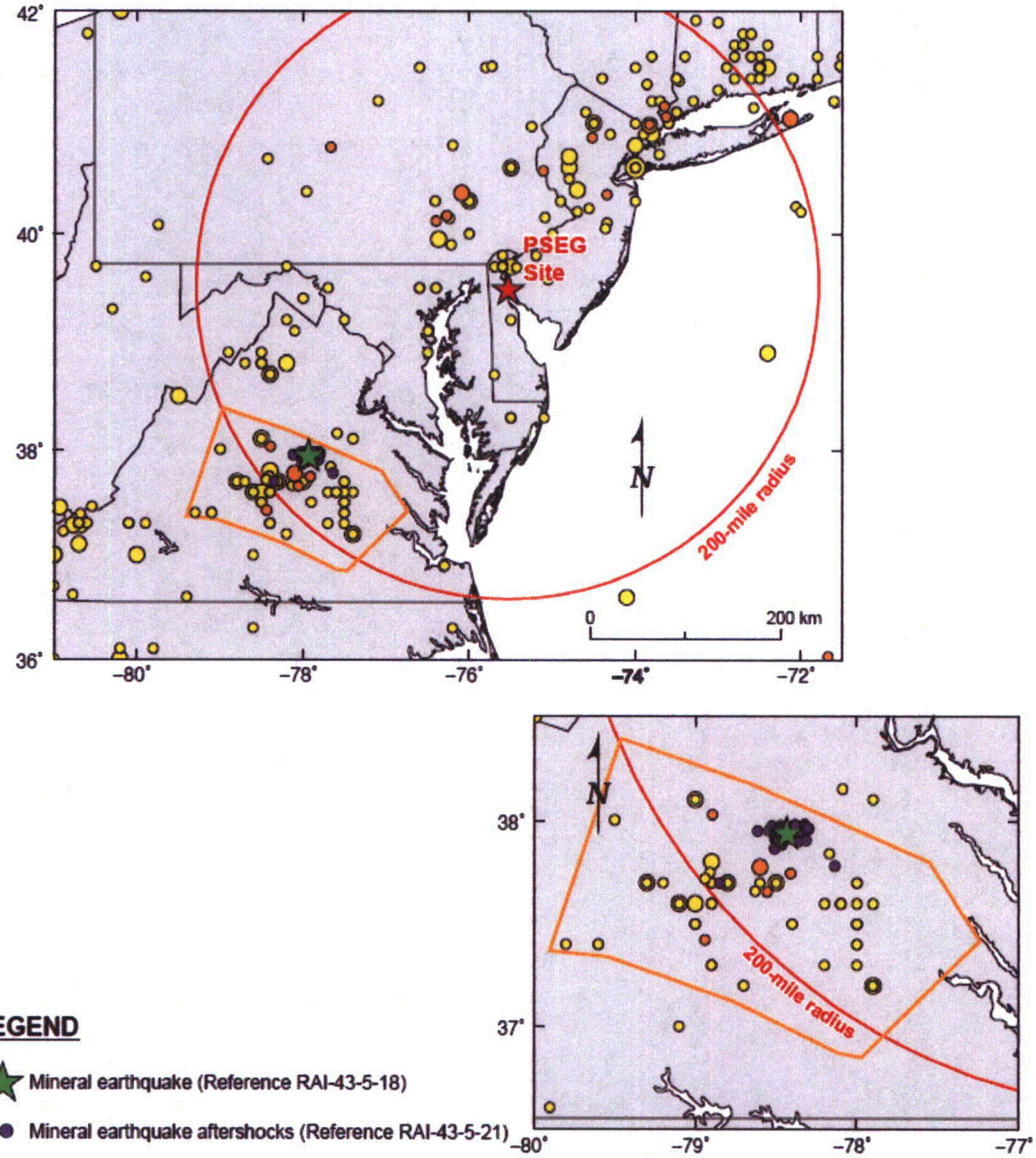
Selected Law Seismic Zones and the Mineral Earthquake

FIGURE RAI-43-5-3

Rev 0



LEGEND

Mineral earthquake (Reference RAI-43-5-18)

Mineral earthquake aftershocks (Reference RAI-43-5-21)

EPRI-SOG seismicity (1627-1984)
(see SSAR Section 2.5.2.1.1)

Magnitude (Emb)

- 3.00 - 3.99
- 4.00 - 4.99
- 5.00 - 5.99
- 6.00 - 7.00

Update seismicity for PSEG site (1985-2009)
(see SSAR Section 2.5.2.1.2)

Magnitude (Emb)

- 3.00 - 3.99
- 4.00 - 4.99
- 5.00 - 5.99
- 6.00 - 7.00

EPRI-SOG seismic zones

Zone 29

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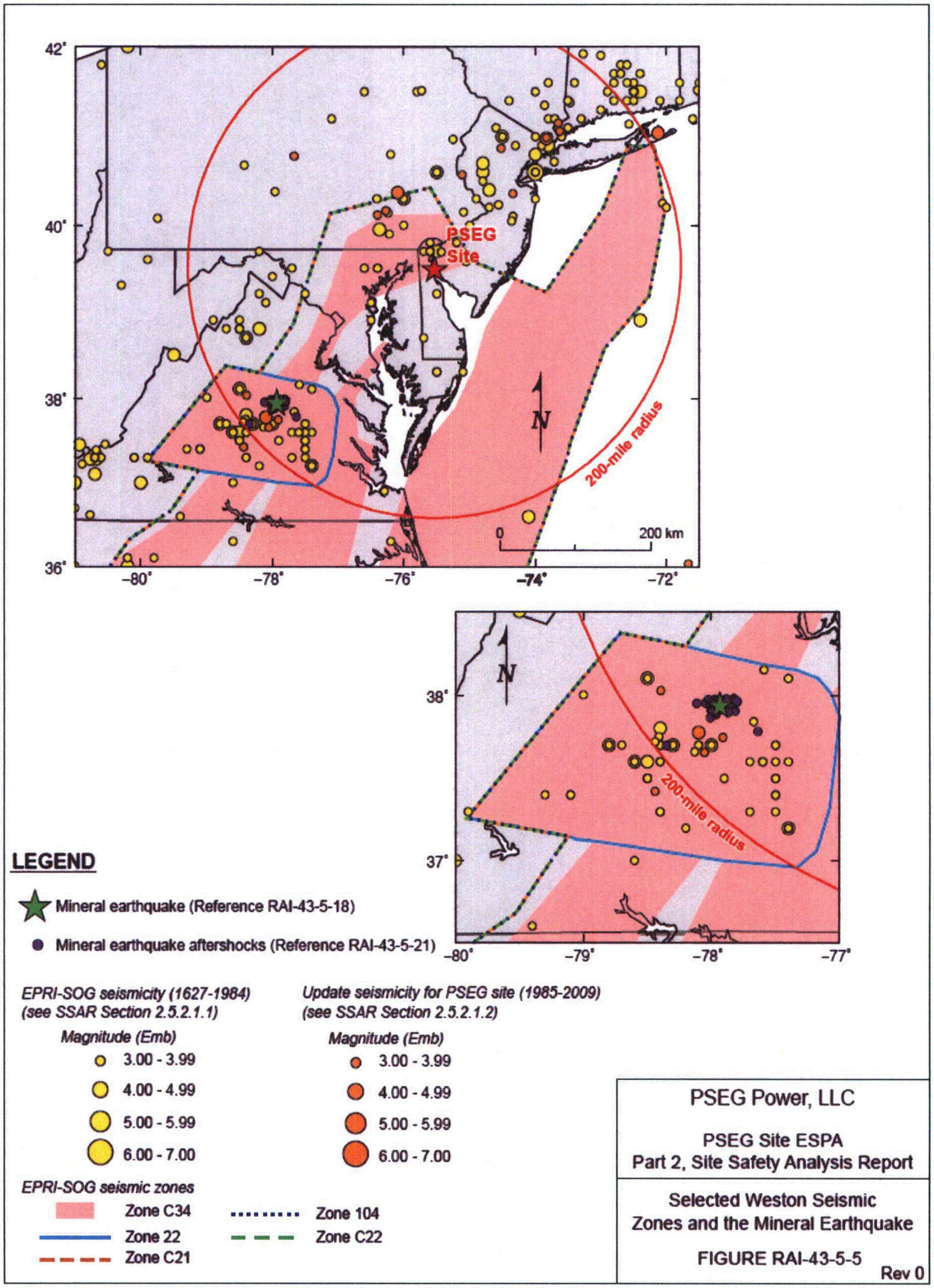
Selected Rondout Seismic Zones and the Mineral Earthquake

FIGURE RAI-43-5-4

Rev 0



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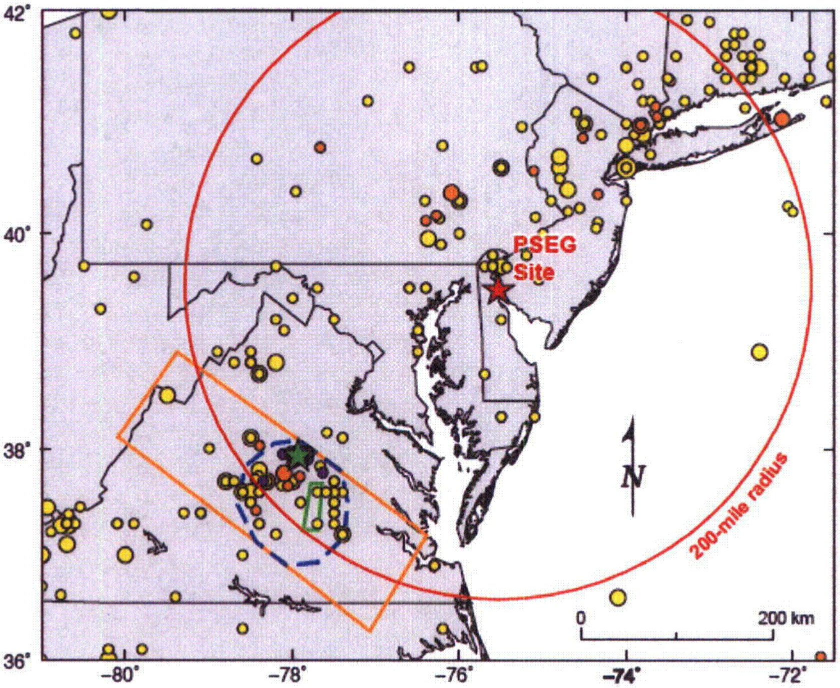
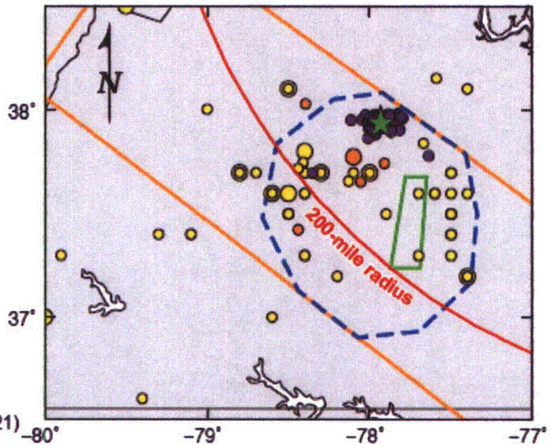
Selected Weston Seismic
Zones and the Mineral Earthquake

FIGURE RAI-43-5-5

Rev 0





LEGEND

Mineral earthquake (Reference RAI-43-5-18)

Mineral earthquake aftershocks (Reference RAI-43-5-21)

EPRI-SOG seismicity (1627-1984)
(see SSAR Section 2.5.2.1.1)

Magnitude (Emb)
- 3.00 - 3.99
- 4.00 - 4.99
- 5.00 - 5.99
- 6.00 - 7.00

Update seismicity for PSEG site (1985-2009)
(see SSAR Section 2.5.2.1.2)

Magnitude (Emb)
- 3.00 - 3.99
- 4.00 - 4.99
- 5.00 - 5.99
- 6.00 - 7.00

EPRI-SOG seismic zones
- Zone 27
- Zone 26
- Zone 28

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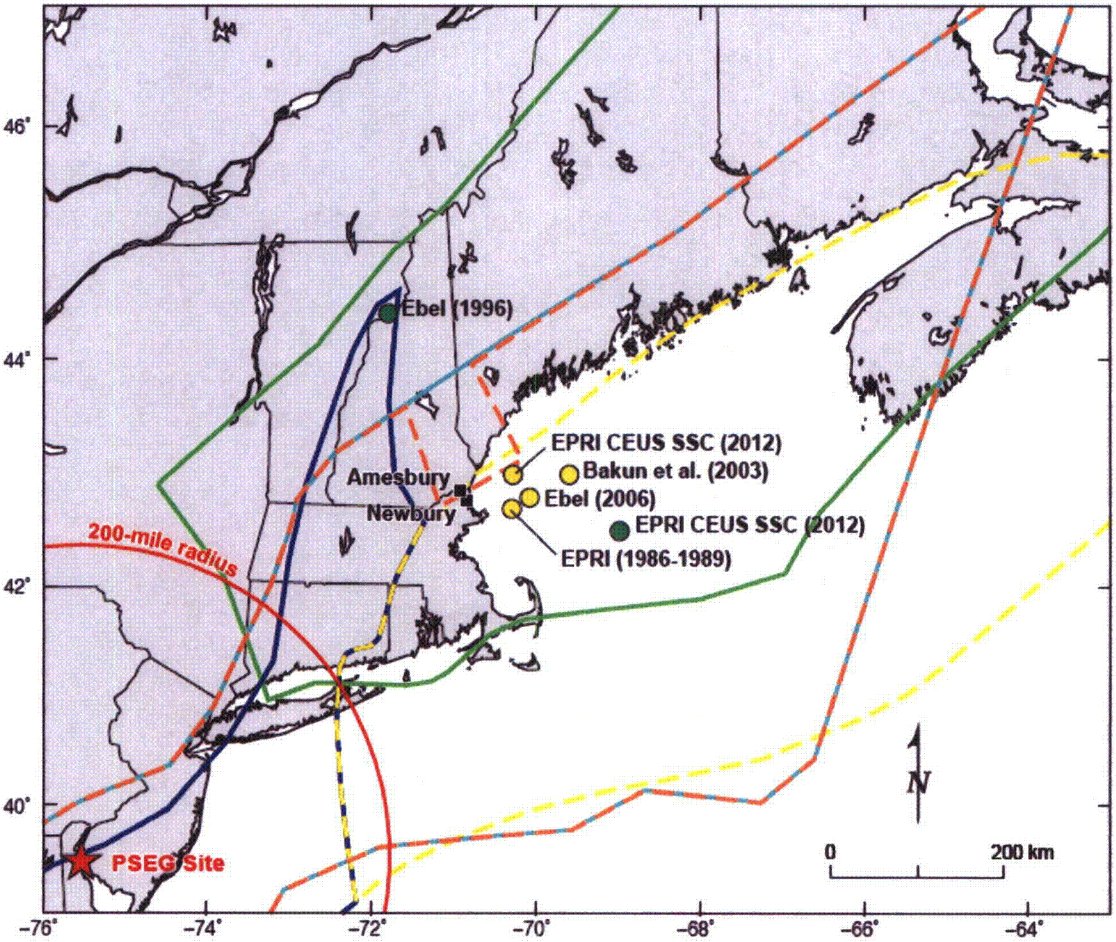
Selected Woodward-Clyde Seismic Zones and the Mineral Earthquake

FIGURE RAI-43-5-6

Rev 0



LEGEND

EPRI-SOG Source Zones

- Bechtel BZ8
- Dames & Moore 53
- Dames & Moore 63
- Law C11
- Law C13

Earthquakes (year)

- 1755
- 1638

Sources:

Bakun et al. (2003) – Reference RAI-43-5-1
Ebel (2006) – Reference RAI-43-5-6
EPRI (1986-1989) – Reference RAI-43-5-10
EPRI (2012) – Reference RAI-43-5-13

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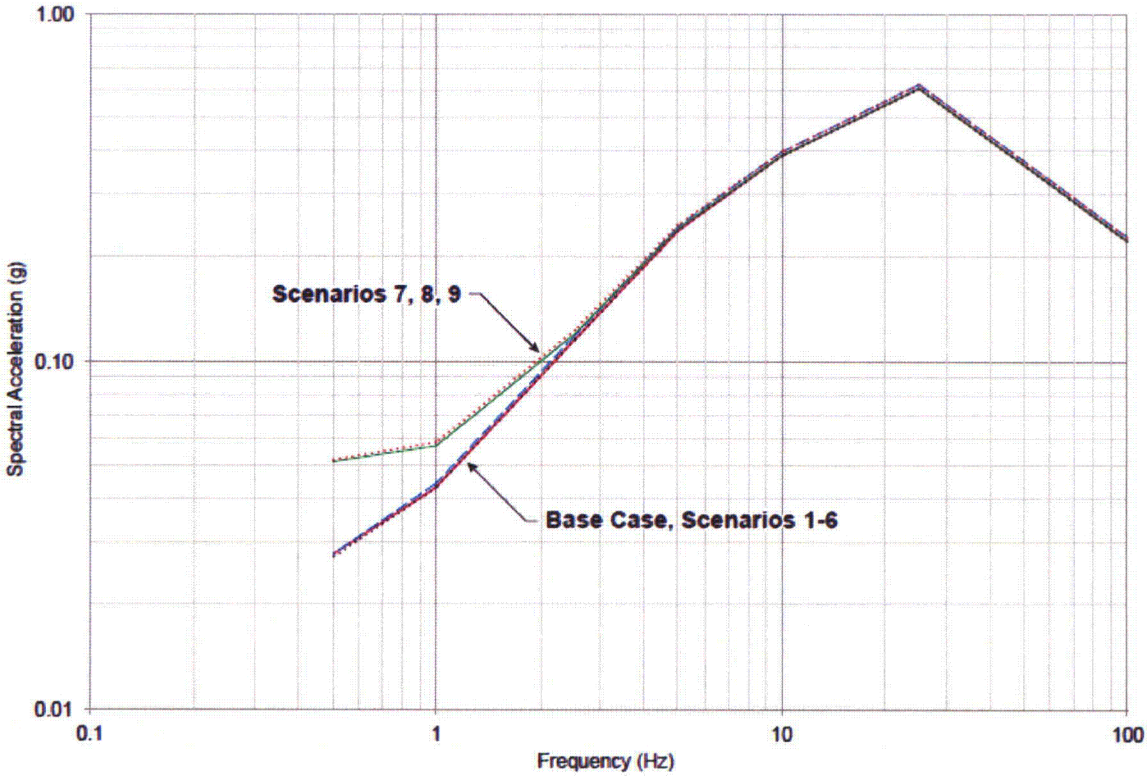
PSEG Site ESPA
Part 2, Site Safety Analysis Report

Revised Locations for the
1755 and 1638 Earthquakes

FIGURE RAI-43-5-7

Rev 0



LEGEND

Base Case Rock Calc, Scenario 3, Scenario 6 (coincident)

Scenario 1, Scenario 2 (coincident)

Scenario 4, Scenario 5 (coincident)

Scenario 7

Scenario 8, Scenario 9 (coincident)

See text for scenario descriptions.

See Table RAI-43-5-4 for data points.

PSEG Power, LLC
PSEG Site ESPA Part 2, Site Safety Analysis Report
Comparison of Hypothetical Rock GMRS for Various Scenarios
FIGURE RAI-43-5-8 Rev 0

References:

RAI-43-5-1 Bakun, W.H., Johnston, A.C., and Hopper, M.G., 2003, Estimating Locations and Magnitudes of Earthquakes in Eastern North America from Modified Mercalli Intensities: Bulletin of Seismological Society of America, v. 93, p. 190-202.

RAI-43-5-2 Budnitz, R.J., Apostolakis, G., Boore, D.M., Cluff, L.S., Coppersmith, K.J., Cornell, C.A., and Morris, P.A., 1997, Recommendations for Probabilistic Seismic Hazard Analysis: Guidance on Uncertainty and Use of Experts: Washington, D.C., US Nuclear Regulatory Commission, NUREG/CR-6372, p. 278

RAI-43-5-3 Chapman, M., 2011, The M 5.7 Central Virgina Earthquake of August 23, 2011: A Complex Rupture, Meeting of the Eastern Section of the Seismological Society of America, October 16-18 2011: Little Rock, AR.

RAI-43-5-4 DGMR, 2012, August 23, 2011 1:51pm; 5.8 Magnitude Earthquake Virginia Department of Mines Minerals and Energy, Division of Geology and Mineral Resources, http://www.dmme.virginia.gov/DMR3/va_5.8_earthquake.shtml.

RAI-43-5-5 Ebel, J.E., 1996, The seventeenth century seismicity of northeastern North America: Seismological Research Letters, v. 67, p. 51-68.

RAI-43-5-6 Ebel, J.E., 2006, The Cape Ann, Massachusetts Earthquake of 1755: A 250th Anniversary Perspective: Seismological Research Letters, v. 77, p. 74-86.

RAI-43-5-7 Ebel, J., 2011, A New Analysis of the Magnitude of the February 1663 Earthquake at Charlevoix, Quebec: Bulletin of Seismological Society of America, v. 101, p. 1024-1038.

RAI-43-5-8 Ellsworth, W.L., Imanishi, K., Luetgert, J.H., and Pratt, T.L., 2011, The MW 5.8 Virginia Earthquake of August 23, 2011: A High Stress Drop Event in a Critically Stressed Crust: Seismological Research Letters, v. 83, p. 212-213.

RAI-43-5-9 Not Used

RAI-43-5-10 EPRI, 1986-1989, Seismic hazard Methodology for the Central and Eastern United States (NP-4726), Vol. 1-3 & 5-10, EPRI.

RAI-43-5-11 EPRI, 1989a, EQHAZARD Primer (NP-6452-D), EPRI, prepared by Risk Engineering for Seismicity Owners Group and EPRI.

RAI-43-5-12 EPRI, 1989b, Probabilistic seismic hazard evaluations at nuclear plant sites in the central and eastern United States: resolution of the Charleston earthquake issue (NP-6395-D), EPRI.

RAI-43-5-13 EPRI, 2012, Central and Eastern United States Seismic Source Characterization for Nuclear Facilities: Palo Alto, CA, Electric Power Research Institute, Report # 1021097.

RAI-43-5-14 Harrison, R.W., Horton, J.W., Carter, M.W., and Schindler, J.S., 2011, Geology of the Central Virginia Seismic Zone in Vicinity of the August, 2011 Earthquakes: What We Know and Don't Know, and Suggested Approaches: Seismological Research Letters, v. 83, p. 213.

RAI-43-5-15 LDEO, 2011, Magnitude 5.8 Quake Rattles East Coast, Lamont-Doherty Earth Observatory, http://www.ldeo.columbia.edu/news-events/magnitude-58-quake-rattles-east-coast.

RAI-43-5-16 McNamara, D.E., Horton, S., Benz, H., Earle, P.S., Withers, M.M., Hayes, G.P., Kim, W., and Chapman, M., 2011, The ANSS Response to the Mw 5.8 Central Virgina Seismic Zone earthquake of August 23, 2011, abstract S14B-02, 2011 Fall Meeting, AGU: San Francisco, CA, December 5-9.

RAI-43-5-17 Mixon, R.B., Powars, D.S., and Daniels, D., 1992, Nature and Timing of Deformation of Upper Mesozoic and Cenozoic Deposits in the Inner Atlantic Coastal Plain, in Gohn, G.S., ed., Proceedings of the 1988 U.S. Geological Survey Workshop on the Geology and geohydrology of the Atlantic Coastal Plain, US Geological Survey Circular 1059, p. 65-73.

RAI-43-5-18 NEIC, 2012, NEIC PDE-W earthquake summary for 23 August 2011 155104 earthquake, USGS, http://neic.usgs.gov/cgi-bin/epic/epic.cgi?SEARCHMETHOD=3&FILEFORMAT=1&SEARCHRANGE=HH&CLAT=37.93&CLON=-77.93&CRAD=10&SYEAR=2011&SMONTH=8&SDAY=23&EYEAR=2011&EMONTH=8&EDAY=23&LMAG=5.5&UMAG=6.1&NDEP1=&NDEP2=&IO1=&IO2=&SLAT2=0.0&SLAT1=0.0&SLON2=0.0&SLON1=0.0&SUBMIT=Submit+Search.

RAI-43-5-19 PSEG Power, LLC, 2012a, Letter ND-2012-0009, Response to Request for Additional Information, RAI No. 43, Vibratory Ground Motion, February 9.

RAI-43-5-20 PSEG Power, LLC, 2012b, Letter ND-2012-0018, Response to Request for Additional Information, RAI No. 43, Vibratory Ground Motion, March, 15.

RAI-43-5-21 SLU, 2012, Aftershock monitoring (for the 2011 Virginia Earthquake), St. Louis University Earthquake Center, http://www.eas.slu.edu/eqc/eqc_significant/2011_Virginia/aftershock.html.

RAI-43-5-22 USGS, 2012, M5.8 Virginia Region Earthquake of 23 August 2011 (poster), US Geological Survey, http://earthquake.usgs.gov/earthquakes/eqarchives/poster/2011/20110823b.php.

RAI-43-5-23 Walsh, L.S., Montesi, L.G., Sauber, J.M., Watters, T.R., Kim, W., Martin, A.J., and Anderson, R., 2011, Comparing the stress change characteristics and aftershock decay rate of the 2011 Mineral, VA, earthquake with similar earthquakes from a variety of tectonic settings, abstract S11B-2241, 2011 Fall Meeting, AGU: San Francisco, CA, December 5-9.

Associated PSEG Site ESP Application Revisions:

In preparation of this response, a typographical error was noted within SSAR Table 2.5.2-7. The Mmax distribution for zone C22 (104-26) was listed as: 5.4 [0.24], 6.0 [0.61], and 6.6 [0.16]. The correct Mmax distribution for that zone is: 5.4 [0.24], 6.0 [0.61], and 6.6 [0.15]. This typographical error only impacts the SSAR table and not any of the calculations conducted for the PSEG Site.

The first paragraph of SSAR Subsection 2.5.1.1.4.2.5.1 will be replaced to include a description of the Mineral earthquake.

The first three paragraphs of SSAR Subsection 2.5.2.1.3 will be replaced to include a description of the Mineral earthquake.

Enclosure 2 documents these changes. The revision to SSAR Figures 2.5.2-3 and 2.5.2-4 are provided in Enclosure 3.

PSEG Letter ND-2012-0039, dated July 19, 2012

ENCLOSURE 2

Proposed Revisions

Part 2 – Site Safety Analysis Report (SSAR)
Section 2.5 – Geology, Seismology and Geotechnical Information

<u>**Marked-up Page**</u>

2.5-29
2.5-99
2.5-106
2.5-107
2.5-158
2.5-165

(References 2.5.1-92 and 2.5.1-253). Hence, geologic information indicates that deformation on the Brandywine fault system ended during the Miocene.

2.5.1.1.4.2.5 Potential Quaternary Tectonic Features within the Site Region

In an effort to provide a comprehensive database of Quaternary tectonic features, Crone and Wheeler (Reference 2.5.1-40), and Wheeler (References 2.5.1-248 and 2.5.1-249) compiled geological information on Quaternary faults, liquefaction features, and possible tectonic features in the CEUS. Crone and Wheeler and Wheeler (Reference 2.5.1-248) evaluated and classified these features into one of four categories based on strength of evidence for Quaternary activity (Classes A, B, C, and D); see Table 2.5.1-2 for definitions (References 2.5.1-40 and 2.5.1-248). Work performed as part of the PSEG Site investigation, including literature review, interviews with experts, and geologic reconnaissance, did not identify any additional potential Quaternary tectonic features within the site region. Crone and Wheeler report only one feature described in the literature that exhibited evidence for Quaternary activity (Class A) (Figure 2.5.1-17). The only Crone and Wheeler feature within the PSEG Site vicinity is the faulting in New Castle County, a Class C feature (Figure 2.5.1-17 and Reference 2

Replace with Insert A

2.5.1.1.4.2.5.1 Central Virginia Seismic Zone

The Central Virginia seismic zone is an area of persistent, low-level seismicity in the Piedmont Province (Figures 2.5.1-1 and 2.5.1-18). The zone extends approximately 75 mi. in a north-south direction, and approximately 90 mi., in an east-west direction, from Richmond to Lynchburg, VA, coincident with the James River (Reference 2.5.1-24). The PSEG Site is located 170 mi. northeast of the northern boundary of the Central Virginia seismic zone. The largest historical earthquake to occur in the Central Virginia seismic zone was the body-wave magnitude (mb) 5.0 Goochland County event on December 23, 1875 (Reference 2.5.1-24). The maximum intensity estimated for this event was Modified Mercalli Intensity (MMI) VII in the epicentral region. More recently, an mb 4.5 earthquake (two closely-spaced events that when combined equal a moment magnitude (M_w) of 4.1) occurred on December 9, 2003 within the Central Virginia seismic zone (CVSZ). The December 9, 2003 earthquake occurred close to the Spotsylvania fault, but due to the uncertainty in the location of the epicenter (3.7 to 5 mi.,) no attempt could be made to locate the epicenter with a specific fault or geologic lineament in the CVSZ (Reference 2.5.1-99).

Seismicity in the CVSZ ranges in depth from 2 to 8 mi. (Reference 2.5.1-251). It is suggested (Reference 2.5.1-38) that seismicity in the central and western parts of the zone may be associated with west-dipping reflectors that form the roof of a detached antiform, while seismicity in the eastern part of the zone near Richmond may be related to a near-vertical diabase dike swarm of Mesozoic age. However, given the depth distribution of 2 to 8 mi. (Reference 2.5.1-251) and broad spatial distribution, it is difficult to uniquely attribute the seismicity to any known geologic structure, and it appears that the seismicity extends both above and below the Appalachian detachment. No capable tectonic sources have been identified within the CVSZ, but two paleoliquefaction sites have been identified within the zone (References 2.5.1-40 and 2.5.1-146). The presence of these paleoliquefaction features on the James and Rivanna rivers shows that the CVSZ reflects both an area of paleo-seismicity as well as observed historical seismicity. Based on the absence of widespread paleoliquefaction, however, it was concluded (Reference 2.5.1-146) that an earthquake of magnitude 7 or larger has not occurred within the seismic zone in the last 2000 to 3000 years, nor in the eastern

"Insert A" for SSAR Subsection 2.5.1.1.4.2.5.1, page 2.5-29 (Question 02.05.02-5)

The Central Virginia seismic zone is an area of persistent, low-level seismicity in the Piedmont Province (Figures 2.5.1-1 and 2.5.1-18). The zone extends approximately 75 mi. in a north-south direction, and approximately 90 mi. in an east-west direction, from Richmond to Lynchburg, VA, coincident with the James River (Reference 2.5.1-24). The PSEG Site is located 170 mi. northeast of the northern boundary of the Central Virginia seismic zone. The largest historical earthquake to occur in the Central Virginia seismic zone was the body-wave magnitude (mb) 5.9 Mineral earthquake on 23 August 2011 (Reference 2.5.1-287). The maximum intensity estimated for this event was Modified Mercalli Intensity (MMI) VII in the epicentral region (see Subsection 2.5.2.1.3 for additional discussion of the Mineral earthquake). Several years prior to the Mineral earthquake an mb 4.5 earthquake (two closely-spaced events that when combined equal a moment magnitude (Mw) of 4.1) occurred on December 9, 2003 within the Central Virginia seismic zone (CVSZ). The December 9, 2003 earthquake occurred close to the Spotsylvania fault, but due to the uncertainty in the location of the epicenter (3.7 to 5 mi.) no attempt could be made to locate the epicenter with a specific fault or geologic lineament in the CVSZ (Reference 2.5.1-99).

2.5.1-278 Ratcliffe, N.M., and Burton, W., 1988, Structural analysis of the Furlong fault and the relation of mineralization to faulting and diabase intrusion, Newark basin, Pennsylvania, in Froelich, A.J., and Robinson, G.R., eds., Studies of the early Mesozoic Basins of the Eastern United States, US Geological Survey Bulletin 1776, p. 176-193.

2.5.1-279 Ratcliffe, N.M., Burton, W.C., and Pavich, M.J., 1990, Orientation, movement history, and cataclastic rocks of Ramapo fault based on core drilling and trenching along the western margin of the Newark basin near Bernardsville, New Jersey, US Geological Survey, Miscellaneous Investigations Map I-1982.

2.5.1-280 Ratcliffe, N.M., and Costain, J., 1985, Northeast Seismicity and Tectonics, in Jacobson, M.L., and R., R.T., eds., National Earthquake Hazards Reduction Program summaries of technical reports, Volume XX, US Geological Survey Open File Report 85-464, p. 54-58.

2.5.1-281 Schlische, R.W., 1992, Structural and stratigraphic development of the Newark extensional basin, eastern North America: Evidence for the growth of the basin and its bounding structures: Geol. Soc. Am. Bull., v. 104, p. 1246-1263.

2.5.1-282 Seborowski, D.K., Williams, G., Kelleher, J.A., and Statton, C.A., 1982, Tectonic implications of recent earthquakes near Annsville, New York: Bulletin of Seismological Society of America, v. 72, p. 1601-1609.

2.5.1-283 Stone, B.M., and Ratcliffe, N.M., 1984, Faults in Pleistocene sediments at trace of Ramapo fault, Geological Survey Research, U.S. Geological Survey Professional Paper 1375, p. 49.

2.5.1-284 Thurber, C.H., and Caruso, T.C., 1985, Crustal structure along the Ramapo fault zone, New York State: Earthquake Notes, v. 56, p. 145-152.

2.5.1-285 Wheeler, R.L., and Crone, A.J., 2001, Known and suggested Quaternary faulting in the midcontinent United States: Engineering Geology, v. 62, p. 51-78.

2.5.1-286 Zoback, M., and Zoback, M., 1980, State of stress in the conterminous United States: Journal of Geophysical Research, v. 85, p. 6113-6156.

Insert Reference 2.5.1-287; see next page

Insert Reference citation for 2.5.1-287:

2.5.1-287 USGS, 2012, M5.8 Virginia Region Earthquake of 23 August 2011 (poster), US Geological Survey, http://earthquake.usgs.gov/earthquakes/eqarchives/poster/2011/20110823b.php.

For the purpose of further analysis, the estimate of mb (called "Emb") for each earthquake was set equal to the reported magnitude (m_{Lg}, mb, m_{bLg}, M_c, M_d, or M_L) from the source catalog. Following this process, 32 earthquakes were identified in the search region with Emb ≥ 3.0. These 32 earthquakes are listed in Table 2.5.2-1 and are plotted in Figure 2.5.2-2, along with the earthquakes from the full EPRI-SOG catalog.

The estimate of mb used in rate and b-value calculations, called "RMB," is calculated for each event in the final catalog. RMB is given as follows (RMB is called mb^* in the terminology of EPRI-SOG) (Reference 2.5.2-33):

$$RMB = Emb + 0.5 * \ln(10) * b * SMB^2 \qquad \text{(Equation 2.5.2-1)}$$

where b is the Richter b-value and is set to 1, an average value for the central and eastern US, and SMB is an estimate of the standard deviation of the uncertainty in Emb.

Inspection of the full EPRI-SOG catalog shows that SMB can be determined from the types of magnitudes available for a given event. By inspection of the later events in the EPRI-SOG catalog (since 1965), earthquakes with body wave magnitudes (m_b, m_B, m_N, m_{Lg}, m_{bLg}) are assigned an SMB of 0.10, and earthquakes with coda (or duration) magnitudes (m_d, m_c) are assigned an SMB of 0.30. With these values of SMB, an RMB magnitude was calculated for each earthquake. This resulted in 17 earthquakes with RMB ≥ 3.3, which is the lower-bound magnitude used in seismicity rate calculations following the EPRI-SOG methodology. Table 2.5.2-1 includes these 17 earthquakes.

For the purpose of additional sensitivity studies (Subsection 2.5.2.4.2.2.2), a second catalog was prepared by substituting into the original EPRI-SOG catalog the earthquakes in the Sykes08 catalog prior to 1985. There were 27 earthquakes in the Sykes08 catalog prior to 1985 with Emb ≥ 3.0. Of these, 13 replaced EPRI-SOG events, 12 were added as new events, and 2 were removed as dependent events. Table 2.5.2-2 lists these 27 earthquakes, the comparable earthquakes in the EPRI catalog, and how each earthquake was treated. Considering the probable low accuracy in location for earthquakes in 1884 and 1938, two of the "new events" may actually depend on other Sykes08 events (i.e., they may be aftershocks); however, all were conservatively retained. Older events should be assigned larger SMB values to reflect decreased accuracy in event location and time. To reflect this, events prior to 1985 in the Sykes08 catalog were assigned SMB values equal to the duplicate event in the EPRI catalog, or, in the case of new events, the largest SMB value of similar events of the same time period. Using these SMB values, RMB magnitudes were calculated for the Sykes08 earthquakes. The combined catalog is labeled the EPRI-Sykes08 catalog.

Replace this and following material on next page with Insert B

2.5.2.1.3 Recent and Historical Seismicity

The updated seismicity catalog described in Subsection 2.5.2.1.2 and the original EPRI-SOG seismicity catalog described in Subsection 2.5.2.1.1 are shown in Figures 2.5.2-3 and 2.5.2-4. These figures demonstrate that there is no significant difference in the spatial pattern of seismicity within the updated region between the EPRI-SOG catalog and the updated catalog. Subsection 2.5.2.4.2.1 provides a quantitative comparison of seismicity rates and shows that there is also no significant difference in seismicity rates determined between the two catalogs. As also noted in the EPRI-SOG study, the most seismically active region within the extent of Figure 2.5.2-3 is the New England region in the northeast section of the figure, well outside of

the PSEG Site region. Within the site region, the largest concentration of earthquakes occurs within the Central Virginia Seismic Zone (CVSZ). The CVSZ is discussed in more detail in Subsection 2.5.1.1.4.2.5.1.

No significant earthquakes, defined as earthquakes with an impact on the seismic hazard at the PSEG Site or the seismic source characterization for the PSEG Site, have occurred within the site region since the end date of the EPRI-SOG seismicity catalog (i.e., post-1984). None of the earthquakes occurring within the site region have had any significant earthquake-induced geologic failure (see discussion of individual earthquakes below for details).

The largest post-1984 earthquake within the site region is the 16 January 1994 Emb 4.5 earthquake in southeast Pennsylvania, approximately 110 kilometers (km) (68 miles [mi.]) from the PSEG Site. In comparison the largest earthquake within the site region from the EPRI-SOG catalog is the 10 August 1884 Emb 5.08 earthquake located at the southern end of Long Island in New York, approximately 182 km (113 mi.) from the PSEG Site. These and the 6 additional earthquakes within the site region with Emb greater than or equal to 4.5 are discussed in additional detail below.

Replace with Insert B

10 August 1884, Emb 5.08, New York City

The location and magnitude of the 10 August 18[illegible] patterns of felt intensity. The earthquake was felt along the Atlan[illegible]ne to central Virginia and to the west (W) as far as northeast Ohio (References 2.5.2-79, 2.5.2-94, and 2.5.2-95). The highest Modified Mercalli intensity (MMI) was VI to VII in southern Long Island, and estimated intensities within the PSEG Site vicinity were MMI IV or less (References 2.5.2-65, 2.5.2-75, and 2.5.2-79). Reported effects of the earthquake include fallen chimneys, cracked walls, and ground shaking induced waves in the Housatonic River in Connecticut (References 2.5.2-79, 2.5.2-94, and NUREG/CR-4750, *A study of earthquake hazards in New York State and adjacent areas: final report covering the period 1982-1985*). The location of the earthquake is constrained to the greater New York City area and southern Long Island based on: (1) the concentration of the highest intensity observations in that region, (2) reports of short-period gravity waves within water bodies, and (3) reports of ground cracking only within this region (Reference 2.5.2-80, NUREG/CR-4750). However, most researchers note that the high population density within the New York City region may introduce bias into intensity-based epicenters for this earthquake (Reference 2.5.2-97, NUREG/CR-4750). The reported location is approximately 182 km (113 mi.) from the PSEG Site. The earthquake has not been positively correlated to any geologic structures (Reference 2.5.2-51, NUREG/CR-4750, 80).

19 December 1737, Emb 4.9, New York City

The location and magnitude of the 19 December 1737 earthquake is based on patterns of felt intensity. Based on the sparse number of felt reports, the earthquake location may be incorrectly located by up to 100 km (62 mi.) (Reference 2.5.2-80). However, intensity estimates near the PSEG Site for this event (MMI III) are significantly lower than those near New York city (MMI VI to VIII) indicating that the event location uncertainty does not accommodate the possibility of the earthquake being located significantly closer to the PSEG Site (References 2.5.2-75, 2.5.2-96, and NUREG/CR-4750). The location of the earthquake within the EPRI-SOG earthquake catalog is approximately 198 km (123 mi.) from the PSEG Site. Felt effects associated with this earthquake include the ringing of bells and the knocking down of chimneys in New York City.

"Insert B" for SSAR Subsection 2.5.2.1.3, pages 2.5-106 and 2.5-107 (Question 02.05.02-5)

The updated seismicity catalog described in Subsection 2.5.2.1.2 and the original EPRI-SOG seismicity catalog described in Subsection 2.5.2.1.1 are shown in Figures 2.5.2-3 and 2.5.2-4. In addition, the figures show the location of the 23 August 2011 Emb 5.9 earthquake that occurred near Mineral, VA (referred to as the Mineral earthquake) (Reference 2.5.2-99). For the PSEG Site ESPA, the Mineral earthquake is characterized as an Emb 5.9 based on the mb 5.9 magnitude reported by the National Earthquake Information Center (NEIC) (Reference 2.5.2-99). These figures demonstrate that there is no significant difference in the spatial pattern of seismicity within the updated region between the EPRI-SOG catalog and the updated catalog. Subsection 2.5.2.4.2.1 provides a quantitative comparison of seismicity rates and shows that there is also no significant difference in seismicity rates determined between the two catalogs. As also noted in the EPRI-SOG study, the most seismically active region within the extent of Figure 2.5.2-3 is the New England region in the northeast section of the figure, well outside of the PSEG Site region. Within the site region, the largest concentration of earthquakes occurs within the Central Virginia Seismic Zone (CVSZ). The CVSZ is discussed in more detail in Subsection 2.5.1.1.4.2.5.1.

The Mineral earthquake is the only significant earthquake to have occurred within the site region since the end date of the EPRI-SOG seismicity catalog (i.e., 1984). This earthquake, and eight other earthquakes within the site region with Emb greater than or equal to 4.5 are discussed in additional detail below.

23 August 2011, Emb 5.9, Mineral, Virginia

The 23 August 2011 Emb 5.9 earthquake (Reference 2.5.2-99) that occurred near Mineral, VA is one of the largest earthquakes to have been widely felt along the east coast since the 1897 Giles County earthquake. The earthquake occurred within the CVSZ (see Subsection 2.5.1.1.4.2.5.1 for further discussion of the CVSZ) (Reference 2.5.2-100). The earthquake has yet to be positively associated with a causative fault (Reference 2.5.2-100; Reference 2.5.2-101; Reference 2.5.2-102). The earthquake was felt throughout much of eastern North America including Michigan, Georgia, and Quebec. The highest levels of damage associated with the earthquake were felt in Louisa County, surrounding the epicenter of the earthquake. Reported Modified Mercalli intensities (MMI) reached VII (moderate to moderate/heavy damage) (Reference 2.5.2-100). Light damage (MMI VI) occurred throughout central Virginia and southern Maryland. The epicenter of the earthquake was approximately 170 mi. (270 km) from the PSEG Site. Reported MMI values for the area immediately surrounding the PSEG Site were between III and IV, indicating weak to light ground shaking and no damage (Reference 2.5.2-100).

2.5.2-96 Winkler, L. "Catalog of U.S. Earthquakes Before the Year 1850." Bulletin of Seismological Society of America 69 (1979): 569-602.

2.5.2-97 Yang, J.-P., and Y. P. Aggarwall. "Seismotectonics of Northeastern United States and Adjacent Canada." J. Geophys. Res. 86 (1981): 4981-98.

2.5.2-98 Benson, R. N., Map of Exposed and Buried Early Mesozoic Rift Basins/Synrift Rocks of the U.S. Middle Atlantic Continental Margin, Delaware Geologic Survey Misc. Map Series No. 5, 1992.

Insert References 2.5.2-99, 2.5.2-100, 2.5.2-101 and 2.5.2-101; see next page

2.5.2-99 NEIC, 2012, NEIC PDE-W earthquake summary for 23 August 2011 155104 earthquake, USGS, http://neic.usgs.gov/cgi-bin/epic/epic.cgi?SEARCHMETHOD=3&FILEFORMAT=1&SEARCHRANGE=HH&CLAT=37.93&CLON=-77.93&CRAD=10&SYEAR=2011&SMONTH=8&SDAY=23&EYEAR=2011&EMONTH=8&EDAY=23&LMAG=5.5&UMAG=6.1&NDEP1=&NDEP2=&IO1=&IO2=&SLAT2=0.0&SLAT1=0.0&SLON2=0.0&SLON1=0.0&SUBMIT=Submit+Search.

2.5.2-100 USGS, 2012, M5.8 Virginia Region Earthquake of 23 August 2011 (poster), US Geological Survey, http://earthquake.usgs.gov/earthquakes/eqarchives/poster/2011/20110823b.php.

2.5.2-101 Chapman, M., 2011, The M 5.7 Central Virginia Earthquake of August 23, 2011: A Complex Rupture, Meeting of the Eastern Section of the Seismological Society of America, October 16-18 2011: Little Rock, AR.

2.5.2-102 DGMR, 2012, August 23, 2011 1:51pm; 5.8 Magnitude Earthquake Virginia Department of Mines Minerals and Energy, Division of Geology and Mineral Resources, http://www.dmme.virginia.gov/DMR3/va_5.8_earthquake.shtml.

Revision to Line C22 as a result of the response to RAI 43, Question 02.05.02-5 is shown in ***bold italic underline***.

Table 2.5.2-7 (Sheet 1 of 2)
Summary of Weston Seismic Source Zones

Source	Description	Closest Source to Site Distance km (mi)	Pa[a]	M_{max} (mb) and Wts.[]	Contributes to 99% of Hazard	New Information Requiring Change in Source	
						Geometry[b]	M_{max}[c]
1	Charlevoix-La Malbaie	919 (571)	1.0	7.2 [1.0]	Yes	No	No
22	Central Virginia	208 (129)	0.82	5.4 [0.19] 6.0 [0.65] 6.6 [0.16]	Yes	No	No
C01	28A+28B+28C +28D+28E	6 (4)	NA	5.4 [0.65] 6.0 [0.25] 6.6 [0.1]	Yes	No	No
C08	21-19-10A	50 (31)	NA	5.4 [0.62] 6.0 [0.29] 6.6 [0.09]	Yes	No	No
C10	21-19-28A	107 (66)	NA	5.4 [0.62] 6.0 [0.29] 6.6 [0.09]	Yes	No	No
C17	103-23	105 (65)	NA	5.4 [0.26] 6.0 [0.58] 6.6 [0.16]	Yes	No	No
C18	103-24	105 (65)	NA	5.4 [0.26] 6.0 [0.58] 6.6 [0.16]	Yes	No	No
C19	103-23-24	105 (65)	NA	5.4 [0.26] 6.0 [0.58] 6.6 [0.16]	Yes	No	No
C21	104-25	0 (0)	NA	5.4 [0.24] 6.0 [0.61] 6.6 [0.15]	Yes	No	No
C22	104-26	0 (0)	NA	5.4 [0.24] 6.0 [0.61] 6.6 [***<u>0.15</u>***]	Yes	No	No
C23	104-22-26	0 (0)	NA	5.4 [0.8] 6.0 [0.14] 6.6 [0.06]	Yes	No	No
C24	104-22-25	0 (0)	NA	5.4 [0.8] 6.0 [0.14] 6.6 [0.06]	Yes	No	No
C27	104-28BCDE-22-25	0 (0)	NA	5.4 [0.3] 6.0 [0.7]	Yes	No	No
C28	104-28BCDE-22-26	0 (0)	NA	5.4 [0.3] 6.0 [0.7]	Yes	No	No
C34	104-28BE-26	0 (0)	NA	5.4 [0.24] 6.0 [0.61] 6.6 [0.15]	Yes	No	No
4	St. Lawrence Rift	750 (466)	1.0	5.4 [0.55] 6.0 [0.28] 6.6 [0.14] 7.2 [0.03]	No	No	No
10	Hudson Valley	316 (196)	1.0	5.4 [0.51] 6.0 [0.33] 6.6 [0.16]	No	No	No
16	SE New England Platform	296 (184)	1.0	5.4 [0.6] 6.0 [0.32] 6.6 [0.08]	No	No	No
19	Moodus	326 (203)	1.0	5.4 [0.56] 6.0 [0.32] 6.6 [0.12]	No	No	No
102	Appalachian Plateau	156 (97)	1.0	5.4 [0.62] 6.0 [0.29] 6.6 [0.09]	No	No	No
103	S. Appalachian	104 (65)	1.0	5.4 [0.26] 6.0 [0.58] 6.6 [0.16]	No	No	No
10A	Intersection of 10 and 21	200 (124)	0.54	5.4 [0.65] 6.0 [0.25] 6.6 [0.1]	No	No	No

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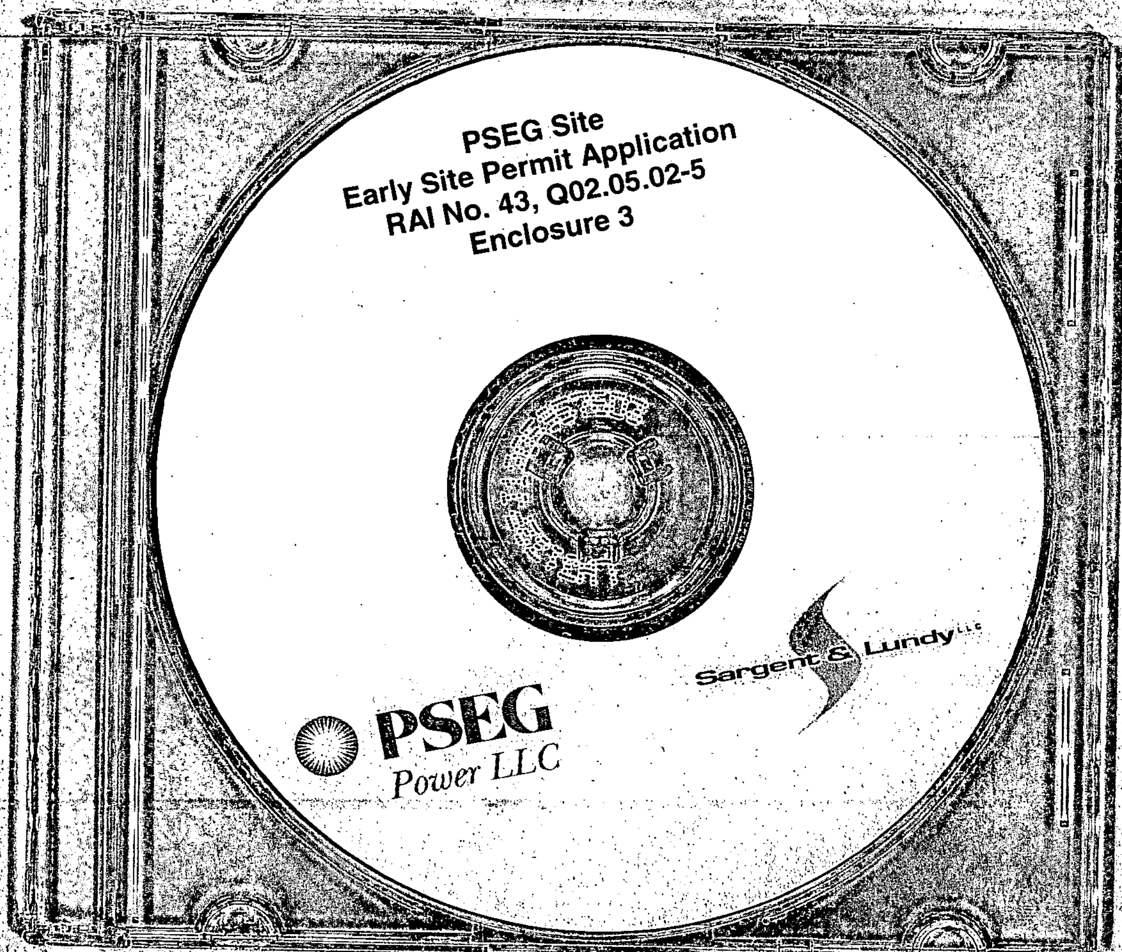
ENCLOSURE 3

CD-ROM Containing Revised SSAR Figures 2.5.2-3 and 2.5.2-4


PSEG Site
Early Site Permit Application
RAI No. 43, Q02.05.02-5
Enclosure 3
PSEG
Power LLC
Sargent & Lundy LLC

PSEG Letter ND-2012-0039, dated July 19, 2012

ENCLOSURE 4

Summary of Regulatory Commitments

ENCLOSURE 4

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 2.5.2 to incorporate the changes in Enclosure 2 and 3 in response to NRC RAI No. 43, Question 02.05.02-5	This revision will be included in a future update of the PSEG ESP application.	Yes	No
PSEG will provide a supplemental response to RAI No. 43, Question 02.05.02-5 to provide a GMRS for the outcrop of the competent layer.	October 5, 2012	Yes	No