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NUCLEAR REGULATORY COMMISSION  
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March 7, 2018

Mr. J. J. Hutto  
Regulatory Affairs Director  
Southern Nuclear Operating Co., Inc.  
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SUBJECT: VOGTLE ELECTRIC GENERATING PLANT, UNITS 1 AND 2 – STAFF REVIEW OF SEISMIC PROBABILISTIC RISK ASSESSMENT ASSOCIATED WITH REEVALUATED SEISMIC HAZARD IMPLEMENTATION OF THE NEAR-TERM TASK FORCE RECOMMENDATION 2.1: SEISMIC (CAC NOS. MF9498 AND MF9499; EPID L-2017-JLD-0005)

Dear Mr. Hutto:

By letter dated March 12, 2012 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML12053A340), the U.S. Nuclear Regulatory Commission (NRC) issued a request for information pursuant to Title 10 of the *Code of Federal Regulations* Part 50, Section 50.54(f) (hereafter referred to as the 10 CFR 50.54(f) letter). The request was issued as part of implementing lessons-learned from the accident at the Fukushima Dai-ichi nuclear power plant. Enclosure 1 to the 10 CFR 50.54(f) letter requested that licensees reevaluate seismic hazards at their sites using present-day methodologies and guidance. Enclosure 1, Item 8, of the 10 CFR 50.54(f) letter requested that certain licensees complete a seismic probabilistic risk assessment (SPRA) to determine if plant enhancements are warranted due to the change in the reevaluated seismic hazard compared to the site's design-basis seismic hazard.

By letter dated March 27, 2017 (ADAMS Accession No. ML17088A130), Southern Nuclear Operating Company, Inc. (SNC, the licensee), provided its SPRA report in response to Enclosure 1, Item (8) of the 10 CFR 50.54(f) letter, for Vogtle Electric Generating Plant, Units 1 and 2 (Vogtle). The NRC staff assessed the licensee's implementation of the Electric Power Research Institute's (EPRI's) Report 1025287, "Seismic Evaluation Guidance - Screening, Prioritization, and Implementation Details (SPID) for the Resolution of Fukushima Near-Term Task Force Recommendation 2.1: Seismic" (ADAMS Accession No. ML12333A170), as endorsed by NRC letter dated February 15, 2013 (ADAMS Accession No. ML12319A074), through the completion of the reviewer checklist in the Enclosure to this letter. As described below, the NRC has concluded that Vogtle's SPRA report meets the intent of the SPID guidance and that the risk and safety insights provided by the SPRA support the NRC's determination that no further response or regulatory action is required.

#### BACKGROUND

The 10 CFR 50.54(f) letter requested, in part, that licensees reevaluate the seismic hazards at their sites using updated hazard information and current regulatory guidance and

methodologies. The request for information and the subsequent NRC evaluations have been divided into two phases:

**Phase 1:** Issue 10 CFR 50.54(f) letters to all licensees to request that they reevaluate the seismic and flooding hazards at their sites using updated seismic and flood hazard information and present-day regulatory guidance and methodologies and, if necessary, to request they perform a risk evaluation.

**Phase 2:** Based upon the results of Phase 1, the NRC staff will determine whether additional regulatory actions are necessary (e.g., updating the design basis and structures, systems, and components (SSCs) important to safety) to provide additional protection against the updated hazards.

By letter dated March 31, 2014 (ADAMS Accession No. ML14092A019), SNC submitted the reevaluated seismic hazard information for the Vogtle site. The NRC performed a staff assessment of the submittal and issued a response letter on April 20, 2015 (ADAMS Accession No. ML15054A296). The NRC's assessment concluded that the licensee conducted the hazard reevaluation using present-day methodologies and regulatory guidance, appropriately characterized the site, and met the intent of the guidance for determining the reevaluated seismic hazard.

By letter dated October 27, 2015 (ADAMS Accession No. ML15194A015), the NRC documented a determination of which licensees were to perform: (1) an SPRA; (2) limited scope evaluations; or (3) no further actions based on a comparison of the reevaluated seismic hazard and the site's design-basis earthquake. As documented in that letter, Vogtle was expected to complete an SPRA, which would also assess high frequency ground motion effects, and a limited-scope evaluation for the spent fuel pool (SFP). These seismic evaluations were expected to be submitted to the NRC by March 30, 2017, and December 31, 2017, respectively.

The completion of the April 20, 2015, NRC staff assessment for the reevaluated seismic hazard and the scheduling of Vogtle's SPRA report submittal described in the NRC's October 27, 2015, letter marked the fulfillment of the Phase 1 process for Vogtle.

In its March 27, 2017, letter, SNC provided the SPRA report that initiated the NRC's Phase 2 decisionmaking process for Vogtle. The NRC described this Phase 2 decisionmaking process in a guidance memorandum from the Director of the Japan Lessons-Learned Division to the Director of the Office of Nuclear Reactor Regulation (NRR) on September 21, 2016 (ADAMS Accession No. ML16237A103). This memorandum details a Senior Management Review Panel (SMRP) consisting of three NRR Division Directors that are expected to reach a screening decision for each plant submitting an SPRA. The SMRP is supported by appropriate technical staff who are responsible for consolidating relevant information and developing recommendations for the consideration of the panel. In presenting recommendations to the SMRP, the supporting technical staff is expected to recommend placement of each SPRA plant into one of three groups:

- 1) **Group 1** includes plants for which available information indicates that further regulatory action is not warranted. For seismic hazards, Group 1 includes plants for which the mean seismic core damage frequency and mean seismic early release frequency clearly demonstrate that a plant-specific backfit would not be warranted.

- 2) **Group 2** includes plants for which further regulatory action should be considered under the NRC's backfit provisions. This group may include plants with relatively large seismic core damage frequency or seismic large early release frequency, such that the event frequency in combination with other factors result in a risk to public health and safety for which a regulatory action is expected to provide a substantial safety enhancement.
- 3) **Group 3** includes plants for which further regulatory action may be needed, but for which more thorough consideration of both qualitative and quantitative risk insights is needed before determining whether a formal backfit analysis is warranted.

The evaluation process that was performed to provide the basis for the staff's grouping recommendation to the SMRP for Vogtle is described below.

### EVALUATION

Upon receipt of the licensee's March 27, 2017, SPRA report, a technical team of staff performed a completeness review to determine if the necessary information to support Phase 2 decisionmaking had been included in the licensee's submittal. The technical team performing the review consisted of staff experts in the fields of seismic hazards, fragilities evaluations, and plant response/risk analyses. On May 2, 2017, the technical team determined that sufficient information was available to perform the detailed technical review in support of the Phase 2 decision.

As described in the 10 CFR 50.54(f) letter, the staff's detailed review focused on verifying the technical adequacy of the licensee's SPRA such that an appropriate level of confidence could be placed in the results and risk insights of the SPRA to support regulatory decisionmaking associated with the 10 CFR 50.54(f) letter. As stated in its March 27, 2017, submittal, the licensee developed and documented the SPRA in accordance with the SPID guidance including performing a peer review against the American Society of Mechanical Engineers (ASME)/American Nuclear Society (ANS) Standard RAS 2008, "Standard for Level 1/Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Applications", including Addenda B, 2013. Table A-2 of the licensee's submittal provided a summary of the SPRA peer review team's facts and observations (F&O's) classified as findings. The findings from the licensee's internal events PRA were not provided. The table included the licensee's dispositions of the SPRA peer review team's findings and a status of the dispositions. The staff reviewed each of the licensee's dispositions of the findings and evaluated whether they were adequately addressed such that the technical adequacy of the SPRA could be judged to be sufficient for the purposes of supporting the regulatory decisionmaking associated with Phase 2.

By letter dated July 6, 2017 (ADAMS Accession No. ML17177A446), the NRC issued a generic audit plan and entered into the audit process described in Office Instruction LIC-111, "Regulatory Audits", dated December 29, 2008 (ADAMS Accession No. ML082900195), to assist in the timely and efficient closure of activities associated with the 10 CFR 50.54(f) letter. The Vogtle site was included in the list of applicable licensees. The staff exercised the audit process in the form of a clarification call that took place on July 6, 2017. In preparation for the call, the staff developed questions to verify information in the licensee's submittal and to gain understanding of non-docketed information that supports the docketed SPRA report. The staff's clarification questions (ADAMS Accession No. ML17292A136) were sent to the licensee in advance of the call to facilitate clear communication and to ensure that the appropriate SNC

staff were available to answer questions in various technical areas. At the conclusion of the call, the staff had no further questions and determined that no additional documentation or information was needed to supplement Vogtle's docketed SPRA report. Consequently, the staff determined that the docketed SPRA report was sufficient to support regulatory decisionmaking associated with Phase 2 of the 10 CFR 50.54(f) letter. Based on the staff's review of the licensee's submittal, including the disposition of the peer review findings as described above, the NRC staff concluded that the technical adequacy of the licensee's SPRA submittal was sufficient to support regulatory decisionmaking associated with Phase 2 of the 10 CFR 50.54(f) letter.

Following the staff's conclusion of the SPRA's technical adequacy, the staff reviewed the risk and safety insights contained in the Vogtle SPRA report. The staff's review process included the completion of the SPRA Submittal Technical Review Checklist (SPRA Checklist) contained in Enclosure 1 to this letter. As described in Enclosure 1, the SPRA Checklist is a document used to record the staff's review of licensees' SPRA submittals against the applicable guidance of the SPID in response to the 50.54(f) letter. The SPRA Checklist also focuses on areas where the SPID contains differing guidance from standard industry SPRA guidance. Enclosure 1 contains the staff's application of the SPRA Checklist to Vogtle's submittal. As documented in the Checklist, the staff concluded that the Vogtle SPRA met the intent of the SPID. The staff further concluded that the peer review findings have been addressed and the analysis used by the licensee in addressing these findings are acceptable for the purposes of this evaluation.

The staff also used the screening criteria described in the August 29, 2017, staff memorandum titled, "Guidance for Determination of Appropriate Regulatory Action Based on Seismic Probabilistic Risk Assessment Submittals in Response to Near Term Task Force Recommendation 2.1: Seismic" (ADAMS Accession No. ML17146A200, non-public) to determine in which Group the technical team would recommend placing Vogtle to the SMRP. The criteria in the staff's guidance document describes thresholds to assist in determining whether to apply the backfit screening process described in Management Directive 8.4, "Management of Facility-Specific Backfitting and Information Collection", dated October 9, 2013 (ADAMS Accession No. ML12059A460), or not to the SPRA report review. The Vogtle SPRA report demonstrated that the plant seismic core damage frequency (SCDF) and seismic large early release frequency (SLERF) were sufficiently low such that no further review is warranted under NTF Recommendation 2.1: Seismic. Based on the review, the technical team determined that recommending Vogtle be classified as a Group 1 site was appropriate and a plant-specific backfit is not warranted.

As a part of the Phase 2 decisionmaking process for SPRAs, the NRC formed the Technical Review Board (TRB), a board of senior-level NRC subject matter experts, to ensure consistency of review across the spectrum of plants that will be submitting SPRA reports. The technical team provided the results of the Vogtle review to the TRB with the Phase 2 recommendation that Vogtle be categorized as a Group 1 plant, meaning that no further response or regulatory actions are required. The TRB members assessed the information presented by the technical team and agreed with the team's Group 1 recommendation for Vogtle.

Subsequently, the technical team met with the SMRP and presented the results of the review including the recommendation for Vogtle to be categorized as a Group 1 plant. The SMRP members also asked questions and provided input to the technical team. The SMRP approved the staff's recommendation that Vogtle should be classified as a Group 1 plant, meaning that no further response or regulatory action is required.

## AUDIT REPORT

The July 6, 2017, generic audit plan describes the NRC staff's intention to issue an audit report that summarizes and documents the NRC's regulatory audit of licensee's submittals associated with reevaluated seismic hazard analyses. The NRC staff's Vogtle audit was limited to the clarification call on July 6, 2017. An audit summary document is included as Enclosure 2 to this letter.

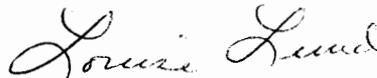
## CONCLUSION

Based on the staff's review of the licensee's submittal against the endorsed SPID guidance, the NRC staff concludes that the licensee responded appropriately to Enclosure 1, Item (8) of the 10 CFR 50.54(f) letter. Additionally, the staff's review concluded that the SPRA is of sufficient technical adequacy to support Phase 2 regulatory decisionmaking in accordance with the intent of the 10 CFR 50.54(f) letter. Based on the results and risk insights of the SPRA report, the NRC staff also concludes that no further response or regulatory actions associated with Near-Term Task Force (NTTF) Recommendation 2.1 "Seismic" are required.

Application of this review is limited to the review of the 10 CFR 50.54(f) response associated with NTTF Recommendation 2.1 "Seismic" review. The staff notes that assessment of the SPRA for use in other licensing applications would warrant reviewing of the SPRA for its intended application. The NRC may use insights from this SPRA assessment in its regulatory activities as appropriate.

If you have any questions, please contact me at (301) 415-3075 or via e-mail at Brett.Titus@nrc.gov.

Sincerely,



Louise Lund, Director  
Division of Licensing Projects  
Office of Nuclear Reactor Regulation

Docket Nos. 50-424 and 50-425

Enclosures:

1. NRC Staff SPRA Submittal Technical Review Checklist
2. NRC Staff Audit Summary

cc w/encls: Distribution via Listserv

## NRC Staff SPRA Submittal Technical Review Checklist

Several nuclear power plant licensees are performing seismic probabilistic risk assessments (SPRAs) as part of their required submittals to satisfy Near-Term Task Force (NTTF) Recommendation 2.1: Seismic. These submittals are prepared according to the guidance in the Electric Power Research Institute – Nuclear Energy Institute (EPRI-NEI) Screening, Prioritization, and Implementation Details (SPID) document (EPRI-SPID, 2012), which was endorsed by the staff for this purpose (Agencywide Documents Access and Management System (ADAMS) Accession No. ML12319A074). The SPRA peer reviews are also expected to follow the guidance in NEI 12-13 (NEI, 2012).

The SPID indicates that an SPRA submitted for the purpose of satisfying NTTF Recommendation 2.1: Seismic must meet the requirements in the ASME-ANS PRA Methodology Standard (the ASME Standard). Either the “Addendum A version” (ASME/ANS Addendum A, 2009) or the “Addendum B version” (ASME/ANS Addendum B, 2013) of the ASME Standard can be used.

Tables 6-4, 6-5, and 6-6 of the SPID also provide a comparison of each of the Supporting Requirements (SRs) of the ASME Standard to the relevant guidance in the SPID. For most SRs, the SPID guidance does not differ from the requirement in the ASME Standard. However, because the guidance of the SPID and the criteria of the ASME Standard differ in some areas, or the SPID does not explicitly address an SR, the staff developed this checklist, in part, to help staff members to address and evaluate the differences.

In general, the SPID allowed departures or differed from the ASME Standard in the following ways:

- (i) In some technical areas, the SPID’s requirements tell the SPRA analyst “how to perform” one aspect of the SPRA analysis, whereas the ASME Standard’s requirements generally cover “what to do” rather than “how to do it”.
- (ii) For some technical areas and issues the requirements in the SPID differ from those in the ASME Standard.
- (iii) The SPID has some requirements that are not in the ASME Standard.

All of the technical positions in the SPID have been endorsed by the U.S. Nuclear Regulatory Commission (NRC) staff, subject to certain conditions concerning peer review outlined in the staff November 12, 2012, letter to NEI (NRC, 2012).

The following checklist is comprised of the 16 “Topics” that require additional staff guidance because the SPID contains specific guidance that differs from the ASME Standard or expands on it. Each is covered below under its own heading, “Topic 1,” “2,” etc. The checklist was discussed during a public meeting on December 7, 2016 (ADAMS Accession No. ML16350A181).

- Topic 1: Seismic Hazard (SPID Sections 2.1, 2.2, and 2.3)
- Topic 2: Site Seismic Response (SPID Section 2.4)
- Topic 3: Definition of the Control Point for the SSE-to-GMRS-Comparison Aspect of the Site Analysis (SPID Section 2.4.2)
- Topic 4: Adequacy of the Structural Model (SPID Section 6.3.1)
- Topic 5: Use of Fixed-Based Dynamic Seismic Analysis of Structures for Sites Previously Defined as “Rock” (SPID Section 6.3.3)
- Topic 6: Use of Seismic Response Scaling (SPID Section 6.3.2)
- Topic 7: Use of New Response Analysis for Building Response, ISRS, and Fragilities
- Topic 8: Screening by Capacity to Select SSCs for Seismic Fragility Analysis (SPID Section 6.4.3)
- Topic 9: Use of the CDFM/H Methodology for Fragility Analysis (SPID Section 6.4.1)
- Topic 10: Capacities of SSCs Sensitive to High-Frequencies (SPID Section 6.4.2)
- Topic 11: Capacities of Relays Sensitive to High-Frequencies (SPID Section 6.4.2)
- Topic 12: Selection of Dominant Risk Contributors that Require Fragility Analysis Using the Separation of Variables Methodology (SPID Section 6.4.1)
- Topic 13: Evaluation of LERF (SPID Section 6.5.1)
- Topic 14: Peer Review of the SPRA, Accounting for NEI 12-13 (SPID Section 6.7)
- Topic 15: Documentation of the SPRA (SPID Section 6.8)
- Topic 16: Review of Plant Modifications and Licensee Actions

**TOPIC 1: Seismic Hazard (SPID Sections 2.1, 2.2, and 2.3)**

<p>The site under review has updated/revised its PSHA from what was submitted to NRC in response to the NTTF Recommendation 2.1: Seismic 50.54(f) letter.</p>	<p>No</p>
<p>Notes from staff reviewer:</p> <p>There are several F&amp;Os related to hazard in the SPRA Peer Review. These findings generally result from guidance provided in the SPID for performing the site-specific PSHA and site response. Staff reviewed Vogtle's seismic hazard results and documented its review in a staff assessment dated April 20, 2015 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML15054A296). The NRC staff has determined, based on its review of the seismic hazard, that the peer review findings have no adverse effect on the SPRA results.</p> <p>Deviation(s) or deficiency(ies) and Resolution: None.</p> <p>Consequence(s): None.</p>	
<p>The NRC staff concludes that:</p> <ul style="list-style-type: none"> <li>• the peer review findings have been addressed and the analysis approach has been accepted by the peer reviewers. The peer review findings referred to relate to the SHA requirements in the Standard, as well as to the requirements in the SPID.</li> <li>• although some peer review findings and observations have not been resolved, the analysis is acceptable on another justified basis.</li> <li>• the guidance in the SPID was followed for developing the probabilistic seismic hazard for the site.</li> <li>• an alternate approach was used, and is acceptable on a justified basis.</li> </ul>	<p>Yes</p> <p>NA</p> <p>Yes</p> <p>NA</p>

**TOPIC 2: Site Seismic Response (SPID Section 2.4)**

<p>The site under review has updated/revise its site response analysis from what was submitted to NRC in response to the NTTF Recommendation 2.1: Seismic 50.54(f) letter.</p>	<p>No</p>
<p>Notes from staff reviewer:</p> <p>There are several F&amp;Os related to hazard in the SPRA Peer Review. These findings generally result from guidance provided in the SPID for performing the site-specific PSHA and site response. The NRC staff reviewed Vogtle's seismic hazard results and documented its review in a staff assessment dated April 20, 2015 (ADAMS Accession No. ML15054A296). The staff has determined, based on its review of the seismic hazard, that the peer review findings have no adverse effect on the SPRA results.</p> <p>Deviation(s) or deficiency(ies) and Resolution: None.</p> <p>Consequence(s): None.</p>	
<p>The NRC staff concludes that:</p> <ul style="list-style-type: none"> <li>• the peer review findings have been addressed and the analysis approach has been accepted by the peer reviewers. The peer review findings referred to relate to the SR requirements SHA-E1 and E2 in the Standard, as well as to the requirements in the SPID.</li> <li>• although some peer review findings and observations have not been resolved, the analysis is acceptable on another justified basis.</li> <li>• the licensee's development of PSHA inputs and base rock hazard curves meets the intent of the SPID guidance or another acceptable approach.</li> <li>• the licensee's development of a site profile for use in the analysis adequately meets the intent of the SPID guidance or another acceptable approach.</li> <li>• although the licensee's development of a <math>V_s</math> velocity profile for use in the analysis does not meet the intent of the SPID guidance, it is acceptable on another justified basis.</li> </ul>	<p>Yes</p> <p>NA</p> <p>Yes</p> <p>Yes</p> <p>NA</p>

**TOPIC 3: Definition of the Control Point for the SSE-to-GMRS-Comparison Aspect of the Site Analysis (SPID Section 2.4.2)**

<p>The issue is establishing the control point where the safe shutdown earthquake (SSE) is defined. Most sites have only one SSE, but some sites have more than one SSE, for example one at rock and one at the top of the soil layer.</p> <p>This control point is needed because it is used as part of the input information for the development of the seismic site-response analysis, which in turn is an important input for analyzing seismic fragilities in the SPRA.</p> <p>The SPID (Section 2.4.1) recommends one of two criteria for establishing the control point for a logical SSE-to-GMRS comparison:</p>	
<p>A) If the SSE control point(s) is defined in the final safety analysis report (FSAR), it should be used as defined.</p> <p>B) If the SSE control point is not defined in the FSAR, one of three criteria in the SPID (Section 2.4.1) should be used.</p> <p>C) An alternative method has been used for this site.</p> <p>The control point used as input for the SPRA is identical to the control point used to establish the GMRS.</p> <p>If <u>yes</u>, the control point can be used in the SPRA and the NRC staff's earlier acceptance governs.</p> <p>If <u>no</u>, the NRC staff's previous reviews might not apply. The staff's review of the control point used in the SPRA is acceptable.</p>	<p>Yes</p> <p>NA</p> <p>NA</p> <p>Yes</p> <p>NA</p>
<p>Notes from staff reviewer: None.</p> <p>Deviation(s) or deficiency(ies) and Resolution: None.</p>	
<p>Consequence(s): None.</p>	
<p>The NRC staff concludes that:</p>	

<ul style="list-style-type: none"><li>• The peer review findings have been addressed and the analysis approach has been accepted by the peer reviewers. The peer review findings referred to relate to the requirements in the SPID. No requirements in the Standard specifically address this topic.</li></ul>	Yes
<ul style="list-style-type: none"><li>• Although some peer review findings and observations have not been resolved, the analysis is acceptable on another justified basis.</li></ul>	NA
<ul style="list-style-type: none"><li>• The licensee's definition of the control point for site response analysis adequately meets the intent of the SPID guidance.</li></ul>	Yes
<ul style="list-style-type: none"><li>• The licensee's definition of the control point for site response analysis does not meet the intent of the SPID guidance, but is acceptable on another justified basis.</li></ul>	NA

**TOPIC 4: Adequacy of the Structural Model (SPID Section 6.3.1)**

<p>The NRC staff review of the structural model finds an acceptable demonstration of its adequacy</p> <p>Used an existing structural model</p> <p>Used an enhancement of an existing model</p> <p>Used an entirely new model</p> <p>Criteria 1 through 7 (SPID Section 6.3.1) are all met.</p>	<p>Yes</p> <p>Yes</p> <p>Yes</p> <p>Yes</p> <p>Yes</p>
<p>Notes from staff reviewer:</p> <p>Conclusions were based on the review of the information contained in the Vogtle SPRA template submittal. Three dimensional Finite Element Method structural models were used for Category I structures and lumped mass, stick models for simple structures. The licensee stated that new, as well as existing models were evaluated using the 2014 seismic hazard information.</p> <p>Deviation(s) or deficiency(ies) and Resolution: None.</p> <p>Consequence(s): None.</p>	
<p>The NRC staff concludes that:</p> <ul style="list-style-type: none"> <li>• The peer review findings have been addressed and the analysis approach has been accepted by the peer reviewers. The peer review findings referred to relate to the SR requirements SFR-C1 through C6 in the Standard, as well as to the requirements in the SPID.</li> <li>• Although some peer review findings and observations have not been resolved, the analysis is acceptable on another justified basis.</li> <li>• The licensee's structural model meets the intent of the SPID guidance.</li> </ul>	<p>Yes</p> <p>NA</p> <p>Yes</p>

<ul style="list-style-type: none"><li>• The licensee's structural model does not meet the intent of the SPID guidance, but is acceptable on another justified basis.</li></ul>	NA
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Notes from staff reviewer:

The structures at Vogtle are founded on “deep” soil and the structural analysis considered soil structure interaction by using the SASSI code. A fixed-base analysis was not performed. As stated above, this topic is moot.

Deviation(s) or deficiency(ies) and Resolution: None.

Consequence(s): None.

The NRC staff concludes that:

- The peer review findings have been addressed and the analysis approach has been accepted by the peer reviewers. The peer review findings referred to relate to the requirements in the SPID. No requirements in the Standard specifically address this topic.
- Although some peer review findings and observations have not been resolved, the analysis is acceptable on another justified basis
- The licensee’s use of fixed-based dynamic analysis of structures for a site previously defined as “rock” adequately meets the intent of the SPID guidance.
- The licensee’s use of fixed-based dynamic analysis of structures for a site previously defined as “rock” does not meet the intent of the SPID guidance, but is acceptable on another justified basis.

NA

NA

NA

NA



<p>The NRC staff concludes that:</p> <ul style="list-style-type: none"><li>• The peer review findings have been addressed and the analysis approach has been accepted by the peer reviewers. The peer review findings referred to relate to the SR requirement SFR-C3 in the Standard, as well as to the requirements in the SPID.</li><li>• Although some peer review findings and observations have not been resolved, the analysis is acceptable on another justified basis.</li><li>• The licensee's use of seismic response scaling adequately meets the intent of the SPID guidance.</li></ul> <p>The licensee's use of seismic response scaling does not meet the intent of the SPID guidance but is acceptable on another justified basis.</p>	<p>NA</p> <p>NA</p> <p>Yes</p> <p>NA</p>
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**TOPIC 7: Use of New Response Analysis for Building Response, ISRS, and Fragilities**

<p>The SPID does not provide specific guidance on performing new response analysis for use in developing ISRS and fragilities. The new response analysis is generally conducted when the criteria for use of existing models are not met or more realistic estimates are deemed necessary. The requirements for new analysis are included in the standard. See SR requirements SFR-C2, C4, C5, and C6.</p> <p>One of the key areas of review is consistency between the hazard and response analyses. Specifically, this means that there must be consistency among the ground motion equations, the soil-structure-interaction analysis (for soil sites), the analysis of how the seismic energy enters the base level of a given building, and the in-structure-response-spectrum analysis. Said another way, an acceptable SPRA must use these analysis pieces together in a consistent way.</p> <p>The following are high-level key elements that should have been considered:</p>	
<p>1. Foundation Input Response Spectra (FIRS) site response developed with appropriate building specific soil velocity profiles.</p> <p>Structure #1 name: Containment Building</p> <p>Structure #2 name: Auxiliary Building</p> <p>Structure #3 name: Control Building</p> <p>Structure #4 name: Fuel Handling Building</p> <p>Structure #5 name: Diesel Generator Building</p> <p>Structure #6 name: Auxiliary Feedwater Pumphouse</p> <p>Structure #7 name: Nuclear Services Cooling Water Tower</p> <p>Structure #8 name: Condensate Storage Tanks</p> <p>Structure #9 name: Refueling Water Storage Tanks</p> <p>Structure #10 name: Reactor Make-up Water Storage Tank</p>	<p>Yes</p>
<p>Are all structures appropriately considered?</p>	<p>Yes</p>

<p>2. Are models adequate to provide realistic structural loads and response spectra for use in the SPRA?</p> <p>1. Is the SSI analysis capable of capturing uncertainties and realistic?</p> <p>2. Is the probabilistic response analysis capable of providing the full distribution of the responses?</p>	<p>Yes</p> <p>Yes</p> <p>NA</p>
<p>Notes from staff reviewer: None.</p> <p>Deviation(s) or deficiency(ies) and Resolution: None.</p> <p>Consequence(s): None.</p>	
<p>The NRC staff concludes:</p> <ul style="list-style-type: none"> <li>• The peer review findings have been addressed and the analysis approach has been accepted by the peer reviewers. The peer review findings referred to relate to the SR requirements SFR-C2, C4, C5, and C6 in the Standard, as well as to the requirements in the SPID.</li> <li>• Although some peer review findings and observations have not been resolved, the analysis is acceptable on another justified basis.</li> <li>• The licensee's FIRS modeling is consistent with the prior NRC review of the GMRS and soil velocity information.</li> <li>• The licensee's structural model meets the intent of the SPID guidance and the Standard's requirements.</li> <li>• The response analysis accounts for uncertainties in accordance with the SPID guidance and the Standard's requirements.</li> <li>• The NRC staff concludes that an acceptable consistency has been achieved among the various analysis pieces of the overall analysis of site response and structural response.</li> </ul>	<p>NA</p> <p>NA</p> <p>Yes</p> <p>Yes</p> <p>Yes</p> <p>Yes</p>

<ul style="list-style-type: none"><li>• The licensee's structural model does not meet the intent of the SPID guidance and the Standard's requirements, but is acceptable on another justified basis.</li></ul>	NA
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<ul style="list-style-type: none"><li>• The peer review findings have been addressed and the analysis approach has been accepted by the peer reviewers. The peer review findings referred to relate to the SR requirements SFR-B1 and B2 in the Standard, as well as to the requirements in the SPID.</li></ul>	NA
<ul style="list-style-type: none"><li>• Although some peer review findings and observations have not been resolved, the analysis is acceptable on another justified basis.</li></ul>	NA
<ul style="list-style-type: none"><li>• The licensee's use of a screening approach for selecting SSCs for fragility analysis meets the intent of the SPID guidance.</li></ul>	Yes
<ul style="list-style-type: none"><li>• The licensee's use of a screening approach for selecting SSCs for fragility analysis does not meet the intent of the SPID guidance but is acceptable on another justified basis.</li></ul>	NA



<p>The NRC staff concludes that:</p> <ul style="list-style-type: none"><li>• The peer review findings have been addressed and the analysis approach has been accepted by the peer reviewers. The peer review findings referred to relate to the requirements in the SPID. No requirements in the Standard specifically address this Topic.</li><li>• Although some peer review findings and observations have not been resolved, the analysis is acceptable on another justified basis.</li><li>• The licensee's use of the CDFM/Hybrid method for seismic fragility analysis meets the intent of the SPID guidance.</li><li>• The licensee's use of the CDFM/Hybrid method for seismic fragility analysis does not meet the intent of the SPID guidance, but is acceptable on another justified basis</li></ul>	<p>NA</p> <p>NA</p> <p>Yes</p> <p>NA</p>
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**TOPIC 10: Capacities of SSCs Sensitive to High-Frequencies (SPID Section 6.4.2)**

<p>The SPID requires that certain SSCs that are sensitive to high-frequency seismic motion must be analyzed in the SPRA for their seismic fragility using a methodology described in Section 6.4.2 of the SPID.</p>	<p>Yes</p>
<p><u>Potential Staff Findings:</u> The NRC staff review of the SPRA's fragility analysis of SSCs sensitive to high frequency seismic motion finds that the analysis is acceptable.</p>	<p>Yes</p>
<p>The flow chart in Figure 6-7 of the SPID was followed.</p>	<p>No</p>
<p>The flow chart was not followed but the analysis is acceptable on another justified basis.</p>	<p>Yes</p>
<p>Notes from staff reviewer: The licensee's SPRA report Section 4.4.2 identified that sensitivity to high frequency was addressed in the following ways: (1) General equipment ruggedness spectra (GERS) capacities were used for critical relays. The GERS capacities used are either the same as or lower than relay capacities at high frequency range. (2) Vogtle is a deep soil site and predominant seismic demands occur in the low frequency range due to soil-structure interaction. (3) Peer review finding 14-8 was addressed. The finding identified that relay fragilities were based on conservative assumptions.  Deviation(s) or deficiency(ies) and Resolution: None.</p>	
<p>Consequence(s): None.</p>	
<p>The NRC staff concludes that:</p>	

<ul style="list-style-type: none"><li>• The peer review findings have been addressed and the analysis approach has been accepted by the peer reviewers. The peer review findings referred to relate to the SR requirement SFR-F3 in the Standard, as well as to the requirements in the SPID.</li></ul>	Yes
<ul style="list-style-type: none"><li>• Although some peer review findings and observations have not been resolved, the analysis is acceptable on another justified basis.</li></ul>	NA
<ul style="list-style-type: none"><li>• The licensee's fragility analysis of SSCs sensitive to high frequency seismic motion meets the intent of the SPID guidance.</li></ul>	Yes
<ul style="list-style-type: none"><li>• The licensee's fragility analysis of SSCs sensitive to high-frequency motion does not meet the intent of the SPID guidance but is acceptable on another justified basis.</li></ul>	NA

**TOPIC 11: Capacities of Relays Sensitive to High-Frequencies (SPID Section 6.4.2)**

<p>The SPID requires that certain relays and related devices (generically, “relays”) that are sensitive to high-frequency seismic motion must be analyzed in the SPRA for their seismic fragility. Although following the Standard is generally acceptable for the fragility analysis of these components, the SPID (Section 6.4.2) contains additional guidance when either circuit analysis or operator-action analysis is used as part of the SPRA to understand a given relay’s role in plant safety. When one or both of these are used, the NRC reviewer should use the following elements of the checklist.</p>	
<p>i) <u>Circuit analysis</u>: The seismic relay-chatter analysis of some relays relies on circuit analysis to assure that safety is maintained.</p> <p>(A) If <u>no</u>, then (B) is moot.</p> <p>(B) If <u>yes</u>:</p> <p><u>Potential Staff Finding</u>: The approach to circuit analysis for maintaining safety after seismic relay chatter is acceptable.</p>	<p>Yes</p> <p>Yes</p>
<p>ii) <u>Operator actions</u>: The relay-chatter analysis of some relays relies on operator actions to assure that safety is maintained.</p> <p>(A) If <u>no</u>, then (B) is moot.</p> <p>(B) If <u>yes</u>:</p> <p><u>Potential Staff Finding</u>: The approach to analyzing operator actions for maintaining safety after seismic relay chatter is acceptable.</p>	<p>Yes</p> <p>Yes</p>
<p>Notes from staff reviewer: None.</p> <p>Deviation(s) or deficiency(ies) and Resolution: None.</p> <p>Consequence(s): None.</p>	

<p>The NRC staff concludes that:</p> <ul style="list-style-type: none"><li>• the peer review findings have been addressed and the analysis approach has been accepted by the staff for the purposes of this evaluation. The peer review findings referred to relate to the SR requirements SPR-B6 (Addendum A) or SPR-B4 (Addendum B) in the Standard, as well as to the requirements in the SPID.</li><li>• although some peer review findings and observations have not been resolved, the analysis is acceptable on another justified basis.</li><li>• the licensee's analysis of seismic relay-chatter effects meets the intent of the SPID guidance.</li><li>• the licensee's analysis of seismic relay-chatter effects does not meet the intent of the SPID guidance, but is acceptable on another justified basis.</li></ul>	<p>Yes</p> <p>NA</p> <p>Yes</p> <p>NA</p>
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<ul style="list-style-type: none"><li>• the licensee’s method for selecting the “dominant risk contributors” for further seismic fragilities analysis using the separation-of-variables methodology meets the intent of the SPID guidance.</li><li>• the licensee’s method for selecting the “dominant risk contributors” for further seismic fragilities analysis using the separation-of-variables methodology does not meet the intent of the SPID guidance, but is acceptable on another justified basis.</li></ul>	<p>Yes</p> <p>NA</p>
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**TOPIC 13: Evaluation of LERF (SPID Section 6.5.1)**

<p>The NRC staff review of the SPRA's analysis of LERF finds an acceptable demonstration of its adequacy.</p> <p><u>Potential Staff Findings:</u></p> <p>A) The analysis follows each of the elements of guidance for LERF analysis in Section 6.5.1 of the SPID, including in Table 6-3.</p> <p>B) The LERF analysis does not follow the guidance in Table 6-3 but the analysis is acceptable on another justified basis.</p>	<p>Yes</p> <p>Yes</p> <p>NA</p>
<p>Notes from staff reviewer: None.</p> <p>Deviation(s) or deficiency(ies) and Resolution: None.</p> <p>Consequence(s): None.</p>	
<p>The NRC staff concludes that:</p> <ul style="list-style-type: none"> <li>• the peer review findings have been addressed and the analysis approach has been accepted by the staff for the purposes of this evaluation. The peer review findings referred to relate to the SR requirements SFR-F4, SPR-E1, SPR-E2, and SPR-E6 (Addendum B only) in the Standard, as well as to the requirements in the SPID.</li> <li>• although some peer review findings and observations have not been resolved, the analysis is acceptable on another justified basis.</li> <li>• the licensee's analysis of LERF meets the intent of the SPID guidance.</li> <li>• the licensee's analysis of LERF does not meet the intent of the SPID guidance but is acceptable on another justified basis.</li> </ul>	<p>Yes</p> <p>NA</p> <p>Yes</p> <p>NA</p>

**TOPIC 14: Peer Review of the SPRA, Accounting for NEI 12-13 (SPID Section 6.7)**

<p>The NRC staff review of the SPRA’s peer review findings, observations, and their resolution finds an acceptable demonstration of the peer review’s adequacy.</p> <p><u>Potential Staff Findings:</u></p> <p>A) The analysis follows each of the elements of the peer review guidance in Section 6.7 of the SPID.</p> <p>B) The composition of the peer review team meets the SPID guidance.</p> <p>C) The peer reviewers focusing on seismic response and fragility analysis have successfully completed the Seismic Qualifications Utility Group training course or equivalent (see SPID Section 6.7).</p> <p>In what follows, a distinction is made between an “in-process” peer review and an “end-of-process” peer review of the completed SPRA report. If an in-process peer review is used, go to (D) and then skip (E). If an end-of-process peer review is used, skip (D) and go to (E).</p> <p>D) The “in process” peer-review process followed the “in process” peer review guidance in the SPID (Section 6.7), including the three “bullets” and the guidance related to NRC’s additional input in the paragraph immediately following those three bullets. These three bullets are:</p> <ul style="list-style-type: none"> <li>• the SPRA findings should be based on a consensus process, and not based on a single peer review team member</li> <li>• a final review by the entire peer review team must occur after the completion of the SPRA project</li> <li>• an “in-process” peer review must assure that peer reviewers remain independent throughout the SPRA development activity.</li> </ul>	<p>Yes</p> <p>Yes</p> <p>Yes</p> <p>Yes</p> <p>NA</p>
<p>If <u>no</u>, go to (F).</p>	

<p>If <u>yes</u>, the “in process” peer review approach is acceptable. Go to (G).</p> <p>E) The “end-of-process” peer review process followed the peer review guidance in the SPID (Section 6.7).</p> <p>If <u>no</u>, go to (F).</p> <p>If <u>yes</u>, the “end-of-process” peer review approach is acceptable. Go to (G).</p> <p>F) The peer-review process does not follow the guidance in the SPID but is acceptable on another justified basis.</p> <p>G) The licensee peer-review Findings and Observations were satisfactorily resolved or were determined not to be significant to the SPRA conclusions for this review application.</p>	<p>NA</p> <p>Yes</p> <p>NA</p> <p>Yes</p>
<p>Notes from staff reviewer: None.</p> <p>Deviation(s) or deficiency(ies) and Resolution: None.</p> <p>Consequence(s): None.</p>	
<p>The NRC staff concludes:</p> <ul style="list-style-type: none"> <li>• the licensee’s peer-review process meets the intent of the SPID guidance.</li> <li>• the licensee’s peer-review process does not meet the intent of the SPID guidance but is acceptable on another justified basis.</li> </ul>	<p>Yes</p> <p>NA</p>



**Topic 16: Review of Plant Modifications and Licensee Actions, If Any**

<p>The licensee:</p> <ul style="list-style-type: none"> <li>• identified modifications necessary to achieve seismic risk improvements</li> <li>• provided a schedule to implement such modifications (if any), consistent with the intent of the guidance</li> <li>• provided Regulatory Commitment to complete modifications</li> <li>• provided Regulatory Commitment to report completion of modifications.</li> </ul>	<p>No</p> <p>NA</p> <p>NA</p> <p>NA</p>
<p>Plant will:</p> <ul style="list-style-type: none"> <li>• complete modifications by</li> <li>• report completion of modifications by</li> </ul>	<p>NA</p> <p>NA</p>
<p>Notes from the Reviewer:</p> <p>Based on the information provided in the submittal, the staff did not identify any potential issues that warranted further consideration under the adequate protection exception to the backfit provisions (10 CFR 50.109(a)(4)(ii)). Further, the risk profile was such that identification of modifications to reduce the risk in accordance with the backfit rule (10 CFR 50.109) and associated guidance (NUREG/BR-0058) was found to be unnecessary.</p> <p>Deviation(s) or Deficiency(ies), and Resolution: None.</p>	
<p>The NRC staff concludes that the licensee:</p> <ul style="list-style-type: none"> <li>• identified plant modifications necessary to achieve the appropriate risk profile</li> <li>• provided a schedule to implement the modifications (if any) with appropriate consideration of plant risk and outage scheduling</li> </ul>	<p>NA</p> <p>NA</p>

## **REFERENCES**

ASME/ANS Addendum A, 2009: Standard ASME/ANS RA-Sa-2009, Addenda A to ASME/ANS RA-S-2008, "Standard for Level 1/Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Applications," American Society of Mechanical Engineers and American Nuclear Society, 2009

ASME/ANS Addendum B, 2013: Standard ASME/ANS RA-Sb-2013, Addenda B to ASME/ANS RA-S-2008, "Standard for Level 1/Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Applications," American Society of Mechanical Engineers and American Nuclear Society, 2013

EPRI-SPID, 2012: "Screening, Prioritization and Implementation Details (SPID) for the Resolution of Fukushima Near-Term Task Force Recommendation 2.1: Seismic," Electric Power Research Institute, EPRI report 1025287, November 2012

NEI, 2012: NEI 12-13 "External Hazards PRA Peer Review Process Guidelines," Nuclear Energy Institute, August 2012

NRC, 2012: "U.S. Nuclear Regulatory Commission Comments on NEI 12-13, 'External Hazards PRA Peer Review Process Guidelines' Dated August 2012," NRC letter to Nuclear Energy Institute, November 16, 2012

AUDIT SUMMARY BY THE OFFICE OF NUCLEAR REACTOR REGULATION RELATED TO  
VOGTLE ELECTRIC GENERATING PLANT, UNITS 1 AND 2  
SUBMITTAL OF SEISMIC PROBABILISTIC RISK ASSESSMENT ASSOCIATED WITH  
REEVALUATED SEISMIC HAZARD IMPLEMENTATION OF THE  
NEAR-TERM TASK FORCE RECOMMENDATION 2.1: SEISMIC  
(CAC NOS. MF9498 AND MF9499; EPID L-2017-JLD-0005)

BACKGROUND AND AUDIT BASIS

By letter dated March 12, 2012 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML12053A340), the U.S. Nuclear Regulatory Commission (NRC) issued a request for information pursuant to Title 10 of the Code of Federal Regulations (10 CFR), Section 50.54(f) (hereafter referred to as the 50.54(f) letter). Enclosure 1 to the 50.54(f) letter requested that licensees reevaluate the seismic hazards for their sites using present-day methods and regulatory guidance used by the NRC staff when reviewing applications for early site permits and combined licenses.

By letter dated October 27, 2015 (ADAMS Accession No. ML15194A015), the NRC made a determination of which licensees were to perform: (1) an SPRA [seismic probabilistic risk assessment], (2) limited scope evaluations, or (3) no further actions based on a comparison of the reevaluated seismic hazard and the site's design-basis earthquake. (Note: Some plant-specific changes regarding whether an SPRA was needed or limited scope evaluations were needed at certain sites have occurred since the issuance of the October 27, 2015, letter.)

By letter dated July 6, 2017 (ADAMS Accession No. ML17177A446), the NRC issued a generic audit plan and entered into the audit process described in Office Instruction LIC-111, "Regulatory Audits", dated December 29, 2008 (ADAMS Accession No. ML082900195), to assist in the timely and efficient closure of activities associated with the letter issued pursuant to Title 10 of the *Code of Federal Regulations* Part 50, Section 50.54(f). The Vogtle Electric Generating Plant, Units 1 and 2 (Vogtle) was included in the list of applicable licensees.

REGULATORY AUDIT SCOPE AND METHODOLOGY

The areas of focus for the regulatory audit are the information contained in the SPRA submittal and all associated and relevant supporting documentation used in the development of the SPRA submittal including, but not limited to, methodology, process information, calculations, computer models, etc.

AUDIT ACTIVITIES

The Vogtle audit took place at the NRC Headquarters in Rockville, MD, beginning on July 6, 2017. Licensee personnel participated remotely, via telephone, from their respective offices. A list of the licensee staff, NRC staff, and contract support personnel that participated in the audit is contained in the table below.

NRC and Contract Support Personnel		Licensee Personnel	
Name	Title	Name	Title
Brett Titus	Project Manager	Randy Bunt	Fukushima Project Manager
Shilp Vasavada	Risk Analyst	Partha Chandran	Risk Analyst
David Heeszel	Geophysicist	Melanie Brown	Seismic Engineer
Robert Pettis	Mechanical Engineer	Matt Euten	Licensing Engineer
Sara Lyons	Risk Analyst		
Mehdi Reisi Fard	Risk Analyst		
Biswajit Dasgupta	Engineer (Southwest Research Institute)		
Daniel Pomerening	Engineer (Southwest Research Institute)		

The NRC staff and the licensee participated in a clarification call that took place on July 6, 2017. In preparation for the call, the staff developed questions to verify information in the licensee's submittal and to gain understanding of non-docketed information that supports the docketed SPRA report. The staff's clarification questions (ADAMS Accession No. ML17292A136) were sent to the licensee in advance of the call to facilitate clear communication and to ensure that the appropriate Southern Nuclear Operating Company, Inc. (the licensee) staff were available to answer questions in various technical areas.

During the call, the licensee provided clarifying information in the following areas:

- component and structural fragilities,
- and how plant response for various scenarios was modeled in the SPRA

The licensee's response to the questions aided in the staff's understanding of the Vogtle seismic probabilistic risk assessment (SPRA) docketed submittal. At the conclusion of the call, the staff had no further questions and determined that no additional documentation or information was needed to supplement Vogtle's docketed SPRA report. The staff determined additional docketed information was not necessary because the licensee's docketed submittal, including the documentation of the licensee's SRPA review team's facts and observations classified as findings, was sufficient to support NRC's regulatory decisionmaking associated with Phase 2 of the 50.54(f) letter.

DOCUMENTS AUDITED

Aside from reviewing the SRPA report submitted by the licensee, the staff did not request to audit any additional documents.

OPEN ITEMS AND REQUEST FOR INFORMATION

Following the clarification call, there were no open items identified by the NRC staff that required proposed closure paths and there were no requests for information discussed or planned to be issued based on the audit call. There were no deviations from the July 6, 2017, generic audit plan.

DEVIATIONS FROM AUDIT PLAN

There were no deviations from the July 6, 2017, generic audit plan.

AUDIT CONCLUSION

The issuance of this document, containing the staff's review of the SPRA submittal, concludes the SPRA audit process for Vogtle.

**SUBJECT: VOGTLE ELECTRIC GENERATING PLANT, UNITS 1 AND 2 – STAFF REVIEW OF SEISMIC PROBABILISTIC RISK ASSESSMENT ASSOCIATED WITH REEVALUATED SEISMIC HAZARD IMPLEMENTATION OF THE NEAR-TERM TASK FORCE RECOMMENDATION 2.1: SEISMIC DATED MARCH 7, 2018**

**DISTRIBUTION:**

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RidsACRS_MailCTR Resource	PBMB R/F	

**ADAMS Accession Nos.: Pkg ML18058A929; Letter ML17293A427;  
Non-concurrence ML18008A305**

<b>OFFICE</b>	NRR/DLP/PBMB/PM	NRR/DLP/PBMB/LA	OGC (NLO)	Non-Concurrence NCP-2017-16
<b>NAME</b>	BTitus	SLent	BHarris	MMarkley
<b>DATE</b>	10/24/17	10/24/17	11/13/17	12/20/17
<b>OFFICE</b>	NRR/DLP/PBMB/BC	NRR/DORL/D	NRR/DRA/D	NRR/DLP/D
<b>NAME</b>	MShams	JGitter	MFranovich	LLund
<b>DATE</b>	11/16/17	2/23/18	2/24/18	3/7/18

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