

## **NRR-PMDAPEm Resource**

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**From:** Jackson, Diane  
**Sent:** Friday, August 28, 2015 10:50 AM  
**To:** Shams, Mohamed  
**Cc:** DiFrancesco, Nicholas; Wyman, Stephen; Spence, Jane; Devlin-Gill, Stephanie; Roche, Kevin; Yee, On; Rivera-Lugo, Richard; Andrukat, Dennis; Wang, George; Tseng, Ian; Schleicher, Lisa; 50.54f\_Seismic Resource; RidsNroDsea Resource  
**Subject:** WATTS BAR NUCLEAR PLANT, UNITS 1 AND 2 - TECHNICAL REVIEW CHECKLIST RELATED TO INTERIM ESEP SUPPORTING IMPLEMENTATION OF NTTF R2.1, SEISMIC (TAC NO. MF5273)  
**Attachments:** Watts Bar R2.1 Seismic ESEP NRC review.docx

August 28, 2015

MEMORANDUM TO: Mohamed K. Shams, Chief  
Hazards Management Branch (JHMB)  
Japan Lessons-Learned Division  
Office of Nuclear Reactor Regulation

FROM: Diane T. Jackson, Chief  
Geosciences and Geotechnical Engineering Branch 2 (RGS2)  
Division of Site Safety and Environmental Analysis  
Office of New Reactors

SUBJECT: WATTS BAR NUCLEAR PLANT, UNITS 1 AND 2 - TECHNICAL REVIEW CHECKLIST RELATED TO INTERIM EXPEDITED SEISMIC EVALUATION PROCESS SUPPORTING IMPLEMENTATION OF NTTF RECOMMENDATION 2.1, SEISMIC, RELATED TO THE FUKUSHIMA DAI-ICHI NUCLEAR POWER PLANT ACCIDENT (TAC NO. MF5273)

The NRC technical staff working through the Geosciences and Geotechnical Engineering Branches 1 and 2 (RGS1 and RGS2) completed the Technical Review Checklist of the Watts Bar Nuclear Plant, Units 1 and 2 response to Enclosure 1, Item (6) of the March 12, 2012, request for information letter issued per Title 10 of the Code of Federal Regulations, Subpart 50.54(f), to power reactor licensees and holders of construction permits requesting addressees to provide further information to support the NRC staff's evaluation of regulatory actions to be taken in response to Fukushima Near-Term Task Force (NTTF) Recommendation 2.1: Seismic which implements lessons learned from Japan's March 11, 2011, Great Tōhoku Earthquake and subsequent tsunami. This addresses the staff review of the interim Expedited Seismic Evaluation Process (ESEP) report in response to Requested Item (6) of Enclosure 1, "Recommendation 2.1: Seismic," of the 50.54(f) letter. Attached is a file containing the technical review checklist to prepare a response letter to the licensee.

The NRC staff reviewed the information provided and, as documented in the enclosed staff checklist, determined that sufficient information was provided to be responsive to this portion of the Enclosure 1 of the 50.54(f) letter. The application of this staff review is limited to the interim ESEP as part of NTTF R2.1: Seismic activities.

This electronic memo constitutes the DSEA concurrence provided that only editorial changes are made to the staff assessment that would not affect the technical conclusions or technical context of the assessment.

This concludes the NRC's efforts associated with TAC NO. MF5273 for the review of the interim ESEP report for the Watts Bar Nuclear Plant, Units 1 and 2.

Docket Nos: 50-390 and 50-391

CONTACT: Stephanie Devlin-Gill  
Office of New Reactors  
301-415-5301

Copy: Nicholas DiFrancesco, Steve Wyman, Jane Spence, Stephanie Devlin-Gill, Kevin Roche, On Yee, Lisa Schleicher, Richie Rivera-Lugo, Dennis Andrukat, George Wang, Ian Tseng, 50.54(f) Seismic Resource, RidsNroDsea Resource

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**From:** Jackson, Diane

**Created By:** Diane.Jackson@nrc.gov

**Recipients:**

"DiFrancesco, Nicholas" <Nicholas.DiFrancesco@nrc.gov>

Tracking Status: None

"Wyman, Stephen" <Stephen.Wyman@nrc.gov>

Tracking Status: None

"Spence, Jane" <Jane.Spence@nrc.gov>

Tracking Status: None

"Devlin-Gill, Stephanie" <Stephanie.Devlin-Gill@nrc.gov>

Tracking Status: None

"Roche, Kevin" <Kevin.Roche@nrc.gov>

Tracking Status: None

"Yee, On" <On.Yee@nrc.gov>

Tracking Status: None

"Rivera-Lugo, Richard" <Richard.Rivera-Lugo@nrc.gov>

Tracking Status: None

"Andrukat, Dennis" <Dennis.Andrukat@nrc.gov>

Tracking Status: None

"Wang, George" <George.Wang@nrc.gov>

Tracking Status: None

"Tseng, Ian" <Ian.Tseng@nrc.gov>

Tracking Status: None

"Schleicher, Lisa" <Lisa.Schleicher@nrc.gov>

Tracking Status: None

"50.54f\_Seismic Resource" <50.54f\_Seismic.Resource@nrc.gov>

Tracking Status: None

"RidsNroDsea Resource" <RidsNroDsea.Resource@nrc.gov>

Tracking Status: None

"Shams, Mohamed" <Mohamed.Shams@nrc.gov>

Tracking Status: None

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TECHNICAL REVIEW CHECKLIST  
BY THE OFFICE OF NUCLEAR REACTOR REGULATION  
RELATED TO EXPEDITED SEISMIC EVALUATION PROCESS INTERIM EVALUATION  
IMPLEMENTING NTTF RECOMMENDATION 2.1 SEISMIC  
WATTS BAR NUCLEAR PLANT, UNITS 1 AND 2  
DOCKET NOS. 50-390 AND 50-391

By letter dated March 12, 2012 (USNRC, 2012a), the U.S. Nuclear Regulatory Commission (NRC) issued a request for information to all power reactor licensees and holders of construction permits in active or deferred status, pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.54(f) "Conditions of License" (hereafter referred to as the "50.54(f) letter"). Enclosure 1 of the 50.54(f) letter requests addressees to reevaluate the seismic hazard at their site using present-day methods and guidance for licensing new nuclear power plants, and identify actions to address or modify, as necessary, plant components affected with the reevaluated seismic hazards. Requested Information Item (6) in Enclosure 1 to the 50.54(f) letter requests addressees to provide an interim evaluation and actions taken or planned to address a higher seismic hazard relative to the design basis, as appropriate, prior to completion and submission of the seismic risk evaluation.

Additionally, by letter dated April 12, 2013<sup>1</sup>, the Electric Power Research Institute (EPRI) staff submitted EPRI TR 3002000704 "Seismic Evaluation Guidance: Augmented Approach for the Resolution of Fukushima Near-Term Task Force (NTTF) Recommendation 2.1: Seismic" (hereafter referred to as the guidance). The Augmented Approach proposed that licensees would use an Expedited Seismic Evaluation Process (ESEP) to address the interim actions as requested by Information Item (6) in the 50.54(f) letter. The ESEP is a simplified seismic capacity evaluation with a focused scope of certain key installed Mitigating Strategies equipment that is used for core cooling and containment functions to cope with scenarios that involve a loss of all AC power and loss of access to the ultimate heat sink to withstand the Review Level Ground Motion, which is up to two times the safe shutdown earthquake (SSE). Due to the expedited and interim nature of the ESEP, the assessment does not include many considerations that are part of a normal risk evaluation. These deferred items, include but are not limited to, structures, piping, non-seismic failures, and operator actions, as well scenarios such as addressing loss of coolant accidents. By letter dated May 7, 2013<sup>2</sup>, the NRC staff endorsed the guidance. Central and eastern United States licensees with a reevaluated seismic hazard exceeding the SSE submitted an ESEP interim evaluation in December 2014.

Consistent with the interim nature of this activity, the staff performed the review of the licensee's submittal to assess whether the intent of the guidance was implemented. A multi-disciplined team checked whether the identified methods were consistent with the guidance. A senior expert panel reviewed the team's questions, if any, and checklist for consistency and scope. New or updated parameters (e.g., In-Structure Response Spectra, High Confidence of Low Probability of Failure calculations) presented by the licensees were assessed only based on licensee statements for acceptability for the Item (6) response. The application of this staff review is limited to the ESEP interim evaluation as part of NTTF R2.1: Seismic activities.

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<sup>1</sup> ADAMS Accession No. ML13102A142

<sup>2</sup> ADAMS Accession No. ML13106A331

## NTTF Recommendation 2.1 Expedited Seismic Evaluation Process

### Technical Review Checklist for Watts Bar Nuclear Plant, Units 1 and 2

By letter dated December 30, 2014<sup>3</sup>, Tennessee Valley Authority (the licensee) provided an Expedited Seismic Evaluation Process (ESEP) report in a response to Enclosure 1, Requested Information Item (6) of the 50.54(f) letter, for the Watts Bar Nuclear Plant, Units 1 and 2 (Watts Bar).

#### I. Review Level Ground Motion

The licensee:	
<ul style="list-style-type: none"> <li>• described the determination of the review level ground motion (RLGM) using one of the means acceptable by the guidance</li> </ul>	Yes
<ul style="list-style-type: none"> <li>• identified location of the control point and is consistent with March 2014 Seismic Hazard and Screening Report<sup>4</sup> submittal</li> </ul>	Yes
<ul style="list-style-type: none"> <li>• compared the site ground motion response spectra used to select the ESEP RLGM to the SSE.</li> </ul>	Yes
Watts Bar Nuclear Plant used a scaled SSE at a ratio of 2.0	
<b>Notes from the Reviewer:</b> <ol style="list-style-type: none"> <li>1. The licensee used a maximum ratio of 2.0 because the ratio of the ground motion response spectrum (GMRS) to SSE from the March 2014 Seismic Hazard and Screening Report exceeds 2.0.</li> <li>2. A typographical error in the control point elevation was clarified by the licensee in their response to staff questions dated May 26, 2015 (ML15239A083). The correct control point elevation is 664 ft.</li> </ol>	
<b>Deviation(s) or Deficiency(ies), and Resolution:</b> <ul style="list-style-type: none"> <li>• No deviations or deficiencies were identified.</li> </ul>	
The NRC staff concludes:	
<ul style="list-style-type: none"> <li>• the licensee's RLGM meets the intent of the guidance</li> <li>• the RLGM is reasonable for use in the interim evaluation</li> </ul>	Yes Yes

#### II. Selection of the Success Path

The licensee:	
<ul style="list-style-type: none"> <li>• described the success path</li> </ul>	Yes
<ul style="list-style-type: none"> <li>• described normal and desired state of the equipment for the success path</li> </ul>	Yes
<ul style="list-style-type: none"> <li>• ensured that the success path is consistent with the plant's overall mitigating strategies approach or provided a justification for an alternate path</li> </ul>	Yes
<ul style="list-style-type: none"> <li>• stated that the selection process was in accordance with the guidance or meets the intent of the guidance</li> </ul>	Yes
<ul style="list-style-type: none"> <li>• used installed FLEX Phase 1 equipment as part of the success path</li> </ul>	Yes
<ul style="list-style-type: none"> <li>• included FLEX Phase 2 and/or 3 <u>connections</u></li> </ul>	Yes
<ul style="list-style-type: none"> <li>• considered installed FLEX Phase 2 and/or 3 <u>equipment</u></li> </ul>	Yes
<b>Notes from the Reviewer:</b> None	
<b>Deviation(s) or Deficiency(ies), and Resolution:</b> No deviations or deficiencies were identified.	

<sup>3</sup> ADAMS Accession No. ML14365A072

<sup>4</sup> ADAMS Accession No. ML14098A428

## NTTF Recommendation 2.1 Expedited Seismic Evaluation Process

### Technical Review Checklist for Watts Bar Nuclear Plant, Units 1 and 2

The NRC staff concludes that: <ul style="list-style-type: none"> <li>• the selected success path is reasonable for use in the interim evaluation</li> <li>• the licensee considered installed Phase 2 and 3 connections or equipment in the interim evaluation.</li> </ul>	Yes  Yes
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#### III. Selection of the Equipment List

The licensee: <ul style="list-style-type: none"> <li>• developed and provided the ESEL by applying the ESEP</li> <li>• identified equipment considering the following functions:                         <ul style="list-style-type: none"> <li>○ Core cooling (with focus on Mode 1) function</li> <li>○ Available, sustainable water source</li> <li>○ Containment function and integrity</li> </ul> </li> </ul>	Yes  Yes Yes Yes
<b>Notes from the Reviewer:</b> None	
<b>Deviation(s) or Deficiency(ies), and Resolution:</b> <ul style="list-style-type: none"> <li>• No deviations or deficiencies were identified.</li> </ul>	
For PWR Plants ONLY	
The licensee included indicators / instrumentation for the following functions: level, pressure, temperature, that would be indicative of (but not explicitly identified to specific instruments): water level of the steam generator (SG), pressure of SG, containment, and reactor coolant system (RCS); and temperature of the RCS.	Yes
For BWR Plants ONLY	
The licensee considered indicators for the following functions: level, pressure, temperature that would be indicative of (but not explicitly identified to specific instruments): Temperature of suppression pool, RCS, containment); Pressure of suppression pool, RCS, and drywell; water level of the suppression pool.	N/A
<b>Notes from the Reviewer:</b> None	
<b>Deviation(s) or Deficiency(ies), and Resolution:</b> No deviations or deficiencies were identified.	
Through a sampling of the ESEP key components, the NRC staff concludes that: <ul style="list-style-type: none"> <li>• the licensee's process to develop the ESEL meets the intent of the guidance for the interim evaluation</li> <li>• the desired equipment state for the success path were identified</li> <li>• the licensee considered the support equipment for the ESEL</li> <li>• both front-line and support systems appeared to be included in the ESEL as evidenced by inclusion of SSCs on the success path and of support systems (e.g., batteries, motor control centers, inverters).</li> </ul>	Yes  Yes Yes  Yes

## NTTF Recommendation 2.1 Expedited Seismic Evaluation Process

### Technical Review Checklist for Watts Bar Nuclear Plant, Units 1 and 2

#### IV. Walkdown Approach

The licensee: <ul style="list-style-type: none"> <li>• described the walkdown screening approach, including walk-bys and walkdowns performed exclusively for the ESEP, in accordance with the guidance</li> <li>• credited previous walkdown results, including a description of current action(s) to verify the present equipment condition and/or configuration (e.g., walk-bys), in accordance with the guidance</li> <li>• stated that the walkdown was performed by seismically trained personnel</li> </ul>	Yes  Yes  Yes
<b>Notes from the Reviewer:</b> <ol style="list-style-type: none"> <li>1. Unit 1 containment was not accessible for walkdowns or walk-bys. The licensee provided a justification for the Unit 2 walkdowns to apply to both units due to similarity. The walkdown team reviewed photographs of Unit 1 to assure similarity and applicability of findings. This is judged acceptable for this interim evaluation.</li> </ol>	
<b>Deviation(s) or Deficiency(ies), and Resolution:</b> No deviations or deficiencies were identified.	
The licensee: <ul style="list-style-type: none"> <li>• described, as needed, adverse material condition of the equipment (e.g., material degradation)</li> <li>• credited previous walkdown results, included a description of current action(s) to verify the present equipment condition (e.g., walk-bys), meeting the intent of the guidance</li> </ul>	Yes  Yes
The licensee: <ul style="list-style-type: none"> <li>• described the conditions of structural items considered for the interim evaluation, including:                         <ul style="list-style-type: none"> <li>○ spatial interactions (i.e., interaction between block walls and other items/components)</li> <li>○ anchorage</li> <li>○ piping connected to tanks (i.e., differential movement between pipes and tanks at connections)</li> </ul> </li> </ul>	Yes  Yes Yes
<b>Notes from the Reviewer:</b> None	
<b>Deviation(s) or Deficiency(ies), and Resolution:</b> <ul style="list-style-type: none"> <li>• No deviations or deficiencies were identified.</li> </ul>	
The licensee reported deviations for Watts Bar:	No
If deviations were identified, there is a discussion of how the deficiencies were or will be addressed in the ESEP submittal report.	N/A
The NRC staff concludes that: <ul style="list-style-type: none"> <li>• the licensee described the performed walkdown approach, including any credited previous efforts (e.g., Individual Plant Examination of External Events(IPEEE)) consistent with the guidance</li> <li>• the licensee addressed identified deviations consistent with the guidance, if any</li> </ul>	Yes  N/A

#### V. Capacity Screening Approach and HCLPF Calculation Results



## NTTF Recommendation 2.1 Expedited Seismic Evaluation Process

### Technical Review Checklist for Watts Bar Nuclear Plant, Units 1 and 2

<p>The licensee:</p> <ul style="list-style-type: none"> <li>• described the capacity screening process for the ESEL items, consistent with the guidance (e.g., use of EPRI NP-6041 screening table)</li> <li>• presented the results of the screened-out ESEL items in the ESEP report</li> <li>• described the development of in-structure response spectra (ISRS) based on scaling</li> <li>• described the development of ISRS based on new analysis consistent with the guidance</li> <li>• described the method for estimating HCLPF capacity of screened-in ESEL items, including both structural and functional failure modes consistent with the guidance: <ul style="list-style-type: none"> <li>○ use of Conservative Deterministic Failure Margin (CDFM)</li> <li>○ use of fragility analysis (FA)</li> <li>○ use of experience data or generic information</li> </ul> </li> <li>• credited IPEEE spectral shape for HCLPF capacity estimates is similar to or envelopes the RLGM, and anchored at the same control point</li> <li>• presented the results of HCLPF capacities including associated failure modes for screened-in ESEL items</li> <li>• reviewed the ESEL items with the lowest HCLPF values to ensure that their capacities are equal or greater than the RLGM</li> </ul>	<p>Yes</p> <p>Yes</p> <p>Yes</p> <p>N/A</p> <p>Yes</p> <p>Yes</p> <p>N/A</p> <p>N/A</p> <p>Yes</p> <p>Yes</p> <p>Yes</p> <p>Yes</p>
<p><b>Notes from the Reviewer:</b></p> <ol style="list-style-type: none"> <li>1. The staff requested clarification regarding the choice of Review Level Earthquake and demand assessment, as described in Sections 5.2 and 6.1 of the ESEP report. These two sections provide references to the demand that seem to imply that the IPEEE process results that were used in compiling and assessing the ESEL were based on demand spectrum anchored at 0.3g and not 0.5g. In its response dated May 26, 2015 (ML15239A083), the licensee clarified that the IPEEE process results that were used in compiling and assessing the ESEL were based on a demand spectrum anchored at 0.5g. TVA's Letter CNL-15-027 of March 20, 2015 submitted the IPEEE Final Report process results based on a demand spectrum anchored at 0.5g. The staff finds this response acceptable for this interim evaluation.</li> <li>2. The staff requested clarification regarding the seismic demand and HCLPF capacity (originally submitted report to the NRC vs. updated) used in the IPEEE review, and how this information affected the screening of the equipment included in the ESEL. As detailed in the licensee's response dated May 26, 2015 (ML15239A083), this issue was addressed by evaluating the equipment taken from the IPEEE review against the 0.5g HCLPF threshold. The staff determined that this process is acceptable for the purposes of this interim evaluation.</li> <li>3. The staff requested further explanation of the process followed to address the capacity of components located above 40 feet from grade level, as instructed in EPRI-6041. The licensee's response (ML15079A293, dated March 20, 2015) cited independent confirmatory fragility calculations that were performed for all items on the SPRA equipment list, which includes all of the screened ESEL items mounted more than 40 feet above grade. This additional assessment provides HCLPF values that confirm sufficient capacity for ESEL items mounted more than 40 feet above grade. This staff finds this acceptable for this interim evaluation and meets the intent of the guidance.</li> </ol>	

**NTTF Recommendation 2.1 Expedited Seismic Evaluation Process**  
**Technical Review Checklist for Watts Bar Nuclear Plant, Units 1 and 2**

<b>Deviation(s) or Deficiency(ies), and Resolution:</b>	
<ul style="list-style-type: none"> <li>No deviations or deficiencies were identified.</li> </ul>	
The NRC staff concludes that:	
<ul style="list-style-type: none"> <li>the licensee described the implementation of the capacity screening process consistent with the intent of the guidance</li> </ul>	Yes
<ul style="list-style-type: none"> <li>the licensee presented capacity screening and calculation results, as appropriate, in the ESEP report</li> </ul>	Yes
<ul style="list-style-type: none"> <li>the method used to develop the ISRS is consistent with guidance for use in the ESEP</li> </ul>	Yes
<ul style="list-style-type: none"> <li>for HCLPF calculations, the licensee used HCLPF calculation methods as endorsed in the guidance</li> </ul>	Yes
<ul style="list-style-type: none"> <li>no anomalies were noted in the reported HCLPF</li> </ul>	Yes

VI. Inaccessible Items

The licensee:	
<ul style="list-style-type: none"> <li>provided a list of inaccessible items</li> </ul>	N/A
<ul style="list-style-type: none"> <li>provided a schedule of the planned walkdown and evaluation for all inaccessible items</li> </ul>	N/A
<ul style="list-style-type: none"> <li>provided Regulatory Commitment to complete walkdowns.</li> </ul>	N/A
Watts Bar will provide results or complete walkdown by: N/A	
<b>Notes from the Reviewer:</b>	
<p>1. As noted in Section IV of this checklist, Unit 1 containment was not accessible during the walk-by verifications. The licensee used detailed inspection of those equivalent components performed in Unit 2, and recent photographs of Unit 1 to verify similarity. Based on that inspection, the licensee determined that components are well constructed, seismically rugged, and have adequate commodity clearance. This is acceptable for this interim evaluation since the licensee used recent photographs to evaluate inaccessible items in Unit 1 in accordance with guidance.</p>	
<b>Deviation(s) or Deficiency(ies), and Resolution:</b>	
No deviations or deficiencies were identified	
The NRC staff concludes that the licensee:	
<ul style="list-style-type: none"> <li>listed inaccessible items</li> </ul>	N/A
<ul style="list-style-type: none"> <li>committed to provide the results (e.g., walkdowns, walk-bys, etc.) of the remaining inaccessible items consistent with the guidance</li> </ul>	N/A
<ul style="list-style-type: none"> <li>substitutions, if needed, were appropriately justified</li> </ul>	Yes

VII. Modifications to Plant Equipment

The licensee:	
<ul style="list-style-type: none"> <li>identified modifications for ESEL items necessary to achieve HCLPF values that bound the RLGM (excluding mitigative strategies equipment (FLEX)), as specified in the guidance</li> </ul>	N/A
<ul style="list-style-type: none"> <li>provided a schedule to implement such modifications (if any), consistent with the intent of the guidance</li> </ul>	N/A
<ul style="list-style-type: none"> <li>provided Regulatory Commitment to complete modifications</li> </ul>	N/A
<ul style="list-style-type: none"> <li>provided Regulatory Commitment to report completion of modifications.</li> </ul>	N/A

**NTTF Recommendation 2.1 Expedited Seismic Evaluation Process**  
**Technical Review Checklist for Watts Bar Nuclear Plant, Units 1 and 2**

Watts Bar will: <ul style="list-style-type: none"> <li>• complete modifications by <u>N/A</u></li> <li>• report completion of modifications by <u>N/A</u></li> </ul>	
<b>Notes from the Reviewer:</b> None	
<b>Deviation(s) or Deficiency(ies), and Resolution:</b> No deviations or deficiencies were identified.	
The NRC staff concludes that the licensee: <ul style="list-style-type: none"> <li>• identified plant modifications necessary to achieve the target seismic capacity</li> <li>• provided a schedule to implement the modifications (if any) consistent with the guidance</li> </ul>	N/A  N/A

VIII. Conclusions:

The NRC staff assessed the licensee’s implementation of the ESEP guidance. Due to the interim applicability of the ESEP evaluations, use of the information for another application would require a separate NRC review and approval. Based on its review, the NRC staff concludes that the licensee’s implementation of the interim evaluation meets the intent of the guidance. The staff concludes that, through the implementation of the ESEP guidance, the licensee identified and evaluated the seismic capacity of certain key installed Mitigating Strategies equipment that is used for core cooling and containment functions to cope with scenarios that involve a loss of all AC power and loss of access to the ultimate heat sink to withstand a seismic event up to the Review Level Ground Motion (RLGM) and thus, provides additional assurance while the plant seismic risk evaluation is being conducted. In the case of Watts Bar, the RLGM was set at the maximum ratio of two times the SSE in accordance with the guidance because the GMRS is above two times the SSE. The application of this staff review is limited to the ESEP interim evaluation as part of NTTF R2.1: Seismic activities. As noted in the review checklist, the staff did not identify deviations or exceptions were taken from the guidance. The licensee did not identify any modifications of equipment based on the ESEP.

In summary, the licensee, by implementing the ESEP interim evaluation, has demonstrated additional assurance which supports continued plant safety while the longer-term seismic evaluation is completed to support regulatory decision making. The NRC staff concludes that the licensee responded appropriately to Enclosure 1, Item (6) of the 50.54(f) letter, dated March 12, 2012, for Watts Bar Nuclear Plant, Units 1 and 2.

Principal Contributors: Dennis Andrukat, George Wang, Ian Tseng, Lisa Schleicher, On Yee, Richard Rivera-Lugo, Nikolaos Simos (NRC Consultant)