NRR-PMDAPEm Resource

From: MAUER, Andrew [anm@nei.org]
Sent: Thursday, September 04, 2014 6:17 PM
To: DiFrancesco, Nicholas
Subject: Template - Section 6
Attachments: ESEP Report Example - Section 6 Sept4.docx

Nick,

Attached is our proposed Section 6 which is intended to show the level of detail expected in this section of the reports. It is based on a site specific example that primarily relied on the IPEEE which was performed using the SMA approach – which may not be the case for all sites.

Would like to touch base on this Monday (pm) or Tuesday (am).

Thanks,
Andrew

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Sent Date: 9/4/2014 6:16:48 PM
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From: MAUER, Andrew

Created By: anm@nei.org

Recipients:
"DiFrancesco, Nicholas" <Nicholas.DiFrancesco@nrc.gov>
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6.0 Seismic Margin Evaluation Approach

This example is intended to provide the level of detail appropriate for this section of the submittal. It is based on a site specific example that relied primarily on the IPEEE which was performed using the EPRI seismic margins assessment (SMA) approach to comply with NUREG-1407 and GL 88-20 Supplement 4, which may not be the case for all sites.

It is necessary to demonstrate that ESEL items have sufficient seismic capacity to meet or exceed the demand characterized by the RLGM. The seismic capacity is characterized as the peak ground acceleration (PGA) for which there is a high confidence of a low probability of failure (HCLPF). The PGA is associated with a specific spectral shape, in this case the 5%-damped RLGM spectral shape. The HCLPF capacity must be equal to or greater than the RLGM PGA. The criteria for seismic capacity determination are given in Section 5 of EPRI 3002000704.

There are two basic approaches for developing HCLPF capacities:

1. Deterministic approach using the conservative deterministic failure margin (CDFM) methodology of EPRI NP-6041, A Methodology for Assessment of Nuclear Power Plant Seismic Margin (Revision 1) [Ref 10].
2. Probabilistic approach using the fragility analysis methodology of EPRI TR-103959, Methodology for Developing Seismic Fragilities [Ref 11].

6.1 Summary of methodologies used

Plant performed a seismic margin assessment (SMA) in 1993. The SMA is documented in Reference 12 and consisted of screening walkdowns and HCLPF anchorage calculations. The screening walkdowns used the screening tables from Chapter 2 of EPRI NP-6041 [10]. The walkdowns were conducted by engineers trained in EPRI NP 6041 (the engineers attended the EPRI SMA Add-On course in addition to the SQUG Walkdown Screening and Seismic Evaluation Training Course), and were documented on Screening Evaluation Work Sheets from EPRI NP-6041. Anchorage capacity calculations used the CDFM criteria from EPRI NP-6041. Seismic demand was the IPEEE Review Level Earthquake (RLE) for SMA (mean NUREG/CR-0098 [12] ground response spectrum anchored to 0.3g PGA).

Figure 6-1 shows the mean NUREG/CR-0098 ground response spectrum used as the IPEEE RLE for the SMA, compared to the ESEP RLGM response spectrum. The figure shows that IPEEE RLE envelopes the ESEP RLGM at all frequencies greater than about 2.0 Hz. The RLE is slightly less than the RLGM at frequencies below about 2.0 Hz; although this may be disregarded as there are no ESEL items in this frequency range.

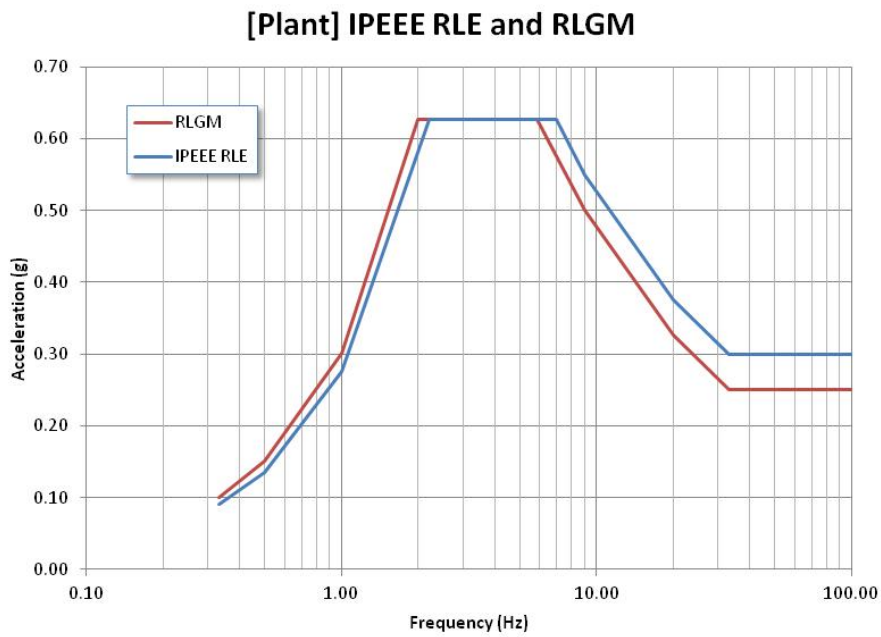

Figure 6-1. *Plant* IPEEE RLE and RLGM.

6.2 HCLPF screening process

The SMA was based on the IPEEE RLE, which was anchored to 0.3g peak ground acceleration. The RLE is equal to the RLGM at frequencies from about 2.0 Hz to about 6.0 Hz, and greater than the RLGM at frequencies above about 6.0 Hz. Therefore, any components whose SMA-based HCLPF exceeds the RLE can be screened out from HCLPF calculations. The screening tables in EPRI NP-6041 are based on ground peak spectral accelerations of 0.8g and 1.2g. These both exceed the RLGM peak spectral acceleration. The anchorage capacity calculations were based on SSE floor response spectra scaled to the RLE, except for equipment in the Auxiliary Building for which new floor response spectra were generated for the RLE. Equipment for which the screening caveats were met and for which the anchorage capacity exceeded the RLE seismic demand can be screened out from ESEP seismic capacity determination because the HCLPF capacity exceeds the RLGM.

The Unit 1 ESEL contains 101 items. Of these, 45 are valves, both power-operated and relief. In accordance with Table 2-4 of EPRI NP-6041, active valves may be assigned a functional capacity of 0.8g peak spectral acceleration without any review other than looking for valves with large extended operators on small diameter piping, and anchorage is not failure mode. Therefore, valves on the ESEL may be screened out from ESEP seismic capacity determination, subject to the caveat about large extended operators on small diameter piping. Power-operated valves were addressed both in the IPEEE fragility calculations and in the

SMA. In the fragility calculations, all of the valves on the IPEEE Equipment List were screened out on the basis of median capacity exceeding 2.0g. In the SMA, the valves were found to meet EPRI NP-6041 Figures F-25 and F-26 (thus meeting the 1.2g peak spectral acceleration screening criteria) or to exceed the RLE floor response spectra on the basis of vendor seismic qualification reports. The IPEEE SMA reviews covered 361 valves in Unit 1, and focused on motor-operated valves on small diameter piping and valves at high elevations in the plant. Relief valves were not included in the IPEEE review except for the power-operated relief valves, which met the criteria. Spring-operated relief valves are considered to meet the EPRI NP-6041 0.8g peak spectral acceleration screening criteria without explicit review. On the basis of the above, the ESEL valves may be screened out from ESEP seismic capacity determination.

The non-valve components in the ESEL are generally screened based on the SMA results. If the SMA showed that the component met the EPRI NP-6041 screening caveats and the CDFM capacity exceeded the RLE demand, the component can be screened out from the ESEP capacity determination.

6.3 Seismic walkdown approach

This section will provide a summary of the methodology and conclusions of the seismic walkdowns performed for the ESEP effort for NTTF 2.1. Licensees may also discuss the extent, basis and use of previous seismic walkdowns performed at the plant for USI A-46, IPEEE, NTTF 2.3 or other initiatives.

6.4 HCLPF calculation process

ESEL items not included in the previous IPEEE evaluations at *plant* were evaluated using the criteria in EPRI NP-6041 [Ref 10]. Those evaluations included the following steps:

- Performing seismic capability walkdowns for equipment not included in previous seismic walkdowns (SQUG, IPEEE, or NTTF 2.3) to evaluate the equipment installed plant conditions
- Performing screening evaluations using the screening tables in EPRI NP-6041 as described in Section 6.3, and
- Performing HCLPF calculations considering various failure modes that include both structural failure modes (e.g. anchorage, load path etc.) and functional failure modes).

All HCLPF calculations were performed using the CDFM methodology and are documented in *plant calculation yyyy* [Ref 13].

6.5 Functional evaluations of Relays

Five relays in the ESEL associated with the FLEX Phase 1 response required functional evaluations. Each relay was evaluated using the SMA relay evaluation criteria in Section 3 of NP-6041.

Two of the five relays were evaluated using the "Relays Associated with Switchgear" criteria in NP-6041. Consistent with that criteria, the two relays are 1) not "seismically sensitive relays part of the control and operation logic", 2) do not lead to lockout of the switchgear breaker, and the ISRS at the switchgear is below the switchgear GERS.

Specific seismic qualification test-based capacities were available for the remaining three relays in [plant] documentation. In-cabinet capacity to demand evaluations were performed using the [plant] relay seismic capacities and the ESEP ISRS scaled with the NP-6041 in-cabinet amplification factors. In each case the capacity exceeded the demand.

The ESEP relay functional evaluations are documented in [plant] calculation yyy [Ref 13].

6.6 Tabulated ESEL HCLPF values (including Key failure modes)

Tabulated ESEL HCLPF values are provided in Attachment C for Unit 1 and Attachment D for Unit 2. The following notes apply to the information in the tables.

- For items screened out using NP 6041 screening tables, the screening level can be provided as >RLGM and the failure mode can be listed as "Screened", (unless the controlling HCLPF value is governed by anchorage).
- For items where anchorage controls the HCLPF value, the HCLPF value is listed in the table and the failure mode is noted as "anchorage."
- For the 2 relays screened out using the switchgear criteria, the switchgear screening level is listed as the HCLPF and "Switchgear relay" is listed as the failure mode.
- For the 3 relays evaluated using [plant] specific seismic qualification tests, the calculated HCLPF value is listed as the HCLPF and "relay function" is listed as the failure mode.

Attachment C

ESEP HCLPF Values and Failure Modes Tabulation, Unit 1

Attachment D

ESEP HCLPF Values and Failure Modes Tabulation, Unit 2