Discussion of Public Comments on
Draft Regulatory Guide DG-1175 *(Revision 3 of RG 1.100)*

SEISMIC QUALIFICATION OF ELECTRIC AND ACTIVE MECHANICAL EQUIPMENT AND FUNCTIONAL QUALIFICATION OF ACTIVE MECHANICAL EQUIPMENT FOR NUCLEAR POWER PLANTS

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Agenda

- Introductions
- Opening Remarks
- Proposed Staff Resolution of comments
- Industry Reply
- Comments from the Public

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Background

- Update of Regulatory Guide 1.100, Rev. 2 "Seismic Qualification of Electric and Mechanical Equipment for Nuclear Power Plants," (June 1988).

– Rev. 3 of RG 1.100 endorses IEEE Std 344-2004 and the ASME QME-1-2007 with exceptions and clarifications

– Incorporated comments from various Offices in NRC

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Background

- Formal public comment period: May 27, 2008 to July 11, 2008.
- Last set of comments were received on September 8, 2008
- 84 comments were received:

- IEEE Nuclear Power Engineering Committee: 33
- ASME Nuclear Codes and Standard Committee: 4
- Nuclear Energy Institute: 22
- Nuclear Utility Group on Equipment Qualification: 5
- Dominion: 6
- Westinghouse Electric Company: 13
- Duke Energy Carolinas: 1 – endorsed NEI comments

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Introduction

- The following slides are to share the understanding of the issues raised in the public comment process and the staff considerations based on the available information.
- The final disposition of issues and the revision to the text in the RG will be subject to the required internal approvals.

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Item 1

1) <u>Functional Qualification of Active Mechanical Equipment</u>

"DG1175 (RG1.100) may overlap with RG1.148 "Functional Specification for Active Valve Assemblies in Systems Important to Safety in Nuclear Power Plants", which endorsed ANSI N278.1-1975."

Discussion

- The Foreword of ASME QME-1-2007 explains that the ANSI N45 Committee's valve task force (N278) was reassigned to the ASME QME in 1982 and designated the Subcommittee on Qualification of Valve Assemblies.

- Endorsing ASME QME-1-2007, which incorporated all the lesson-learned and operating experience of active mechanical equipment, for functional qualification is appropriate.

- The NRC staff plans to withdraw RG 1.148 when RG 1.100 Rev. 3 is issued.

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Item 2

2) <u>Regulatory Analysis Fails to Evaluate Differences in DG-1175 and SRP 3.9.6</u>

"These differences suggest significant additional licensee burdens regarding the methods and procedures used to establish functional qualification and the documents used to demonstrate such functional qualification. The March 2007 revision of SRP 3.9.6 did not refer to any QME-1 functional qualification provisions and guidance".

Discussion

- The SRP Section 3.9.6 acceptance criteria are consistent with the provisions in QME-1-2007 to demonstrate that pumps and valves are capable of performing their design-basis functions.

- The ASME Standard QME-1-2007, as addressed in DG-1175, provides an efficient and effective approach for satisfying the SRP Section 3.9.6 acceptance criteria. The NRC staff will also consider other approaches for the functional design and qualification of pumps, valves, and dynamic restraints proposed by applicants in meeting the SRP Section 3.9.6 acceptance criteria.

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Item 3

3) <u>ASME requests that use of experience-based methods used for USI A46 be allowed and accepted for new plants.</u>

"The experience-based seismic methods have been developed and used by the nuclear industry for quite some time. These methods were approved by the consensus committee process based on sound and accepted engineering judgment, information, and practices."

Discussion

- The staff finds that experience-based methods would be acceptable if similarity can be established with respect to <u>seismic excitation</u>, <u>physical</u>, <u>functional</u>, and <u>dynamic characteristics</u> among the member items in a reference equipment class as well as between equipment in the experience database and those to be seismically qualified.

- As delineated in the General Staff Position 1.1. in DG1175, the use of experience-based method for seismic qualification of electric equipment will be subject to review by the NRC staff.

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Item 4

4) <u>The NRC has made the QME Nonmandatory Appendices mandatory.</u>

The NUGEQ disagrees with requiring the use of the nonmandatory appendices and believes this may be counterproductive and limit licensee commitments to the use of ASME QME-1. QME-1 makes clear that mandatory appendices contain provisions that must be followed and non-mandatory appendices provide information or guidance that is not imposed.

Discussion

- The staff agrees that Mandatory Appendices contain provisions that must be followed. Compliance to Nonmandatory Appendices, which provide information or guidance, is voluntary.

- However, if a user commits to use any of the <u>Nonmandatory</u> Appendices for its qualification of active mechanical equipment, then all the criteria and procedures that are delineated in <u>both the Mandatory Appendices</u> and those <u>committed Nonmandatory Appendices</u> would then become the requirements of the qualification program.

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Item 5

5) <u>Fragile electronic components, such as solid-state relays and microprocessor-based components</u>

"*Some solid-state relays and microprocessor-based components are quite fragile in terms of withstanding earthquake excitations*". Industry requested the definition of "fragile electronic components". Industry also commented that they are not aware of any solid-state relays and microprocessor-based components that are considered fragile or particularly vulnerable to earthquake motions.

Discussion

The RG statement will be revised to say "*Some solid-state relays and microprocessor-based components <u>are sensitive to</u> earthquake motion."* A seismic test would be needed to confirm if particular equipment is sensitive to high-frequency earthquake motion.

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Item 6

6) <u>Inadvertent high frequency content presented in previous tests</u>

- DG stated that *"credit should not be taken for the inadvertent high frequencies present in some of the IEEE-344-type seismic qualification tests of equipment in the past, which may have shown ZPA of the TRS to be up to 100 Hz.."*
- Industry commented that as long as the frequency content can be demonstrated to be sufficient using IEEE Std 344-2004 Annex B "Frequency Content and Stationarity", previous tests should be credited.

Discussion

- The acceptance of previous tests can be justified by demonstrating that the frequency content of the power spectral density (PSD) of the test waveform is compatible with PSD of the amplified portion of the RRS in accordance with Annex B of IEEE 344-2004. *(Note: This is similar to the acceptable justification stated in SRP 3.7.1)*

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Item 7

7) <u>High-frequency sensitive equipment and COL/DC ISG-1</u>

- New plants are not being qualified for high frequency ground-motions rather they are being screened for high frequency sensitivity. Such high-frequency motions are not part of the certified design basis. Refer to COL/DC-ISG-1, "Interim Staff Guidance on Seismic Issues Associated with High Frequency Ground Motion in Design Certification and Combined License Applications".

Discussion

- All equipment in new nuclear plants must satisfy the regulations for seismic qualification delineated in Appendix A of 10 CFR Part 100 and 10 CFR Part 50 Appendix S.
- The staff's position is that there is no inconsistency between COL/DC-ISG-1 and DG1175. The ISG provided guidance on the methodology to determine whether the equipment is sensitive to the effects of high frequency ground motion. DG-1175 (RG1.100) described the test methods that the staff considered acceptable for use in seismic qualification of electric and active mechanical equipment.

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Item 8

8)Test Experience Data

- The use of the frequency-by-frequency mean of the successful TRS is not adequate to define TES. When using test experience data, an equipment capacity factor has to be considered to obtain an equivalent confidence level for performance and to cover the uncertainties in high-level testing for an equipment class. The acceptable equipment capacity factor is 1.4 for TES
- NRC policy is to address applications in a probabilistic framework. We recognize that the IEEE approach is deterministic and may have reasonable conservatism; however, a factor of 1.4 provides confidence in equipment performance and accounts for the natural variability in equipment, failure mode uncertainty, and the limited testing that is undertaken.

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Item 9

9) <u>Definition of Operating Basis Earthquake</u>

- *"Electric equipment should be qualified with five one-half SSE events followed by one full SSE event (SECY-93-087) even if the OBE of a plant is defined to be one-third of SSE or less".* The DG-1175 position does not recognize that some plants are licensed with an OBE that is greater or less than one-half the SSE. The plant licensing basis should define whether the OBE is one-third or one-half of the SSE, or has no relationship to the SSE.

Discussion

- For nuclear power plants that were licensed with the elimination of the OBE, electric equipment should be qualified with five one-half SSE events followed by one full SSE event (SECY-93-087) even if the OBE of a plant is defined to be one-third of SSE or less.
- For operating reactors, seismic qualification is based on the OBE level in accordance with the plant specific licensing basis.

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Item 10

10) <u>Statistical Independent Motions Requirement of Time Histories</u>

The acceptance criteria for Coherent Function and Correlation Coefficient is overly conservative.

Discussion

- For the coherence function, numerical values ranging from 0.0 to a maximum of 0.3 and an average of approximately 0.2 are acceptable.
- An absolute value of the correlation coefficient function of greater than 0.16 must be justified by the applicant.
  - In cases where equipment is placed on foundations which are of a size and flexibility such that seismic input motions at the equipment foundation have similar properties to the free field, the NRC positions on the numerical values for the coherence function and the correlation coefficient functions for defining statistically independent motions are the same as the free field.

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Item 10, continued

- In the absence of scientific study of the values of coherent function and correlation coefficient at elevated floor levels for equipment qualification, the staff has determined that values different from those given in the RG can be used subject to NRC review and approval.

- NRC will perform additional research to provide the technical basis to support the value of coherent function and correlation coefficient currently accepted by the staff.

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Item 11

11) <u>The use of median-centered horizontal in-structure response spectrum</u>

- *The use of a median-centered horizontal in-structure response spectrum as the RRS for the candidate equipment is not acceptable. In-structure response spectra should be developed in accordance with the licensing basis and NRC guidance described in the latest revision of Regulatory Guide 1.122, Rev. 1, "Development of Floor Design Response Spectra for Seismic Design of Floor-Supported Equipment or Components."*

  The capacity derived from earthquake experience data is an average capacity from many samples. It is appropriate to compare it to an "average" demand such as median-centered. It would also be overly conservative to require the RRS be developed using normally conservative analytical approaches in RG 1.122 and also implement the conservative assumption of the ground motion for the experience data earthquakes to represent the capacity for the class.

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Item 11, continued

Discussion

- For operating reactors, In-structure response spectra used as the RRS for the qualification of candidate equipment should be in accordance with the licensing basis. Any changes to seismic qualification approach will be subject to staff review and approval.

- For new reactors, the use of median-centered horizontal in-structure response spectrum as the RRS for the candidate equipment is generally not acceptable.

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Conclusion

- Any questions or comments?