EPRI | ELECTRIC POWER RESEARCH INSTITUTE

Seismic Walkdown Guidance

For Resolution of Fukushima Near-Term Task Force Recommendation 2.3: Seismic

2012 TECHNICAL REPORT

May 31, 2012

Mr. Adrian P. Heymer, Executive Director
Strategic Programs
Nuclear Energy Institute
1776 I St NW, Suite 400
Washington, DC 20006-3708

SUBJECT: ENDORSEMENT OF ELECTRIC POWER RESEARCH INSTITUTE (EPRI) DRAFT REPORT 1025286, "SEISMIC WALKDOWN GUIDANCE"

Dear Mr. Heymer:

On behalf of the Nuclear Regulatory Commission (NRC), I am responding to the Nuclear Energy Institute's (NEI's) letter[1] of May 29, 2012, "Final Draft of Industry Seismic Walkdown Guidance (EPRI 1025286)," which requested NRC's endorsement of Draft 7 of EPRI Report 1025286, "Seismic Walkdown Guidance," dated May 2012 (hereafter, EPRI guidance document). NEI's letter was submitted to support licensee responses to Enclosure 3 of the March 12, 2012, information request[2] that was issued pursuant to Title 10 of the *Code of Federal Regulations (10 CFR)*, Section 50.54(f) (hereafter, 50.54(f) letter). The 50.54(f) letter was issued in the course of implementing the lessons learned from the accident at the Fukushima Dai-ichi nuclear facility. The NRC staff would like to acknowledge that this document was the product of significant interaction between the NRC, NEI, and other stakeholders at numerous public meetings. These interactions and the insights gained from them allowed for the development of this document in a very short time-frame.

The NRC staff confirmed that the EPRI guidance document directs licensees to perform walkdowns in a manner that will address the Requested Information items 1.a through 1.g in the 50.54(f) letter. Additionally, the NRC staff finds that Section 8, "Submittal Report," of the EPRI guidance document delineates the appropriate information to be submitted in response to Requested Information items 2.a through 2.f. of Enclosure 3 of the 50.54(f) letter.

As described above, the NRC staff has reviewed the EPRI guidance document and finds that performance and reporting of seismic protection walkdowns in accordance with this document would be responsive to the 50.54(f) letter. In addition, the EPRI guidance document also incorporates the suggestions made by the Advisory Committee on Reactor Safeguards during a subcommittee meeting on May 22, 2012.

[1] The Agencywide Documents Access and Management System (ADAMS) Accession No. of NEI's May 29, 2012, letter was not available at the time this letter was issued.
[2] The 50.54(f) letter is available in ADAMS under Accession No. ML12053A340.

The NRC requests that EPRI publish a final version of the guidance document within one month of receipt of this letter. The final version should incorporate this letter between the title page and the first section and remove the draft markings from the document. If you, or your staff, have additional questions, please contact myself or Mr. Christopher Gratton at 301-415-1055, or by email at Christopher.Gratton@nrc.gov.

Sincerely,

/RA/

David L. Skeen, Director
Japan Lessons-Learned Project Directorate
Office of Nuclear Reactor Regulation

cc: E. Leeds
M. Johnson
R. Taylor

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Seismic Walkdown Guidance

For Resolution of Fukushima Near-Term Task Force Recommendation 2.3: Seismic

This document does NOT meet the requirements of 10CFR50 Appendix B, 10CFR Part 21, ANSI N45.2-1977 and/or the intent of ISO-9001 (1994).

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1025286
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THE FOLLOWING ORGANIZATION, UNDER CONTRACT TO EPRI, PREPARED THIS REPORT:

MPR Associates, Inc.

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NOTE

For further information about EPRI, call the EPRI Customer Assistance Center at 800.313.3774 or e-mail askepri@epri.com.

Acknowledgments

The following organization, under contract to the Electric Power Research Institute (EPRI), prepared this report:

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This report describes research sponsored by EPRI.

This publication is a corporate document that should be cited in the literature in the following manner:

Seismic Walkdown Guidance: For Resolution of Fukushima Near-Term Task Force Recommendation 2.3: Seismic EPRI, Palo Alto, CA: 2012. 1025286.

Product Description

Following the accident at the Fukushima Daiichi nuclear power plant resulting from the March 11, 2011, Great Tohoku Earthquake and subsequent tsunami, the NRC established the Near Term Task Force (NTTF) in response to Commission direction. The NTTF issued a report that made a series of recommendations, some of which were to be acted upon "without unnecessary delay." Subsequently, the NRC issued a 50.54(f) Letter that requests information to assure that these recommendations are addressed by all U.S. nuclear power plants. This report provides guidance for conducting seismic walkdowns as required in the 50.54(f) Letter, Enclosure 3, Recommendation 2.3: Seismic [1]. Every U.S. nuclear power plant is required to perform seismic walkdowns to identify and address degraded, non-conforming or unanalyzed conditions and to verify the current plant configuration with the current seismic licensing basis. The nuclear power industry and the NRC agreed to cooperate in the development of guidelines and procedures to perform these walkdowns.

Results and Findings

This report provides guidance and procedures to perform the Recommendation 2.3: Seismic walkdowns including selection of personnel, selection of a sample of SSCs that represent diversity of component types and assures inclusion of components from critical systems/functions discussed in the NRC letter, conduct of the walkdowns, evaluation against the plant seismic licensing basis, and reporting requirements. The report includes checklists to be used by the Seismic Walkdown Engineers for seismic evaluations.

Challenges and Objectives

The objective of the work reported in this document is to provide guidance on the performance of plant seismic walkdowns to satisfy the requirements of NTTF Recommendation 2.3: Seismic.

Applications, Value and Use

The guidance in this report is intended for use by all U.S. nuclear power plants to meet the requirements of NTTF Recommendation 2.3: Seismic. The primary value in this guidance is that it has been

reviewed with the NRC and can be applied by all plants to provide a uniform and acceptable industry response to the NRC. The guidance will also be used as the basis for development of an industry training course to further assure its proper application.

Perspective

The schedule for satisfying the requirements of Recommendation 2.3: Seismic is aggressive. The guidance therefore must be generic and endorsed by the NRC so that it can be applied uniformly across the U.S. industry. This report was produced with extensive input and participation from utility seismic engineers and similarly extensive review by the NRC.

Approach

The approach taken was to formulate guidance for the seismic walkdowns by using a sampling procedure that aligns the scope of the effort with the required schedule while achieving the objectives of the walkdowns as described in the NRC 50.54(f) Letter. The sample includes representative items of equipment needed to safely shut down the reactor and maintain containment integrity. In some cases, equipment lists from the Individual Plant Examination for External Events (IPEEE) that were developed for plants in the early 1990's can be used to identify the sample items. The sample needs to be suitably diverse across a spectrum of plant safety-related equipment including different classes of equipment. In keeping with the lessons learned by over thirty years of industry investigation of earthquake effects on mechanical and electrical equipment, the Seismic Walkdown Guidance includes a focus on equipment anchorage and seismic spatial interactions, as well as consideration of other potentially adverse seismic conditions such as seismically-induced fire and seismically-induced flood.

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Section 1: Purpose and Approach

Purpose

Enclosure 3 to the NRC 50.54(f) Letter [1] states the following purposes of the NRC request:

- To gather information with respect to Near-Term Task Force (NTTF) Recommendation 2.3, as amended by staff requirements memorandum (SRM) associated with SECY-11-0124 and SECY-11-0137,
- To request licensees to develop a methodology and acceptance criteria for seismic walkdowns to be endorsed by the NRC staff,
- To request licensees to perform seismic walkdowns using the NRC-endorsed walkdown methodology, as defined herein,
- To identify and address degraded, nonconforming, or unanalyzed conditions through the corrective action program, and
- To verify the adequacy of licensee monitoring and maintenance procedures.

The 50.54(f) Letter also requests that the procedures used by licensees to conduct the walkdowns include the following characteristics:

a. Determination of the seismic walkdown scope and any combined effects

b. Consideration of NUREG-1742, EPRI Report NP-6041, GIP, and common issues and findings discussed in the responses to TI 2515/183

c. Pre-walkdown actions (e.g., data collection, review of drawings and procedures, identification of the plant licensing basis, identification of current seismic protection levels)

d. Identification of SSCs requiring seismic protection and used in the protection of the reactor and spent fuel pool, including the ultimate heat sink (UHS)

e. Description of the walkdown team composition and qualifications

f. Details of the information to be collected during the walkdown including equipment access considerations

g. Documentation and peer review requirements

The guidance contained in this document is intended to meet the above objectives. The remainder of Section 1: Purpose and Approach provides an overview of the guidance; details for implementing this guidance are included in the remaining sections of this document.

Approach

The approach for addressing the actions and information requested in the 50.54(f) Letter includes the following activities, which are described in detail in the sections shown in parentheses:

- Assign personnel with appropriate qualifications (Section 2)
- Select structures, systems and components (SSCs) to be evaluated (Section 3)
- Perform Seismic Walkdowns and Area Walk-Bys (Section 4)
- Evaluate potentially adverse seismic conditions with respect to the seismic licensing basis (Section 5)
- Perform peer reviews (Section 6)
- Report the actions taken to reduce or eliminate the seismic vulnerabilities identified by the Individual Plant Examination of External Events (IPEEE) program (Section 7)
- Prepare submittal report (Section 8)

A summary of these sections is provided below.

Section 2: Personnel Qualifications

The qualifications of personnel who will perform the key activities required to fulfill the requirements and expectations of the 50.54(f) Letter are described in Section 2: Personnel Qualifications. These personnel are responsible for:

- Selecting the SSCs that should be placed on the Seismic Walkdown Equipment List (SWEL), as described in Section 3,
- Performing the Seismic Walkdowns and Area Walk-Bys, as described in Section 4,
- Performing the seismic licensing basis evaluations, as described in Section 5, and
- Identifying the list of plant-specific vulnerabilities identified during the IPEEE program and describing the actions taken to eliminate or reduce them, as described in Section 7.

Personnel qualification requirements for the peer reviewers are addressed in Section 6: Peer Review.

Section 3: Selection of SSCs

The process used to select the items that will be included in the overall Seismic Walkdown Equipment List (SWEL) is described in detail in Section 3: Selection of SSCs. In general, the SWEL is comprised of two groups of items, which are described at a high level in the following subsections.

Sample of Required Items for the Five Safety Functions – SWEL 1

As shown in Figure 1-1, Screen #1 is used to narrow the scope of SSCs in the plant to those that are designed to Seismic Category (SC) I requirements (because they have a seismic licensing basis).

Screen #2 in Figure 1-1 narrows the scope of SSCs by selecting only those that do not regularly undergo inspections to confirm that their configuration continues to be consistent with the plant licensing basis. Cable/conduit raceways and HVAC ductwork, although not included as "equipment" in the SWEL, are reviewed during area walk-bys of the spaces containing items on the SWEL.

Screen #3 in Figure 1-1 narrows the scope of SSCs to be included in SWEL 1 to those associated with maintaining the five safety functions. These five safety functions include the four safe shutdown functions (reactor reactivity control, reactor coolant pressure control, reactor coolant inventory control, and decay heat removal, which includes the Ultimate Heat Sink), plus the containment functions.

Screen #4 in Figure 1-1 represents a process intended to result in SWEL 1 that sufficiently represents the broader population of plant equipment and systems needed to meet the objectives of the 50.54(f) Letter. The following five sample selection attributes are used:

- A variety of types of systems
- Major new or replacement equipment
- A variety of types of equipment
- A variety of environments
- Equipment enhanced due to vulnerabilities identified during the IPEEE program

Spent Fuel Pool Related Items – SWEL 2

As shown in Figure 1-2, Screen #1 and Screen #2 are used to narrow the scope of SSCs to those that have a seismic licensing basis and those that are appropriate for an equipment walkdown process. Screen #3 in Figure 1-2 represents a process intended to result in SWEL 2 that sufficiently represents the broader population

of spent fuel pool (SFP) SC I equipment and systems to meet the objectives of the 50.54(f) Letter, and includes the following sample selection attributes:

- A variety of types of systems
- Major new or replacement equipment
- A variety of types of equipment
- A variety of environments

Screen #4 in Figure 1-2 identifies items of the SFP that could potentially cause a rapid drain-down of the pool, even if such items are not Seismic Category I. Any items identified as having the potential for rapidly draining the SFP should be added to SWEL 2.

Section 4: Seismic Walkdowns and Area Walk-Bys

Figure 1-3 shows the major activities associated with performing the Seismic Walkdowns and Area Walk-Bys using the SWEL (SWEL 1 plus SWEL 2) and activities associated with evaluating the seismic licensing basis of items with potentially adverse seismic conditions. Details of the process for conducting these evaluations are described in Section 4: Seismic Walkdowns and Area Walk-Bys. Overviews of these two key activities are discussed in the following subsections.

Seismic Walkdowns

Seismic Walkdowns focus on the seismic adequacy of the items on the SWEL. The walkdowns focus on the following conditions:

- Adverse anchorage conditions
- Adverse seismic spatial interactions
- Other adverse seismic conditions (e.g., degradation)

If a potentially adverse seismic condition is identified during the equipment walkdown, the condition is evaluated with respect to the current licensing basis (CLB), as described in Section 5: Seismic Licensing Basis Evaluations.

Area Walk-Bys

Area Walk-Bys are to be conducted in each area of the plant that contains an item on the SWEL. The Area Walk-By will identify potentially adverse seismic conditions associated with other SSCs located in the vicinity of the SWEL item. As discussed in detail in Section 4: Seismic Walkdowns and Area Walk-Bys, the key examination factors that should be considered in Area Walk-Bys include the following:

- Anchorage conditions (if visible without opening equipment)
- Significantly degraded equipment in the area
- Potential seismic interactions

- A visual assessment (from the floor) of cable/conduit raceways and HVAC ducting (e.g., condition of supports or fill conditions of a cable tray)
- Potential adverse interactions that could cause flooding/spray and fire in the area
- Other housekeeping items, including temporary installations

If a potentially adverse seismic condition is identified during the Area Walk-Bys, the condition is evaluated with respect to the current licensing basis (CLB), as described in Section 5: Seismic Licensing Basis Evaluations.

Section 5: Seismic Licensing Basis Evaluations

Potentially adverse seismic conditions identified in either the equipment Seismic Walkdowns or the Area Walk-Bys are evaluated with respect to their seismic licensing basis, as described in detail in Section 5: Seismic Licensing Basis Evaluations. If the potentially adverse seismic condition cannot be readily shown to meet its seismic licensing basis, then the condition will be evaluated further under the plant's Corrective Action Program (CAP). Under the CAP, if the condition is found not to meet the seismic licensing basis, it is expected that an assessment of the extent of condition would be performed. Seismic Category I equipment that cannot perform its intended safety function during or after the design basis seismic event is, by definition, not in compliance with its seismic licensing basis.

Section 6: Peer Review

The peer review function and activities of the Peer Review Team are described in detail in Section 6: Peer Review. A minimum of two individuals, one of whom has seismic engineering experience as it applies to nuclear power plants, should comprise the Peer Review Team.

The Peer Review Team should provide an overview of the entire effort associated with the program, including the following activities:

- Review the selection of the SSCs included on the SWEL
- Review a sample of the checklists prepared for the Seismic Walkdowns and Area Walk-Bys
- Review the licensing basis evaluations
- Review the decisions for entering or not entering the potentially adverse seismic conditions into the CAP process
- Review the submittal report
- Summarize the results of the peer review process in the submittal report

It is recommended that these peer review activities be performed during implementation of this program, to the extent practicable, rather than waiting until all the work is complete.

Section 7: IPEEE Vulnerabilities

Guidance for identifying the plant-specific vulnerabilities identified during the IPEEE program[1] and reporting the actions taken to eliminate or reduce them, as required in the 50.54(f) Letter, under Requested Information, Item 2.c, is described in detail in Section 7: IPEEE Vulnerabilities. To address this request for information, it is not necessary to repeat or update any of the IPEEE evaluations.

Section 8: Submittal Report

Requirements of the submittal report are described in detail in Section 8: Submittal Report. In accordance with the 50.54(f) Letter, the submittal report will include the following:

a. Information on the plant-specific hazard licensing bases and a description of the protection and mitigation features considered in the licensing basis evaluation

b. Information related to development of the SWEL and implementation of the walkdown process

c. A description of the actions taken to eliminate or reduce plant-specific vulnerabilities (including any seismic anomalies, outliers, or other findings) identified by the IPEEE program and the completion dates for these actions

d. Results of the walkdown including key findings and identified degraded, nonconforming, or unanalyzed conditions. This will include a detailed description of the actions taken or planned to address these conditions using the guidance in Regulatory Issues Summary 2005-20, Revision, 1, Revision to NRC Inspection Manual Part 9900 Technical Guidance, "Operability Conditions Adverse to Quality or Safety," including entering the condition in the corrective action program

e. Any planned or newly installed protection[2] and mitigation features

f. Results and any subsequent actions taken in response to the peer review

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[1] In cases where a licensee did not conduct an IPEEE-specific study, the licensee should use the equivalent information from the study that was used to meet the same purpose.

[2] The term "protection" as used in the 50.54(f) Letter is clarified at the end of Section 1: Purpose and Approach.

Clarifications

Seismic Protection

The term "seismic protection" is used in several places in the 50.54(f) Letter, including Requested Information Item 1.d "Identification of SSCs requiring seismic protection . . ." SSCs that must function during and/or following an earthquake are designed for the displacements, velocities, or accelerations associated with the seismic event; therefore the term "protection" is more appropriate when used with respect to flooding or high wind events.

Licensee Monitoring and Maintenance Procedures

The 50.54(f) Letter requires the seismic walkdown activity to "verify the adequacy of licensee monitoring and maintenance procedures." This will not be done directly by the Seismic Walkdowns and Area Walk-Bys, but it will be indirectly verified based on the findings from these activities, e.g., if degraded conditions are found, the issue, along with the underlying cause, will be evaluated under the plant's CAP.

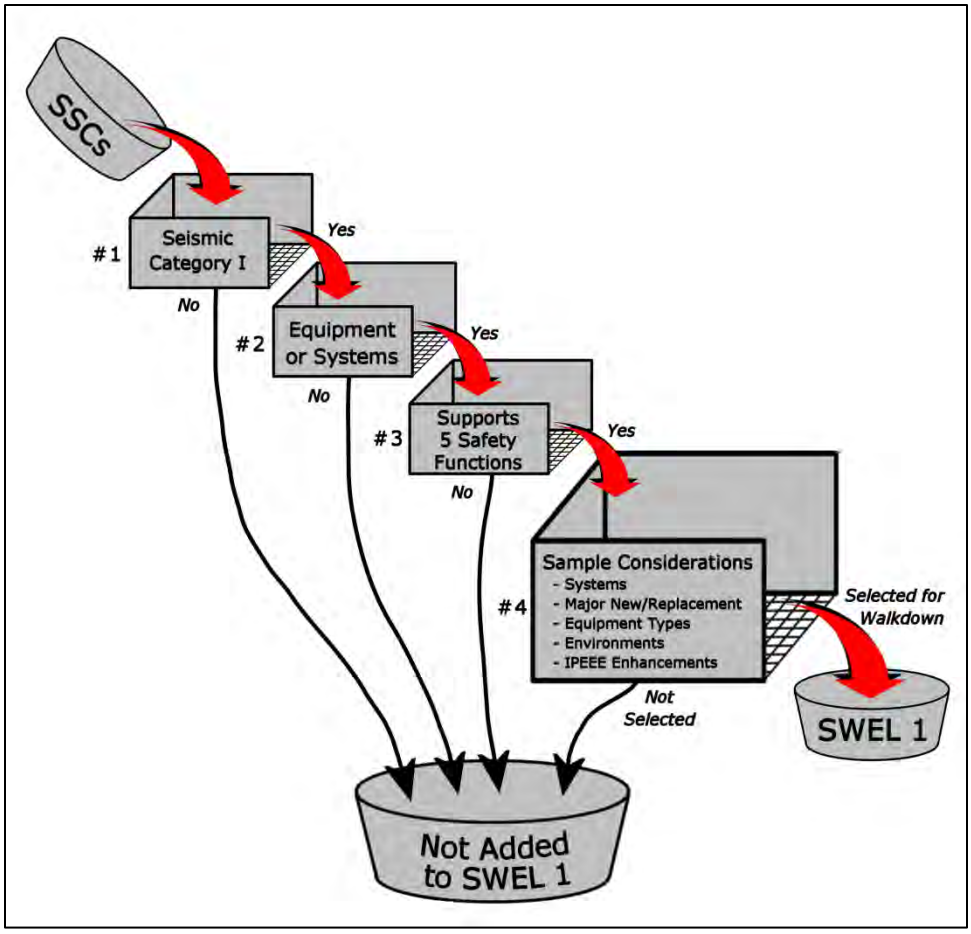

Figure 1-1
Sample of Required Items for the Five Safety Functions – SWEL 1

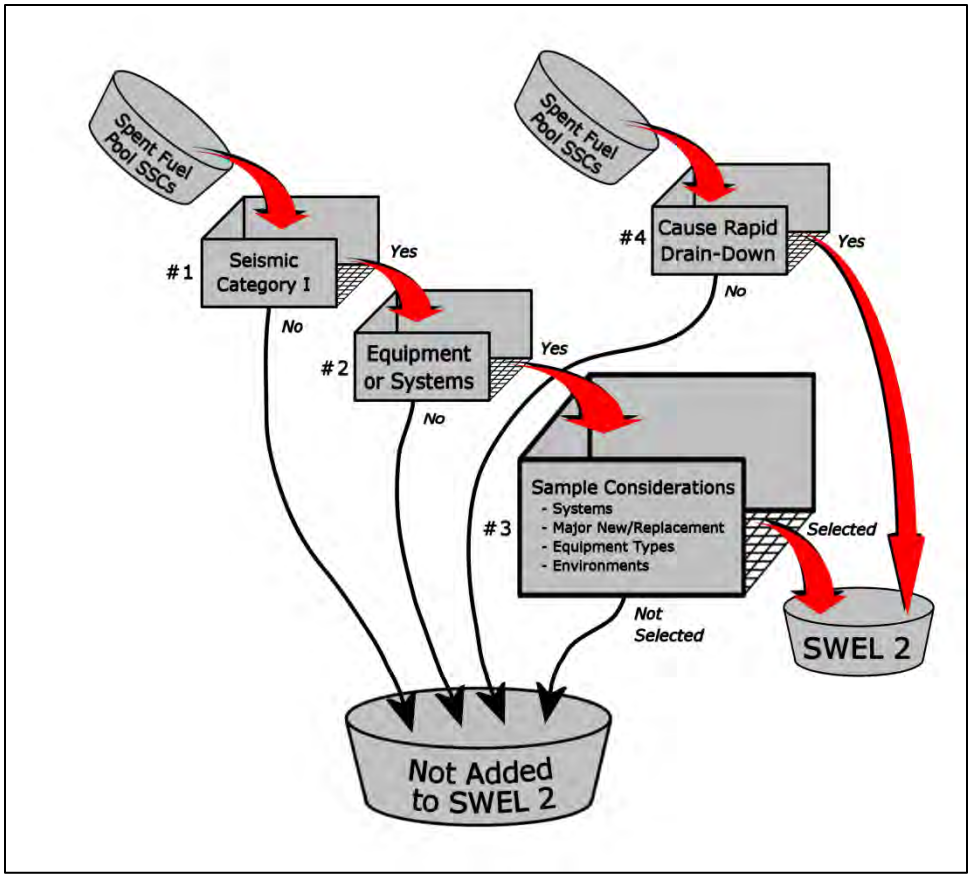

Figure 1-2
Spent Fuel Pool Related Items – SWEL 2

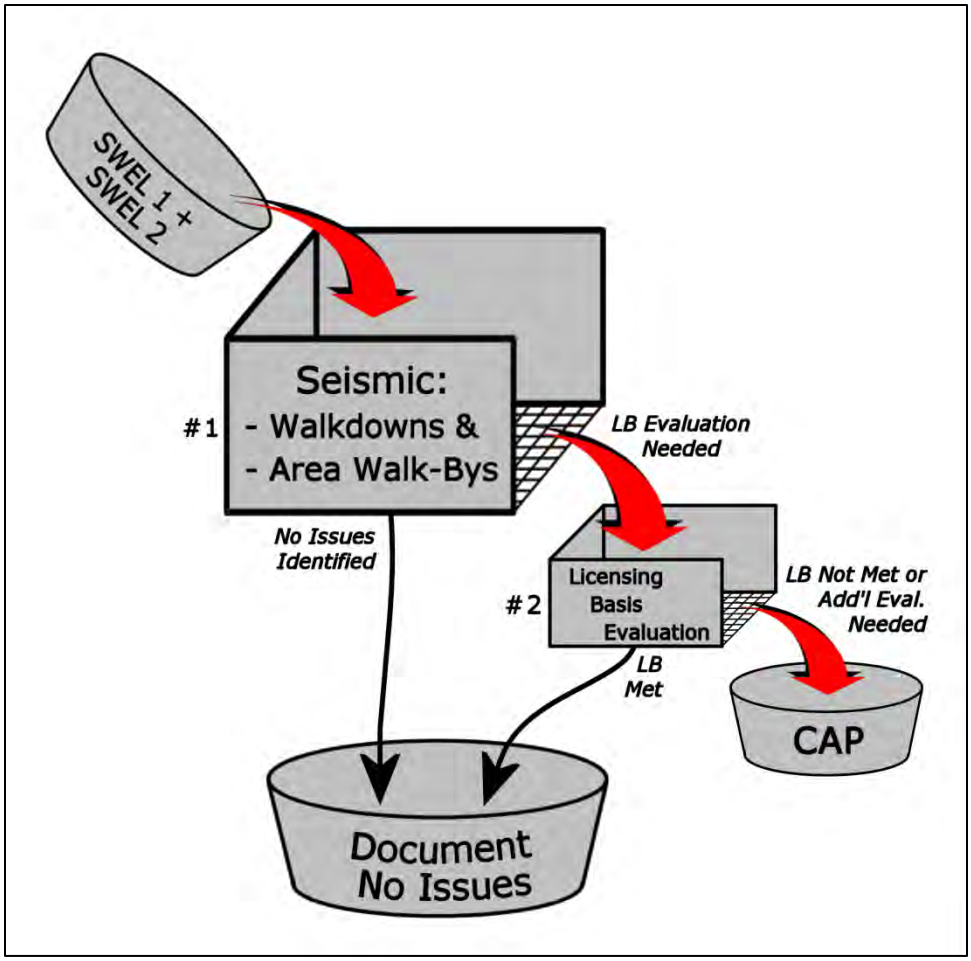

Figure 1-3
Seismic Walkdowns, Area Walk-Bys, and Licensing Basis Evaluations

Section 2: Personnel Qualifications

This section defines the qualifications for personnel who will be involved in performing the activities described in this Seismic Walkdown Guidance. These personnel are responsible for:

- Selecting the SSCs that should be placed on the Seismic Walkdown Equipment List, as described in Section 3: Selection of SSCs;
- Performing the Seismic Walkdowns and Area Walk-Bys, as described in Section 4: Seismic Walkdowns and Area Walk-Bys;
- Performing the seismic licensing basis evaluations, as described in Section 5: Seismic Licensing Basis Evaluations; and
- Identifying the list of plant-specific vulnerabilities identified during the IPEEE program and reporting the status of actions taken to eliminate or reduce them, as described in Section 7: IPEEE Vulnerabilities.

Guidance is also provided for how personnel should interact with each other while performing the above scope of work.

Personnel qualification requirements for the peer reviewers are addressed in Section 6: Peer Review.

Equipment Selection Personnel

The Equipment Selection Personnel are responsible for identifying the sample of SSCs to be walked down in accordance with Section 4: Seismic Walkdowns and Area Walk-Bys. This list of SSCs is called the Seismic Walkdown Equipment List (SWEL). Guidelines for developing the SWEL are included in Section 3: Selection of SSCs.

The Equipment Selection Personnel should have knowledge of plant operations, plant documentation, and associated SSCs. They should have the capability to select a broad distribution of SSCs for the SWEL. The Equipment Selection Personnel should also have knowledge of the IPEEE program (and the USI A-46 program, if applicable).

The Equipment Selection Personnel may request support from others who may help develop the SWEL. In particular, input from plant operations personnel may be useful for identifying:

- Major equipment and systems that may have been added or changed,
- Equipment and systems located in different environments, and
- Equipment and systems that may be accessible for inspection during the plant walkdowns.

Plant Operations Personnel

The participation of plant operations personnel is an integral part of this program. Two of their most important responsibilities are described below.

First, plant operations personnel should provide information to the Equipment Selection Personnel who develop the SWEL, as described in Section 3: Selection of SSCs. For example, plant operations personnel may be able to point to major changes or additions to the plant since the IPEEE program had been completed (as illustrated by Screen #4 in Figure 1-1). Their input may also be useful in identifying SSCs that are in a variety of environments and that are accessible for inspection during the plant walkdowns. Along with Equipment Selection Personnel, a plant operations staff member should sign off on the SWEL to indicate their participation in the SWEL development process.

Second, plant operations personnel should provide information and support to the Seismic Walkdown Engineers (SWEs) during the walkdowns to answer questions on the function and operation of equipment so the SWEs can decide whether malfunction of certain features of an item of equipment will affect its safety-related function. In addition, the plant operations personnel should be available to give the SWEs access to and facilitate inspection of equipment, including its anchorage.

To fulfill these responsibilities, the plant operations personnel should have knowledge of and experience with the specific plant systems being evaluated for potentially adverse seismic conditions. This knowledge should cover both steady state and transient operations of various systems and the associated plant-specific operating procedures. The plant operations personnel should also be able to supply information on the consequences of, and operator recovery from, functional anomalies.

Seismic Walkdown Engineers

The Seismic Walkdown Engineers (SWEs) are responsible for performing the Seismic Walkdowns and Area Walk-Bys, as described in Section 4: Seismic Walkdowns and Area Walk-Bys. The SWEs should have:

- A degree in mechanical or civil/structural engineering, or equivalent; and
- Experience in seismic engineering as it applies to nuclear power plants.

In addition, the SWEs must successfully complete one of the following two training courses:

- NTTF 2.3 Seismic Walkdown Training Course,[3] or
- SQUG Walkdown Training Course[4]

The Seismic Walkdowns and Area Walk-Bys may be conducted by one or more Seismic Review Teams (SRTs), each of which must include at least two SWEs. The SWEs are expected to conduct the Seismic Walkdowns and Area Walk-Bys together. During these evaluations, the SWEs are expected to actively discuss their observations and judgments with each other. Additionally, the SWEs are expected to come to agreement on the results of their Seismic Walkdowns and Area Walk-Bys before reporting the results of their review. Cases for which a potentially adverse seismic condition may exist should be documented in the checklist for further evaluation.

The SWEs may be assisted by other individuals while conducting the Seismic Walkdowns and Area Walk-Bys. For example, systems engineers or plant operations personnel may accompany the SWEs during the Seismic Walkdowns and Area Walk-Bys to facilitate access to and inspection of equipment and systems. They may also provide additional information about the safety-related functions of the SWEL items as well as nearby equipment and systems that could cause adverse seismic interactions.

Nevertheless, regardless of what help the SWEs receive from others, the SWEs are responsible for the seismic evaluations, engineering judgments, and documentation necessary to complete the Seismic Walkdowns and Area Walk-Bys.

The qualifications and experience of the SWEs should be documented as described in Section 8: Submittal Report.

Licensing Basis Reviewer

The Licensing Basis Reviewer is responsible for determining whether the potentially adverse seismic conditions identified by the SWEs meet the plant seismic licensing basis for those items, as described in Section 5: Seismic Licensing Basis Evaluations.

The Licensing Basis Reviewer should have knowledge and experience in the following areas:

- Seismic licensing basis for the SSCs in the plant
- Seismic qualification methods and documentation for the plant
- Requirements and procedures for entering the Corrective Action Program (CAP) for the plant

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[3] The NTTF 2.3 Seismic Walkdown Training Course is a 2-day course developed by EPRI. This course is based on this Seismic Walkdown Procedure.

[4] The SQUG Walkdown Training Course is a 5-day course sponsored by EPRI. This course is based on the Generic Implementation Procedure (GIP) [3].

The Licensing Basis Reviewer is expected to interface with the SWEs to understand the identified potentially adverse seismic conditions. A SWE and the Licensing Basis Reviewer may be the same person.

More than one Licensing Basis Reviewer may be used to evaluate whether conditions identified by the SWEs meet the plant seismic licensing basis.

IPEEE Reviewers

Personnel performing the activities described in Section 7: IPEEE Vulnerabilities should have adequate engineering experience to review and understand the results of the IPEEE program.

Section 3: Selection of SSCs

This section provides guidance for selecting the structures, systems, and components (SSCs) that should be placed on the Seismic Walkdown Equipment List (SWEL) so that they can be walked down by the Seismic Walkdown Engineers (SWE), as described in Section 4: Seismic Walkdowns and Area Walk-Bys. A SWEL should be developed for each unit.

Guidance is provided in this section for selecting SSCs in each of the following two groups:

- The process for selecting a sample of items to safely shut down the reactor and maintain containment integrity is illustrated in Figure 1-1. This process produces the first Seismic Walkdown Equipment List (SWEL 1).
- The process for selecting spent fuel pool related items is illustrated in Figure 1-2. This process produces the second Seismic Walkdown Equipment List (SWEL 2).

The SWELs from these two groups are combined into a single SWEL for use during the Seismic Walkdowns and Area Walk-Bys. Details for selecting the SSCs in each of these two groups are provided below.

The equipment selection process described in this section is to be performed by Equipment Selection Personnel and a plant operations staff member, as described in Section 2: Personnel Qualifications. Along with Equipment Selection Personnel, a plant operations staff member should sign off on the SWEL to indicate their participation in the SWEL development process.

A summary of the process used to select the SSCs for the Seismic Walkdowns and the equipment lists should be included in the submittal report, as described in Section 8: Submittal Report.

Sample of Required Items for the Five Safety Functions

The process for selecting a sample of the SSCs for shutting down the reactor and maintaining containment integrity includes the following four screens, as shown in Figure 1-1:

- Screen #1 – Seismic Category I
- Screen #2 – Equipment or Systems

- Screen #3 – Support for the 5 Safety Functions
- Screen #4 – Sample Considerations

The process for selecting SSCs using each of these four screens is described below. This will result in the first Seismic Walkdown Equipment List (SWEL 1).

Screen #1 – Seismic Category I

Screen #1 in Figure 1-1 narrows the scope of SSCs in the plant to those that are classified as Seismic Category (SC) I. This is done because only such items have a defined seismic licensing basis against which to evaluate the as-installed configuration. Selecting these items is intended to comply with the request in the NRC 50.54(f) Letter, under the "Requested Actions" section, to "verify current plant configuration with the current license basis." Typically, the plants have equipment lists that define the SSCs that are Seismic Category I.

Screen #2 – Equipment or Systems

Screen #2 in Figure 1-1 narrows the scope of SSCs by selecting only those that do not regularly undergo inspections to confirm that their configuration continues to be consistent with the plant licensing basis. The types of SSCs not selected for addition to SWEL 1 are those described below:

- Seismic Category I Structures are typically confirmed to meet their seismic licensing bases through analyses. Periodic inspections of SC I structures are routinely performed to confirm that degradation (e.g., concrete spalling) has not occurred, which could cause the structures to not meet their licensing basis. Inspections to identify structural degradation are included in plant programs designed to address the Maintenance Rule. Therefore, SC I structures are not included on SWEL 1. Nevertheless, there are architectural features, such as masonry walls, that should be considered, as discussed in Appendix D: Seismic Spatial Interaction.
- Containment Penetrations are typically confirmed to meet their seismic licensing bases through analyses. Periodic inspections and/or testing are performed, as required by ASME Section XI, to verify that these penetrations have not degraded. Therefore, containment penetrations are not included on the SWEL. Other containment integrity systems, such as the containment spray system, the containment isolation valves, and the support systems and components required to accomplish the isolation function may be considered for inclusion on SWEL 1.
- Seismic Category I Piping Systems have been confirmed to meet their licensing bases through several generic NRC programs, e.g., IE Bulletin 79-14. Periodic walkdowns by plant system engineers and ASME Section XI, In-service Inspections ensure that SC I piping

systems are maintained in accordance with their licensing bases. Therefore, SC I piping systems are not included on SWEL 1.

The potential for distribution system seismic interaction (i.e., cable/conduit raceways and HVAC ductwork) to affect SWEL items is evaluated during the Seismic Walkdowns. A general review of distribution systems is performed during the Area Walk-Bys as described in Section 4: Seismic Walkdowns and Area Walk-Bys.

After applying the above selection criteria, it is expected that the SWEL will typically include mechanical and electrical equipment plus tanks and heat exchangers. Examples of these types of equipment are listed in Appendix B: Classes of Equipment. Note that Equipment Class 0 (Other) is included in this list. This general category includes types of equipment not in any of the other 21 classes listed.

Screen #3 – Support for the 5 Safety Functions

Screen #3 in Figure 1-1 narrows the scope of SSCs to be included on SWEL 1 to those associated with maintaining the following five safety functions:

- Reactor reactivity control
- Reactor coolant pressure control
- Reactor coolant inventory control
- Decay heat removal
- Containment function

The first four functions are associated with bringing the reactor to a safe shutdown condition. The fifth function is associated with maintaining containment integrity.

The recommended approach for selecting SSCs associated with these five safety functions is to develop a list of equipment in various systems associated with these five safety functions. Details for implementing this approach are provided in the following subsections.

Previous Equipment List

Previous programs that may have developed a base list of SSCs include the IPEEE program[5] and, for some plants, the USI A-46 program. These base lists may be appropriate as a starting point for selecting SSCs associated with the five safety functions described above. The IPEEE program was intended to address the seismic margin of SSCs associated with all of the above five safety functions. For plants that used the Seismic Probability Risk Assessment (SPRA) method, SSCs from the dominant functional/systemic sequences can be used for the base

[5] In cases where a licensee did not conduct an IPEEE-specific study, the licensee should use the equivalent information from the study that was used to meet the same purpose.

list. For plants that used the NRC Seismic Margins Assessment (NRC SMA) method, SSCs from the important sequences and cut sets could be used for the base list. For plants that used the EPRI Seismic Margins Assessment (EPRI SMA) method, SSCs from the success paths could be used for the base list.

The USI A-46 program was intended to address the seismic adequacy of mechanical and electrical equipment in about 60 of the older nuclear power reactors in the U.S. SSCs from the walkdown Safe Shutdown Equipment List (SSEL) developed in this program address the first four safe shutdown functions listed above.

Systems Typically Used for Safety Functions

The frontline and support systems that are typically used to accomplish the five safety functions are listed in Appendix B of EPRI NP-6041 [4]. The frontline systems for Pressurized Water Reactors (PWRs) are shown in Table B-1 of this reference. The frontline systems for Boiling Water Reactors (BWRs) are shown in Table B-2 of this reference. The support systems for both PWRs and BWRs are shown in Table B-3 of this reference. Copies of these tables are included in Appendix E: Systems to Support Safety Functions.

Note that in some cases, more than one type of system can be used to accomplish a safety function. Also, some systems can be used to accomplish more than one safety function.

The major pieces of equipment in the Nuclear Steam Supply System (NSSS) that are located inside the containment are excluded from the scope of this program. Also excluded are the supports for this equipment along with all the components mounted in or on this NSSS equipment. The technical basis for excluding such equipment from the scope of this program is summarized below:

- Primary reactor components such as reactor vessels, reactor fuel and internals, pressurizers, steam generators, steam separators, recirculation pumps, reactor coolant pumps, and associated piping in domestic nuclear plants are designed for seismic loadings. The requirements for seismic design of these components and their supports are specified in the Safety Analysis Reports for each plant and in the ASME codes.
- The primary reactor components and supports are subject to formal, periodic in-service inspection under Section XI of the ASME Boiler and Pressure Vessel Code. As a result, any deficiencies in the installation, support, and anchorage of this equipment would have been detected and corrected and are not current concerns.
- The adequacy of the seismic design of primary reactor components and supports has been reviewed and verified for a number of older operating plants in the NRC's Systematic Evaluation Program (SEP) and for all operating nuclear plants under USI A-2, Asymmetric Blowdown Loads on Reactor Primary Coolant Systems. These

program reviews confirmed that seismic design and installation of NSSS equipment is not a significant seismic-safety issue.

Screen #4 – Sample Considerations

Screens #1 to #3, discussed above, describe a process that narrows the list of candidate items to those of most significance. By contrast, Screen #4 represents a process intended to result in a SWEL that sufficiently represents a broad population of plant Seismic Category I equipment and systems to meet the objectives of the NRC 50.54(f) Letter. Screen #4 in Figure 1-1 considers the following five sample selection attributes that should be represented in SWEL 1:

- A variety of types of systems
- Major new and replacement equipment
- A variety of types of equipment
- A variety of environments
- Equipment enhanced due to vulnerabilities identified during the IPEEE program

It is expected that SWEL 1, taken as a whole, will include representative items from some of the variations within each of the above five attributes. Additionally, the development of SWEL 1 should include consideration of the importance of the contribution to risk for the SSCs. For example, numerical measures derived from the available PRA models (internal or seismic), such as Fussell-Vesely Importance and Risk Achievement Worth, could be used to determine potentially risk-significant SSCs.

The size of the sample should be sufficiently large to include a variety of items that collectively include variations within all of the above five attributes. It is anticipated that SWEL 1 will include from about 90 to 120 items.

It is not expected that the sample will include every permutation from every variation within the above attributes. For example, some of the systems in the plant will not have had installation of major new and replacement equipment. Further, some systems may have only a limited number of different types of equipment. For example, certain fluid systems may not have batteries on racks. Similarly, not all plants have all of the various types of equipment classes described in Appendix B: Classes of Equipment. For example, some plants generate DC power using inverters and therefore do not have motor generators.

In the process of selecting equipment for the sample, it is recommended that the Equipment Selection Personnel consult with and obtain advice from plant operators and others (e.g., systems engineers, maintenance personnel, etc.). For example, operators may be able to identify equipment with operational issues or that have been exposed to repeated maintenance activities. Such activity may have left the equipment in a state that no longer conforms to its seismic licensing basis.

Each of the above listed attributes is discussed below in more detail.

Various types of systems

Equipment from various types of systems should be selected for the sample. The types of systems to be considered include frontline and support systems such as the types listed in Appendix B of EPRI NP-6041 [4] (copies of these lists are included in Appendix E: Systems to Support Safety Functions).

Major new and replacement equipment

A robust sampling of the major new or replacement equipment installed within the past 15 years (i.e., since the approximate completion of the seismic IPEEE evaluations) should be selected for SWEL 1. This equipment would not have been included in the earlier IPEEE or USI A-46 programs.

To illustrate which new or replacement equipment may be appropriate for inclusion on SWEL 1, the following two examples are provided.

- Example 1: Pressure Transmitter Replacement. An obsolete pressure transmitter was replaced with a new transmitter. Features of the replacement item and its installation are compared to the original item as follows:
  - The spatial envelope of the replacement transmitter is almost the same as the original.
  - The mounting bolt pattern for the replacement transmitter is different than the original but uses the same number of bolts.
  - The weight of the replacement transmitter is within about 3 pounds of the original.
  - The routing of the flex conduit and sensing line to the replacement transmitter is similar to the original.

  Such a replacement should not be considered a major replacement and therefore need not be added to the SWEL.
- Example 2: Transformer Replacement. An obsolete 480 volt transformer, connected to its associated 480 switchgear, was replaced with a new, digitally controlled 480 volt transformer. Features of the replacement item and its installation are compared to the original item as follows:
  - The weight and the location of the center of gravity of the replacement transformer are significantly different than the original.
  - The design of the mounting and anchorage of the replacement transformer is significantly different than the original.
  - Overhead equipment, including lighting and other items within the zone of influence, had to be re-installed above the replacement transformer.

Any one of the three differences cited above would be a sufficient reason for considering the replacement to be a "major" replacement and therefore the component would be considered for addition to the SWEL.

It is recommended that the Equipment Selection Personnel consult with and obtain advice from plant operators and others (e.g., systems engineers, maintenance personnel, etc.) to also identify those items of equipment that have been modified or upgraded recently (e.g., within the past year or so).

Various types of equipment

Various types of equipment should be selected for the sample. This may be accomplished by including at least one item from each of the classes of equipment listed in Appendix B: Classes of Equipment.

Various environments

The equipment to be selected for the sample should be from different locations in the plant that have different operating environments. For example, this could include equipment in environments that are dry and hot, wet and cold, mild and harsh, and inside and outside buildings.

Equipment enhanced as a result of the IPEEE program[6]

During the IPEEE program, plant-specific seismic vulnerabilities (including anomalies, outliers, or other findings) were identified. Some of this equipment should be included in SWEL 1. Note that the actions taken to eliminate or reduce IPEEE vulnerabilities will be documented as described in Section 7: IPEEE Vulnerabilities.

Spent Fuel Pool Related Items

The process for selecting a sample of the SSCs associated with the spent fuel pool (SFP) includes the following four screens, as shown in Figure 1-2. These screens narrow the scope of SSCs to be included in the second Seismic Walkdown Equipment List (SWEL 2):

- Screen #1 – Seismic Category I
- Screen #2 – Equipment or Systems
- Screen #3 – Sample Considerations
- Screen #4 – Rapid Drain-Down

The process for selecting SSCs using the first three screens listed above is similar to the approach described earlier for developing SWEL 1.

[6] In cases where a licensee did not conduct an IPEEE-specific study, the licensee should use the equivalent information from the study that was used to meet the same purpose.

Screen #1 – Seismic Category I, limits the items to those that have a seismic licensing basis.

Screen #2 – Equipment or Systems, considers only those items associated with the spent fuel pool that are appropriate for an equipment walkdown process.

Screen #3 – Sample Considerations, represents a process intended to result in SWEL 2 that sufficiently represents a broad population of SFP Seismic Category I equipment and systems to meet the objectives of the NRC 50.54(f) Letter. Screen #3 in Figure 1-2 considers the following four sample selection attributes[7] that should be represented in SWEL 2:

- A variety of types of systems
- Major new and replacement equipment
- A variety of types of equipment
- A variety of environments

It is anticipated that the number of equipment samples selected for SWEL 2 will include a much smaller number of items than for SWEL 1 because there are not as many systems and items of equipment associated with the spent fuel pool as there are for bringing the plant to a safe shutdown condition and maintaining containment integrity.

Screen #4 – Rapid Drain-Down, identifies items that could allow the spent fuel pool (SFP) to drain rapidly. Based on typical designs of spent fuel pools at nuclear power plants, this scope of items would be typically limited to hydraulic lines connected to the SFP and the equipment connected to those lines. The adequacy of the SFP structure is typically assessed by analysis as a Seismic Category I structure. Therefore, the SFP structure is assumed to be seismically adequate for the purposes of this program.

The SSCs that should be identified are not limited to Seismic Category I items, but may be limited to those that could allow rapid drain-down of the SFP. Rapid drain-down is defined as lowering the water level to the top of the fuel assemblies within 72 hours after the earthquake.

Determination of the potential for rapid drain-down could include the following assessments:

- Determine whether there are SFP penetrations below about 10 feet above the top of the fuel assemblies. If there are no such penetrations, then no rapid drain-down items would be added to SWEL 2.

[7] The four sample selection attributes used for SWEL 2 are the same as the first four attributes used for SWEL 1. The fifth attribute used in SWEL 1 (equipment enhancements that were made as a result of IPEEE) is not used for SWEL 2 because such items are already included in SWEL 1.

- For SFP penetrations below about 10 feet above the top of the fuel assemblies, an assessment of the potential for rapid drain-down from these lines should be performed including the systems connected to them.

If there are SFP penetrations below about 10 feet above the top of the fuel assemblies and a drain-down assessment is needed, the following should be considered:

- Determine how pool sloshing would reduce the initial volume of water in the spent fuel pool during the seismic event.
- Boil-off of water should also be considered.
- It is not necessary to consider mechanisms in which water is pumped out of the SFP.
- Because gravity is the driving force, the minimum size of the leak path can be estimated for various elevations of penetrations located below about 10 feet above the top of the fuel assemblies.
- Instead of performing this drain-down assessment, it is acceptable to identify those SFP items associated with penetrations below about 10 feet above the top of the fuel assemblies and add them to SWEL 2.
- Any items identified as having the potential for rapidly draining the SFP should be added to SWEL 2.

The basis for both inclusion and exclusion of SFP items on SWEL 2 should be provided in the submittal report.

Equipment Access

The purpose for preparing lists of equipment to be included on the SWEL is to allow those items to be walked down, as described in Section 4: Seismic Walkdowns and Area Walk-Bys. Of course, to be able to perform the Seismic Walkdowns on these items, it is necessary to have access to them and to be able to view their anchorage. However, in some cases it may not be possible to gain access to the equipment or to view the anchorage within the 180-day response period because the equipment is located in inaccessible areas of the plant (e.g., high radiation areas) or the anchorage cannot be seen (e.g., anchorage is inside an electrically energized cabinet).

It is recommended that when selecting equipment for the sample that those items that are accessible and have visible anchorage be selected wherever possible, while at the same time addressing all the sample selection attributes described above.

For example, if two trains of equipment are located in areas of the plant with significantly different background radiation levels, it is recommended that the equipment in the lower radiation area be placed on the SWEL.

Another example is that to be able to view the anchorage of a switchgear cabinet in a line-up of similar cabinets, it is recommended that a cabinet that is out of service (e.g., a breaker has been temporarily removed from the switchgear cabinet) be placed on the SWEL. This may make it possible to view the anchorage for a switchgear cabinet and avoid adverse electrical safety issues.

It is recognized that it may not be possible to select only accessible equipment with visible anchorage for all the items on the SWEL, while at the same time addressing all the sample selection attributes. For example, if the plant is at power, it may not be possible to access equipment inside the containment. Under these circumstances, the inaccessible sample item on the SWEL should be identified as being inaccessible and a plan developed for walking down that item in the future (i.e., after the 180-day response period). This inaccessible condition and the plan for future Seismic Walkdowns and Area Walk-Bys should be included in the submittal report.

Section 4: Seismic Walkdowns and Area Walk-Bys

This section provides guidance for conducting Seismic Walkdowns and Area Walk-Bys. These activities are represented as Screen #1 in Figure 1-3.

The Seismic Walkdowns and Area Walk-Bys described in this section are to be conducted by at least two Seismic Walkdown Engineers (SWEs) whose qualifications are described in Section 2: Personnel Qualifications. It is expected that the SWEs will be using their engineering judgment, based on their experience and training, to identify potentially adverse seismic conditions. These engineers may also rely upon new or existing analyses, where needed, to inform their judgment.

The SWEs are expected to conduct the Seismic Walkdowns and Area Walk-Bys together. During these evaluations, the SWEs are expected to actively discuss their observations and judgments with each other. Additionally, the SWEs are expected to come to agreement on the results of their Seismic Walkdowns and Area Walk-Bys before reporting the results of their work. For purposes of later review by others, it may be useful to describe on the Seismic Walkdown or Area Walk-By checklists features that, after significant discussion between the SWEs, were found to be seismically adequate. Any issue that cannot be resolved by consensus of the SWEs should be further evaluated in accordance with Section 5: Seismic Licensing Basis Evaluations.

If a condition cannot be easily determined to be acceptable, then that condition should be documented on the Seismic Walkdown or Area Walk-By checklist and evaluated further, as described in Section 5: Seismic Licensing Basis Evaluations.

The results of the walkdown of each item on the SWEL and the walk-by of each nearby area should be documented on the checklists shown in Appendix C: Checklists. Both SWEs should sign the completed checklists to indicate they agree with the conclusions. The results of these evaluations should also be included in the submittal report, as described in Section 8: Submittal Report.

The SWEs should be assisted by other individuals, as appropriate. For example, systems engineers or plant operations personnel may accompany the SWEs during the Seismic Walkdowns and Area Walk-Bys to facilitate access to and inspection of equipment and systems. They may also provide additional

information about the safety-related functions of the SWEL items as well as nearby equipment and systems that could cause adverse seismic interactions.

Nevertheless, regardless of what help the SWEs receive from others, the SWEs are responsible for the seismic evaluations, engineering judgments, and documentation necessary to complete the Seismic Walkdowns and Area Walk-Bys.

Seismic Walkdowns

Seismic Walkdowns focus on the seismic adequacy of the items on the SWEL (SWEL 1 plus SWEL 2) developed in Section 3: Selection of SSCs. The Seismic Walkdowns should also evaluate the potential for nearby SSCs to cause adverse seismic interactions with the SWEL items. The Seismic Walkdowns focus on the following adverse seismic conditions associated with the subject item of equipment:

- Adverse anchorage conditions
- Adverse seismic spatial interactions
- Other adverse seismic conditions

If items on the SWEL or those nearby SSCs are judged not to have potentially adverse seismic conditions, then it is not necessary to conduct a licensing basis evaluation of those SSCs. However, if potentially adverse seismic conditions are identified, then further evaluations should be performed, as described in Section 5: Seismic Licensing Basis Evaluations.

The results of the Seismic Walkdowns should be documented on the Seismic Walkdown Checklist (SWC) shown in Appendix C: Checklists.

Details for identifying potentially adverse anchorage conditions, adverse seismic interactions, and other adverse seismic conditions during the Seismic Walkdowns are described in the following subsections. Preparations for conducting the Seismic Walkdowns are also described.

Adverse Anchorage Conditions

Guidance for identifying anchorage that could be degraded, non-conforming, or unanalyzed relies on visual inspections of the anchorage and verification of anchorage configuration. Details for these two types of evaluations are provided in the following two subsections.

The evaluation of potentially adverse anchorage conditions described in this subsection applies to the anchorage connections that attach the identified item of equipment to the civil structure on which it is mounted. For example, the anchor bolts that secure the base of a Motor Control Center (MCC) to the concrete floor would be evaluated in this subsection. Evaluation of the connections that secure components within the MCC is covered later in the subsection "Other Adverse Seismic Conditions."

Visual Inspections

The purpose of the visual inspections is to identify whether any of the following potentially adverse anchorage conditions are present:

- Bent, broken, missing, or loose hardware
- Corrosion that is more than mild surface oxidation
- Visible cracks in the concrete near the anchors
- Other potentially adverse seismic conditions

Based on the results of the visual inspection, the SWEs should judge whether the anchorage is potentially degraded, non-conforming, or unanalyzed. The results of this visual inspection should be documented on the Seismic Walkdown Checklist (SWC), shown in Appendix C: Checklists. If there is clearly no evidence of degraded, nonconforming, or unanalyzed conditions, then this should be indicated on the checklist and a licensing basis evaluation is not necessary. However, if it is not possible to judge whether the anchorage is degraded, non-conforming, or unanalyzed, then further evaluations of the anchorage should be performed, as described in Section 5: Seismic Licensing Basis Evaluations.

Configuration Verifications

In addition to the visual inspections of the anchorage as described above, the configuration of the installed anchorage should be verified to be consistent with existing plant documentation for at least 50% of the items on the SWEL.

Line-mounted equipment (e.g., valves mounted on pipelines without separate anchorage) need not be evaluated for anchorage adequacy and should not be counted in establishing the 50% sample size.

Examples of documentation that can be used for verifying that the anchorage installation configurations are consistent with the plant documentation include the following:

- Design drawings
- Seismic qualification reports of analyses or shake table tests
- IPEEE or USI A-46 program documentation

If plant documentation showing the characteristics of the anchorage for a particular item of equipment cannot be located, then that item should be evaluated further, as described in Section 5: Seismic Licensing Basis Evaluations.

Adverse Seismic Spatial Interactions

An adverse seismic spatial interaction is the physical interaction between the SWEL item and a nearby SSC caused by relative motion between the two during an earthquake. An inspection should be performed in the area adjacent to and surrounding the SWEL item to identify any seismic interaction conditions that

could adversely affect the capability of that SWEL item to perform its intended safety-related functions.

The three types of seismic spatial interaction effects that should be considered are as follows:

- Proximity
- Failure and falling of SSCs
- Flexibility of attached lines and cables

Detailed guidance for evaluating each of these types of seismic spatial interactions is described in Appendix D: Seismic Spatial Interaction.

The Seismic Walkdown Engineers should exercise judgment to identify seismic interaction hazards.

Other Adverse Seismic Conditions

In addition to adverse anchorage conditions and adverse seismic interactions, described above, there may be other potentially adverse seismic conditions that could challenge the seismic adequacy of a SWEL item. Examples of the types of conditions that could pose potentially adverse seismic conditions include the following:

- Degraded conditions
- Loose or missing fasteners that secure internal or external components to equipment
- Large, heavy components mounted on a cabinet that are not typically included by the original equipment manufacturer
- Cabinet doors or panels that are not latched or fastened
- Other adverse conditions

Any identified other adverse seismic conditions should be documented on the Seismic Walkdown Checklist (SWC), shown in Appendix C: Checklists.

Preparations for Seismic Walkdowns

The following preparations are recommended prior to the Seismic Walkdowns and Area Walk-Bys:

- Obtain the Seismic Walkdown Equipment List (SWEL)
- Enter available data for each item of equipment onto the Seismic Walkdown Checklist (SWC) including:
    - Tag number or equipment ID
    - Equipment/System description
    - Location in the plant
    - Floor elevation

        - Whether a configuration verification of the anchorage for that item is needed
    - Obtain drawings showing area layouts and equipment locations
    - Obtain in-structure response spectra for elevations in the plant where SWEL items are mounted
    - Obtain the plant documentation showing the anchorage for 50% of the items on the SWEL
    - Obtain available documents from prior seismic walkdowns, e.g., IPEEE and USI A-46 checklists and data sheets
    - Obtain plant documentation for IE Bulletin 80-11 masonry block walls
    - Arrange for badging and dosimetry
    - Arrange for plant operations and/or maintenance personnel to open cabinets and other equipment for anchorage inspection
    - Arrange for plant operations/systems personnel to provide answers to operations/systems questions than may arise during the Seismic Walkdowns and Area Walk-Bys
    - Obtain current operability evaluations[8] affecting items on the SWEL or dependent upon those items on the SWEL

Area Walk-Bys

The purpose of the Area Walk-Bys is to identify potentially adverse seismic conditions associated with other SSCs located in the vicinity of the SWEL items.

Vicinity is generally defined as the room containing the SWEL item. If the room is very large (e.g., Turbine Hall), then the vicinity should be identified based on judgment, e.g., on the order of about 35 feet from the SWEL item. This vicinity should be described on the Area Walk-By Checklist (AWC), shown in Appendix C: Checklists.

The key examination factors that should be considered during Area Walk-Bys include the following:

- Anchorage conditions (if visible without opening equipment)
- Significantly degraded equipment in the area
- A visual assessment (from the floor) of cable/conduit raceways and HVAC ducting (e.g., condition of supports or fill conditions of cable trays)

[8] It is recognized that the condition of plant equipment could change between the point in time when the SWEL is developed and when the seismic walkdown is performed. It is not necessary to consider this change when obtaining the current operability evaluations.

- Potentially adverse seismic interactions including those that could cause flooding, spray, and fires in the area
- Other housekeeping items that could cause adverse seismic interaction (including temporary installations and equipment storage)

The Area Walk-Bys are intended to identify adverse seismic conditions that are readily identified by visual inspection, without necessarily stopping to open cabinets or taking an extended look. Therefore, it is expected that the Area Walk-By will take significantly less time than it takes to conduct the Seismic Walkdowns described above for a SWEL item. If a potentially adverse seismic condition is identified during the Area Walk-By, then additional time may be needed to evaluate adequately whether there is an adverse condition and to document any findings.

The results of the Area Walk-Bys should be documented on the Area Walk-By Checklist (AWC) shown in Appendix C: Checklists. A separate AWC should be filled out for each area inspected. If there are several SWEL items in an area, then it is necessary to complete only one AWC for that area. It is necessary to describe only those potentially adverse seismic conditions found during the Area Walk-By.

Additional details for evaluating the potential for adverse seismic interactions that could cause flooding, spray, or fire in the area are provided in the following two subsections.

Seismically-Induced Flooding/Spray Interactions[9]

Seismically-induced flooding/spray interactions are the effect of possible ruptures of vessels or piping systems that could spray, flood or cascade water into the area where SWEL items are located. This type of seismic interaction was considered during the IPEEE program. Those prior evaluations may provide information useful for the Area Walk-Bys.

One area of particular concern is threaded fire protection piping with long unsupported spans. If adequate seismic supports are present or there are isolation valves near the tanks or charging sources, flooding may not be a concern. Numerous failures have been observed in past earthquakes resulting from sprinkler head impact. Less frequent but commonly observed failures have occurred due to flexible headers and stiff branch pipes, non-ductile mechanical couplings, seismic anchor motion and failed supports.

Examples where seismically-induced flooding/spray interactions could occur include the following:

[9] Guidance for seismically-induced flooding/spray interactions adapted from Appendix F of [4].

- Fire protection piping with inadequate clearance around fusible-link sprinkler heads
- Non-ductile mechanical and threaded piping couplings can fail and lead to flooding or spray of equipment
- Long, unsupported spans of threaded fire protection piping
- Flexible headers with stiffly supported branch lines
- Non-Seismic Category I tanks

The Seismic Walkdown Engineers should exercise judgment to identify only those seismically-induced interactions that could lead to flooding or spray.

Seismically-Induced Fire Interactions

Seismically-induced fire interactions can occur when equipment or systems containing hazardous/flammable material fail or rupture. This type of seismic interaction was considered during the IPEEE program. Those prior evaluations may provide information useful for the Area Walk-By.

Examples where seismically-induced fire interactions could occur include the following:

- Hazardous/flammable material stored in inadequately anchored drums, inadequately anchored shelves, or unlocked cabinets
- Natural gas lines and their attachment to equipment or buildings
- Bottles containing acetylene or similar flammable chemicals
- Hydrogen lines and bottles

Another example where seismically-induced fire interaction could occur is when there is relative motion of between a high voltage item of equipment (e.g., 4160 volt transformer) and an adjacent support structure when they have different foundations. This relative motion can cause high voltage busbars, which pass between the two, to short out against the grounded bus duct surrounding the busbars and cause a fire.

The Seismic Walkdown Engineers should exercise judgment to identify only those seismically-induced interactions that could lead to fires.

Section 5: Seismic Licensing Basis Evaluations

This section provides guidance and criteria for performing seismic licensing basis evaluations of the SSCs identified when potentially adverse seismic conditions are identified during the Seismic Walkdowns and Area Walk-Bys. This activity is illustrated as Screen #2 in Figure 1-3.

For the conditions found to meet the plant seismic licensing basis, no further action is warranted, except to document that result, as described in Section 8: Submittal Report.

For the conditions that do not appear to meet the plant seismic licensing basis, additional licensing basis evaluations are necessary. If the identified condition cannot be readily[10] shown to meet the seismic licensing basis, then the identified condition should be entered into the plant Corrective Action Program (CAP) in accordance with the plant's existing processes and procedures. This activity is illustrated as the CAP bucket in Figure 1-3.

Seismic Category I equipment that cannot perform its intended safety function during or after the design basis ground motion is, by definition, not in compliance with its seismic licensing basis.

The seismic licensing basis evaluations described in this section are to be conducted by Licensing Basis Reviewers, as described in Section 2: Personnel Qualifications.

The results of the seismic licensing basis evaluations should be documented as described in Section 8: Submittal Report.

Approach

When a potentially adverse seismic condition is identified it will be evaluated against its seismic licensing basis. This is done by:

- Determining the Current Licensing Basis (CLB) for the plant as it relates to the seismic adequacy of the equipment,

[10] Consistent with the plant Corrective Action Program

- Identifying what seismic qualification documentation may exist for the equipment, and
- Evaluating whether the as-installed condition of the equipment is consistent with the CLB and the existing seismic documentation.

Current Licensing Basis

The Current Licensing Basis (CLB) is the set of Nuclear Regulatory Commission (NRC) requirements applicable to a specific plant, plus a licensee's docketed and currently effective written commitments for ensuring compliance with, and operation within, applicable NRC requirements and the plant-specific licensing basis, including all modifications and additions to such commitments over the life of the facility operating license[11].

The set of NRC requirements applicable to a specified plant CLB includes:

- NRC regulations in 10 CFR Parts 2, 19, 20, 21, 26, 30, 40, 50, 51, 54, 55, 70, 72, 73 and 100 and appendices thereto
- Commission Orders
- License Conditions
- Exemptions
- Technical Specifications
- Plant-specific design basis information defined in 10 CFR 50.2 and documented in the most recent UFSAR (as required by 10 CFR 50.71)
- Licensee Commitments remaining in effect that were made in docketed licensing correspondence (such as licensee responses to NRC bulletins, License Event Reports, Generic Letters and Enforcement Actions)
- Licensee Commitments documented in NRC safety evaluations

Seismic Qualification Documentation

Depending upon the requirements defined in the CLB, several different methods may have been used to demonstrate that Seismic Category I equipment will perform their intended safety-related functions during and/or after an earthquake. These typically include seismic analyses, shake table testing, and for some plants use of earthquake experience data based on the GIP [3] for new and replacement equipment.

Seismic Licensing Basis Evaluations

It may be possible to easily show that the installation of a particular item of equipment either meets or violates the seismic licensing basis using previous evaluations. For example, the IPEEE and USI A-46 programs addressed the seismic adequacy of equipment anchorage and adverse seismic interactions for each item of equipment on their safe shutdown equipment lists. The documentation from these programs can be useful in assessing those potentially

[11] Current Licensing Basis is defined in NRC Inspection Manual Part 9900.

adverse seismic conditions identified during the Seismic Walkdowns and Area Walk-Bys.

An example where it can be shown that the licensing basis is met is a motor control center (MCC) that contains essential relays and is found to have a minimum gap of 1 inch with an adjacent MCC. If the seismic analyses of these MCCs show that the maximum relative displacement under SSE conditions between the two MCCs is at most 0.5 inches at any height considering in-phase and out-of-phase motions, then the MCC is considered seismically adequate and need not be bolted or tied to the adjacent MCC to avoid potential relay chatter due to impact.

An example where it is easy to show that the seismic licensing basis is not likely to be met is a tall, narrow, unanchored MCC, located on an upper elevation in the plant. In this case, during a licensing basis earthquake, the MCC would likely tip over, become damaged, and render the MCC unable to fulfill its safety-related functions. Such an MCC would not meet its seismic licensing basis. In this case, the condition would be entered into the plant CAP for further review and disposition.

If it cannot be easily determined that a potentially adverse seismic condition meets the plant seismic licensing basis, then that condition would be entered into the plant CAP for further review and disposition in accordance with the plant's existing processes and procedures.

The principal purpose for entering the plant CAP is to determine whether potentially adverse seismic conditions identified during the Seismic Walkdowns and Area Walk-Bys meet the plant seismic licensing basis. If it is determined that the seismic licensing basis is not met for that one item of equipment, then an extent of condition evaluation should be initiated as appropriate to identify instances where such a violation could occur in other similar equipment. Additionally, if any degraded condition is found, the underlying cause will also be evaluated under the plant's CAP.

Section 6: Peer Review

This section describes the peer review requirements for the activities performed to meet the 50.54(f) Letter [1].

The Peer Review Team should consist of a minimum of two individuals, one of whom has seismic engineering experience as it applies to nuclear power plants.

At least two members of the Peer Review Team should be involved in each peer review activity. It is expected that the team member with the most relevant knowledge and experience will take the lead in each of the review activities.

One of the peer reviewers should be designated as the overall Team Leader. The peer review Team Leader is responsible for the entire peer review process, including completion of the final peer review documentation. The Team Leader is expected to provide oversight related to both the process and technical aspects of the peer review. For teams with more than two members, the Team Leader should have a sufficient level of involvement in all the elements of the peer review to assure consistency throughout the process and with this Seismic Walkdown Guidance. The Team Leader should also pay attention to potential issues that could occur at the interface between various activities.

The peer review process includes the following activities:

- Review the selection of the SSCs included on the SWEL
- Review a sample of the checklists prepared for the Seismic Walkdowns and Area Walk-Bys
- Review the licensing basis evaluations
- Review the decisions for entering the potentially adverse conditions into the CAP process
- Review the submittal report
- Summarize the results of the peer review process in the submittal report

It is recommended that these peer review activities be performed during implementation of this program, to the extent practicable, rather than waiting until all the work is complete.

Selection of SSCs

The selection of items for the Seismic Walkdown Equipment List (SWEL) should be peer reviewed. The guidance in Section 3: Selection of SSCs should be used as the basis for this peer review. The person who acts as lead reviewer for this peer review activity should have knowledge of plant design, plant operations, plant documentation, and associated SSCs.

An important element of this peer review process is verifying that the items on the SWEL adequately represent a diverse sample of the equipment required to perform the five safety functions discussed in Section 3: Selection of SSCs.

The peer review of the selection of SSCs should be summarized in the submittal report. This summary should include a discussion of the peer review activities, peer review findings, and resolution of peer review comments. The checklist shown in Appendix F: Checklist for Peer Review of SSC Selection may be used as part of the process and summary of this peer review. The checklist may be used multiple times as part of an iterative process. In this instance, only the final checklist, for which all the questions are answered in the affirmative, closes out this element of the peer review. The final checklist should be signed by the participating peer review team members. The summary should be included in the submittal report, as described in Section 8: Submittal Report.

Seismic Walkdowns and Area Walk-bys

The results of the Seismic Walkdowns and Area Walk-Bys should be peer reviewed. This peer review should consist of:

- A sample review of about 10% to 25% of the documentation packages, including checklists, photographs, drawings, and
- An interview with the SWEs to verify that they followed the guidance in Section 4: Seismic Walkdowns and Area Walk-Bys.

In the process of reviewing the checklists and associated information, questions may arise. At times it may be beneficial to enter the plant to visually inspect the equipment or area in order to close out the peer review questions.

The number of documentation packages reviewed should consider the following factors:

- The level of walkdown experience of the SWEs
- Whether the peer review is early stage (in which case the results can be used to improve the process) or late stage
- The degree to which the SWEs are involved in the peer reviews of the documentation packages (particularly in early stage reviews)
- The result of the initial peer review (e.g., identification of errors or problems would lead to expansion of the number of reviews)

- The degree to which the interviews with the SWEs provide confidence that the Seismic Walkdowns and Area Walk-Bys were properly conducted.

The person who acts as lead reviewer for this peer review activity should have seismic engineering knowledge and experience as it applies to nuclear power plants.

The peer review of the Seismic Walkdowns and Area Walk-Bys should be summarized in the submittal report. This summary should include a discussion of the peer review activities, peer review findings, and resolution of peer review comments, as described in Section 8: Submittal Report.

Seismic Licensing Basis Evaluations

The results of the seismic licensing basis evaluations should be peer reviewed. The guidance in Section 5: Seismic Licensing Basis Evaluations should be used as the basis for this peer review. The person who acts as lead reviewer for this peer review activity should have knowledge and experience in the following areas:

- Seismic licensing basis for the SSCs in the plant
- Seismic qualification methods and documentation for the plant
- Requirements and procedures for entering or not entering the CAP for the plant

This peer review should include a review of the licensing basis evaluations developed, including the decisions for entering potentially adverse seismic conditions into the plant's CAP.

The peer review of the seismic licensing basis evaluations should be summarized in the submittal report. This summary should include a discussion of the peer review activities, peer review findings, and resolution of peer review comments. This summary should be included in the submittal report, as described in Section 8: Submittal Report.

Submittal Report

A review of the submittal report should be performed by members of the Peer Review Team. This review should determine and state whether the objectives and requirements of the 50.54(f) Letter are met.

The Peer Review Team should also provide a summary of their peer review process and results, as discussed above, for inclusion in the submittal report. The Peer Review Team Leader should sign off that all necessary elements of the peer review were completed.

Section 7: IPEEE Vulnerabilities

This section provides guidance for addressing and reporting the evaluations related to the IPEEE program and the actions taken in response to the vulnerabilities that were identified during that program.

It is not necessary to repeat or update any of the IPEEE evaluations.

In cases where a licensee did not conduct an IPEEE-specific study, the licensee should address the equivalent information from the study that was used to meet the same purpose.

The activity to identify the seismic vulnerabilities and actions taken to eliminate or reduce them, should be conducted by IPEEE Reviewers, as described in Section 2: Personnel Qualifications.

Identification of Seismic Vulnerabilities

Several different external events were evaluated in the IPEEE program including those associated with seismic events, internal fires, high winds, tornadoes, external floods, transportation accidents, and nearby facility accidents. The actions taken to eliminate or reduce plant-specific vulnerabilities identified by the IPEEE program that are relevant to this Seismic Walkdown Guidance are only those associated with seismic events.

Several different methods were used by licensees for conducting the seismic evaluations in the IPEEE program. Consequently, the types of seismic vulnerabilities reported in their IPEEE reports also varied.

Similarly, because the criterion for identifying "vulnerabilities" was not precisely defined for the IPEEE program, licensees used several different terms to describe the conditions found, including, for example:

- Anomalies
- Outliers
- Findings

The seismic vulnerabilities that were identified during the IPEEE program should be documented and readily available for inspection.

Actions Taken to Eliminate/Reduce IPEEE Seismic Vulnerabilities

Generic Letter No. 88-20, Supplement 4 [2] states that the staff "expected that the licensee will move expeditiously to correct any vulnerabilities that it determines warrant correction." It also states that the "changes should also be reported in the IPEEE submittal." This generic letter also recognized that changes to the plant may not be warranted if "the plant design and operation meet NRC regulations and that further safety improvements are not substantial or are not cost effective."

Because the IPEEE program did not require licensees to report when the changes identified in the IPEEE program had been completed, the 50.54(f) Letter requests licensees to describe the actions taken to reduce or eliminate the seismic vulnerabilities.

To fulfill this request, the submittal report should describe:

- Actions taken to eliminate or reduce the IPEEE seismic vulnerabilities identified above, and
- Date the actions were completed.

It would be beneficial to verify the current status of the changes made to address the IPEEE seismic vulnerabilities, if the information is readily available.

There was a range of actions that could have been taken to eliminate or reduce seismic vulnerabilities. Therefore, the methods for verifying completion of those actions will also vary.

For example, a change may have been made to a plant operational or maintenance procedure. The current revision of that procedure could be reviewed to verify that the change was made to address the identified seismic vulnerability.

Another example is a change to the design or installation of an item of equipment. In this case, plant records may be reviewed to verify that the change was completed and when that occurred. In addition, the equipment could be inspected to verify that the subject change was made.

Those actions taken to eliminate or reduce the IPEEE seismic vulnerabilities, along with the date the actions were completed, should be listed in the submittal report, as described in Section 8: Submittal Report.

Sample Selection for Seismic Walkdown

In addition to identifying the actions taken to address the IPEEE vulnerabilities, a sample of IPEEE enhancements should be included in SWEL 1, as described in Section 3: Selection of SSCs.

Section 8: Submittal Report

This section provides guidance for preparing the submittal report to provide the information requested in the 50.54(f) Letter, Enclosure 3, Recommendation 2.3: Seismic [1]. Ultimately, the controls for responding to the 50.54(f) Letter should be governed by the process used by the licensee for responding to NRC requests for information "under oath and affirmation."

The information to be included in the submittal report for each of the main activities described in this Seismic Walkdown Guidance is given below. Appendix H: Documentation Requirements in 50.54(f) Letter, includes a summary of how the documentation requirements defined in the 50.54(f) Letter are met in this Seismic Walkdown Guidance.

A separate submittal report should be provided for each unit.

The following topics should be included in the submittal report:

- Seismic Licensing Basis
- Personnel Qualifications
- Selection of SSCs
- Seismic Walkdowns and Area Walk-Bys
- Licensing Basis Evaluations
- IPEEE Vulnerabilities Resolution Report
- Peer Review

For those cases where some SWEL items were inaccessible within the 180-day reporting period, an updated submittal report should be submitted later.

A description of the contents to be included for each of these topics is provided below.

Seismic Licensing Basis

A summary of the licensing basis for the Seismic Category I SSCs in the plant should be provided. This would include a summary of the Safe Shutdown Earthquake (SSE) and which codes, standards, and methods were used in the design of the Seismic Category I SSCs for meeting the plant-specific seismic licensing basis requirements.

Personnel Qualifications

The Equipment Selection Personnel who perform the equipment selection process should be identified along with a summary of their background and experience.

The Seismic Walkdown Engineers (SWEs) who perform the Seismic Walkdowns and Area Walk-Bys should be identified along with a summary of their background and experience.

The Licensing Basis Reviewers who perform the seismic licensing basis evaluations should be identified along with a summary of their background and experience.

For those activities performed under the plant Corrective Action Program (CAP), personnel qualifications for those involved in the CAP are generally covered in plant-specific CAP procedures and therefore need not be described in the submittal report.

The IPEEE Reviewers who identify the IPEEE vulnerabilities and the actions taken to eliminate or reduce them should be identified along with a summary of their background and experience.

The Peer Review Team members who perform the peer review should be identified along with a summary of their background and experience.

Selection of SSCs

A summary of the process used to select the SSCs that were included in each of the SWELs should be provided. This discussion should note how the process met the objectives of the guidance, particularly as it relates to incorporating the appropriate variety of classes of equipment, environments, primary and secondary systems, new and replacement equipment, and other elements discussed in Section 3: Selection of SSCs.

Several types of equipment lists developed during the SSCs selection process should be provided in the submittal report as described below. The SWEL (SWEL 1 plus SWEL 2) should include information on each item of equipment and its relevant attributes, including those attributes that led to its inclusion in the SWEL.

Sample of Required Items for the Five Safety Functions

The following two lists of equipment should be included in the submittal report from the equipment selection process shown in Figure 1-1 for "Sample of Required Items for the Five Safety Functions":

- Base List 1. The equipment coming out of Screen #3 and entering Screen #4 in Figure 1-1 is defined as "Base List 1" This list of equipment should be included in the submittal report.

- SWEL 1. The equipment coming out of Screen #4 and entering the SWEL 1 bucket in Figure 1-1 is the first Seismic Walkdown Equipment List. This list of equipment should be included in the submittal report.

Spent Fuel Pool Related Items

The following three lists of equipment should be included in the submittal report from the equipment selection process shown in Figure 1-2 for "Spent Fuel Pool Related Items":

- Base List 2. The equipment coming out of Screen #2 and entering Screen #3 in Figure 1-2 is defined as "Base List 2." This list of equipment should be included in the submittal report.
- Rapid Drain-Down. The equipment coming out of Screen #4 and entering the SWEL 2 bucket in Figure 1-2 is the equipment that could potentially cause the SFP to drain rapidly. This list of equipment should be included in the submittal report. The basis for determining which SSCs could or could not cause rapid drain-down should also be described in the submittal report.
- SWEL 2. The equipment coming out of Screens #3 and #4 and entering the SWEL 2 bucket in Figure 1-2 is the second Seismic Walkdown Equipment List. This list of equipment along with a description of the distribution of the various sample selection attributes among the items on SWEL 2 should be included in the submittal report.

Inaccessible Items

Equipment and areas that are inaccessible during the 180-day period should be listed, along with a schedule for completion of the Seismic Walkdowns and Area Walk-Bys. An updated submittal report should be submitted after the completion of all the Seismic Walkdowns and Area Walk-Bys.

Seismic Walkdowns and Area Walk-Bys

A summary of the approach used by the licensee to implement the Seismic Walkdowns and Area Walk-Bys should be included in the submittal report.

The results of the Seismic Walkdowns of each item of equipment on the SWEL (SWEL 1 plus SWEL 2) should be documented on Seismic Walkdown Checklists (SWCs) (template shown in Appendix C: Checklists) and included in the submittal report.

The results of the Area Walk-Bys in areas of the plant near the equipment on the SWEL should be documented on an Area Walk-By Checklist (AWC) (template shown in Appendix C: Checklists) and included in the submittal report.

A summary of the results of the Seismic Walkdowns and Area Walk-Bys should be included in the main body of the report. This summary should include an overview of the number of items walked down and the number of areas walked-by. The number of potentially adverse seismic conditions identified and a summary of the nature of these conditions should be provided.

A table should be provided that lists each potentially adverse seismic condition identified during the Seismic Walkdowns and the Area Walk-Bys. This table should describe how the condition has been addressed (e.g., placement in the CAP) and its current status. The status of each item should be provided in the updated submittal report.

Licensing Basis Evaluations

The results of the seismic licensing basis evaluations of the potentially adverse seismic conditions identified during the Seismic Walkdowns and Area Walk-Bys should be included in the submittal report. Any use of the plant Corrective Action Program (CAP) to evaluate the seismic licensing basis for these potentially adverse seismic conditions should also be included in the submittal report.

If some of the seismic licensing basis evaluations are not completed by the time the report of this program must be submitted to the NRC, then a schedule for completing them should be included in the submittal report.

Any planned or newly installed changes to the plant as a result of implementing this Seismic Walkdown Guidance should also be described in the submittal report.

IPEEE Vulnerabilities

The list of seismic vulnerabilities identified during the IPEEE program should be available for inspection. The 50.54(f) Letter calls these “plant-specific vulnerabilities (including any seismic anomalies, outliers, or other findings).”

A description of the actions taken to eliminate or reduce these seismic vulnerabilities, when these actions were completed, and whether the configuration management program has maintained the IPEEE actions (including procedural changes) such that the vulnerabilities continue to be addressed, should be included in the submittal report.

In cases where a licensee did not conduct an IPEEE-specific study, the licensee should report the equivalent information from the study that was used to meet the same purpose.

Peer Review

Each element of and the entire process in this Seismic Walkdown Guidance should be reviewed by the Peer Review Team, as described in Section 6: Peer

Review. The results of these peer reviews and how these reviews affected the work described in this Seismic Walkdown Guidance should be documented in the submittal report.

Submittal Report

The submittal report should include a cover page that documents the licensee management review of the entire document.

If items on the SWEL were inaccessible during the 180-day period, an updated submittal report is necessary. All sections of this report should be updated, including the current status of items that was entered into the CAP.

Section 9: References

1. NRC (E Leeds and M Johnson) Letter to All Power Reactor Licensees et al., "Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendation 2.1, 2.3, and 9.3, of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident," Enclosure 2.3, "Recommendation 2.3: Seismic."
2. Generic Letter No. 88-20, Supplement 4, Individual Plant Examination of External Events (IPEEE) For Severe Accident Vulnerabilities - 10CFR 50.54(f).
3. Generic Implementation Procedure (GIP) for Seismic Verification of Nuclear Plant Equipment, Revision 3A, December 2001, Seismic Qualification Utility Group (SQUG).
4. EPRI NP-6041-SL, Revision 1, "A Methodology for Assessment of Nuclear Power Plant Seismic Margin (Revision 1)," Electric Power Research Institute, August 1991.

Appendix A: Initializations and Acronyms

The initializations and acronyms used in this report are defined in this appendix.

ASME	-	American Society of Mechanical Engineers
AWC	-	Area Walkdown Checklist
BWR	-	Boiling Water Reactor
CAP	-	Corrective Action Program
CLB	-	Current Licensing Basis
EPRI	-	Electric Power Research Institute
GIP	-	Generic Implementation Procedure (GIP) for Seismic Verification of Nuclear Plant Equipment
HCLPF	-	High Confidence, Low Probability of Failure
HVAC	-	Heating, Ventilating, and Air Conditioning
IPEEE	-	Individual Plant Examination for External Events
LB	-	Licensing Basis
MCC	-	Motor Control Center
MEL	-	Master Equipment List
NRC	-	Nuclear Regulatory Commission
NTTF	-	Near-Term Task Force
PRA	-	Probabilistic Risk Assessment
PRT	-	Peer Review Team
PWR	-	Pressurized Water Reactor

SC	-	Seismic Category
SFP	-	Spent Fuel Pool
SMA	-	Seismic Margin Assessment
SPEL	-	Success Path Equipment List (used in IPEEE SMA)
SPRA	-	Seismic Probabilistic Risk Assessment
SQUG	-	Seismic Qualification Utility Group
SRT	-	Seismic Review Team
SSC	-	Structure, System, and Component
SSEL	-	Safe Shutdown Equipment List (used in USI A-46)
SWC	-	Seismic Walkdown Checklist
SWE	-	Seismic Walkdown Engineer
SWEL	-	Seismic Walkdown Equipment List
UHS	-	Ultimate Heat Sink
USI A-2	-	Unresolved Safety Issue A-2, "Asymmetric Blowdown Loads on Reactor Primary Coolant Systems"
USI A-46	-	Unresolved Safety Issue A-46, "Seismic Qualification of Equipment in Operating Plants"

Appendix B: Classes of Equipment

The following list of classes of mechanical and electrical equipment is adapted from Table A-1 of EPRI NP-6041 [4]. This list of equipment classes is based on the GIP [3].

Table B-1
Classes of Equipment

0. Other	11. Chillers
1. Motor Control Centers and Wall-Mounted Contactors	12. Air Compressors
2. Low Voltage Switchgear and Breaker Panels	13. Motor Generators
3. Medium Voltage, Metal-Clad Switchgear	14. Distribution Panels and Automatic Transfer Switches
4. Transformers	15. Battery Racks
5. Horizontal Pumps	16. Battery Chargers and Inverters
6. Vertical Pumps	17. Engine Generators
7. Pneumatic-Operated Valves	18. Instrument Racks
8. Motor-Operated and Solenoid-Operated Valves	19 Temperature Sensors
9. Fans	20. Instrumentation and Control Panels
10. Air Handlers	21. Tanks and Heat Exchangers

Appendix C: Checklists

This appendix includes the following two types of checklists for use in documenting the Seismic Walkdowns and Area Walk-bys, as described in Section 4: Seismic Walkdowns and Area Walk-Bys:

- Seismic Walkdown Checklist (SWC)
- Area Walk-By Checklist (AWC)

Status: Y N U

Seismic Walkdown Checklist (SWC)

Equipment ID No. _____ Equip. Class[12] _____

Equipment Description _____

Location: Bldg. _____ Floor El. _____ Room, Area _____

Manufacturer, Model, Etc. (optional but recommended) _____

Instructions for Completing Checklist

This checklist may be used to document the results of the Seismic Walkdown of an item of equipment on the SWEL. The space below each of the following questions may be used to record the results of judgments and findings. Additional space is provided at the end of this checklist for documenting other comments.

Anchorage

1. Is the anchorage configuration verification required (i.e., is the item one of the 50% of SWEL items requiring such verification)? Y☐ N☐

2. Is the anchorage free of bent, broken, missing or loose hardware? Y☐ N☐ U☐ N/A☐

3. Is the anchorage free of corrosion that is more than mild surface oxidation? Y☐ N☐ U☐ N/A☐

4. Is the anchorage free of visible cracks in the concrete near the anchors? Y☐ N☐ U☐ N/A☐

5. Is the anchorage configuration consistent with plant documentation? (Note: This question only applies if the item is one of the 50% for which an anchorage configuration verification is required.) Y☐ N☐ U☐ N/A☐

6. Based on the above anchorage evaluations, is the anchorage free of potentially adverse seismic conditions? Y☐ N☐ U☐

[12] Enter the equipment class name from Appendix B: Classes of Equipment.

Seismic Walkdown Checklist (SWC)

Equipment ID No. _____ Equip. Class[12] _____

Equipment Description _____

Interaction Effects

7. Are soft targets free from impact by nearby equipment or structures? Y☐ N☐ U☐ N/A☐

8. Are overhead equipment, distribution systems, ceiling tiles and lighting, and masonry block walls not likely to collapse onto the equipment? Y☐ N☐ U☐ N/A☐

9. Do attached lines have adequate flexibility to avoid damage? Y☐ N☐ U☐ N/A☐

10. Based on the above seismic interaction evaluations, is equipment free of potentially adverse seismic interaction effects? Y☐ N☐ U☐

Other Adverse Conditions

11. Have you looked for and found no other seismic conditions that could adversely affect the safety functions of the equipment? Y☐ N☐ U☐

Comments (Additional pages may be added as necessary)

Evaluated by: _____ Date: _____

_____ _____

Status: Y N U

Area Walk-By Checklist (AWC)

Location: Bldg. _____ Floor El. _____ Room, Area[13] _____

Instructions for Completing Checklist

This checklist may be used to document the results of the Area Walk-By near one or more SWEL items. The space below each of the following questions may be used to record the results of judgments and findings. Additional space is provided at the end of this checklist for documenting other comments.

1. Does anchorage of equipment in the area appear to be free of potentially adverse seismic conditions (if visible without necessarily opening cabinets)? Y☐ N☐ U☐ N/A☐

2. Does anchorage of equipment in the area appear to be free of significant degraded conditions? Y☐ N☐ U☐ N/A☐

3. Based on a visual inspection from the floor, do the cable/conduit raceways and HVAC ducting appear to be free of potentially adverse seismic conditions (e.g., condition of supports is adequate and fill conditions of cable trays appear to be inside acceptable limits)? Y☐ N☐ U☐ N/A☐

4. Does it appear that the area is free of potentially adverse seismic spatial interactions with other equipment in the area (e.g., ceiling tiles and lighting)? Y☐ N☐ U☐ N/A☐

[13] If the room in which the SWEL item is located is very large (e.g., Turbine Hall), the area selected should be described. This selected area should be based on judgment, e.g., on the order of about 35 feet from the SWEL item.

Area Walk-By Checklist (AWC)

Location: Bldg. _____ Floor El. _____ Room, Area[13] _____

5. Does it appear that the area is free of potentially adverse seismic interactions that could cause flooding or spray in the area?	Y☐ N☐ U☐ N/A☐
6. Does it appear that the area is free of potentially adverse seismic interactions that could cause a fire in the area?	Y☐ N☐ U☐ N/A☐
7. Does it appear that the area is free of potentially adverse seismic interactions associated with housekeeping practices, storage of portable equipment, and temporary installations (e.g., scaffolding, lead shielding)?	Y☐ N☐ U☐ N/A☐
8. Have you looked for and found no other seismic conditions that could adversely affect the safety functions of the equipment in the area?	Y☐ N☐ U☐

Comments (Additional pages may be added as necessary)

Evaluated by: _____ Date: _____

Appendix D: Seismic Spatial Interaction

An adverse seismic spatial interaction is the physical interaction of any nearby SSC with an item of equipment on the SWEL caused by relative motions between the two during an earthquake. An inspection should be performed in the area adjacent to and surrounding the SWEL item to identify any seismic interaction condition that could adversely affect the capability of that SWEL item to perform any of its intended safety-related functions.

The following three types of seismic spatial interaction effects should be considered:

- Proximity
- Failure and falling of SSCs
- Flexibility of attached lines

Guidance for evaluating each of these types of seismic spatial interactions is described below.[14]

Engineering judgment should be applied while evaluating the potential for adverse seismic spatial interactions and their potential to adversely affect the safety-related functions a SWEL item. For example, if a fluorescent tube became loose and fell onto the body of a high pressure horizontal pump (assuming there were no delicate instruments mounted on the pump), it may be judged that the impact loads would not adversely affect the performance of the pump. On the other hand, if that fluorescent tube fell onto an instrument panel in the main control room, such an impact could create a problem (e.g., damage gauges, injure operators) and therefore should be considered a potentially adverse seismic interaction condition. For cases such as these where engineering judgment is required, the basis for reaching such conclusions should be documented on the Seismic Walkdown Checklist (SWC).

Proximity

Seismic proximity interaction is the impact of adjacent equipment or structures on SWEL items due to their relative motion during seismic excitation. This relative motion can be the result of the vibration and movement of the SWEL

[14] Seismic spatial interaction guidance is adapted from Appendix D of [3].

item itself or any adjacent SSCs. When sufficient anchorage, bracing, or other means are provided to preclude large deflections, seismic proximity effects are not typically a concern.

Guidance for evaluating proximity effects for distributed systems and for mechanical and electrical equipment is provided below

Proximity Effects for Distributed Systems

The motion of piping, conduit, cable raceways, and other distribution lines may result in impact interactions with SWEL items. Nonsafety-related piping is commonly supported with rod hangers or other forms of flexible dead load support, with little or no lateral restraint. Where adequate clearance with SWEL items is not provided, potential impact interaction may result. The integrity of the piping is typically not a concern. (Threaded fittings, cast iron pipes and fittings, and Victaulic couplings may be exceptions where large anchor movement or brittle failures are possible.) In general, impacts between distribution systems (piping, conduit, ducts, raceways) and SWEL items of comparable size are not a cause for concern; the potential for large relative motions between dissimilar size systems should be carefully evaluated to assure that a large system cannot carry away a smaller one.

Engineering judgment should be exercised by the Seismic Walkdown Engineers in estimating potential motions of distribution systems in proximity to the SWEL item under evaluation. For screening purposes, a clearance of 2 inches for relatively rigid cable tray and conduit raceway systems and 6 inches for relatively flexible systems would normally be adequate to prevent impacts, subject to the judgment of the Seismic Walkdown Engineers.

Where potential interaction may involve systems with significant thermal movements during plant normal operating conditions, the thermal displacements should be evaluated along with those resulting from seismic deflections. Inter-equipment displacement limits may be developed from the applicable floor response spectra to assist in this effort.

Proximity Effects for Mechanical and Electrical Equipment

Inadequately anchored or inadequately braced mechanical and electrical equipment such as pumps, valves, vessels, cabinets, and switchgear may deflect or overturn during seismic loadings resulting in impact with nearby SWEL items. Certain items, such as tanks with high height-to-diameter aspect ratios, can deflect and impact nearby equipment. Electrical cabinets in proximity to each other may pound against each other.

The Seismic Walkdown Engineers should use judgment in such cases to evaluate the potential displacements and their potential effect on nearby SWEL items.

Failure and Falling of SSCs

SWEL items can be damaged and unable to accomplish their safety-related function due to impact caused by failure of overhead or adjacent SSCs. (This interaction hazard is commonly referred to as a II over I concern.) This seismic interaction effect can occur from nearby or overhead:

- Mechanical and electrical equipment;
- Piping, raceways, and HVAC systems;
- Architectural features; and
- Operations, maintenance, and safety equipment.

The seismic interaction effects that are of concern for these types of SSCs are described below. It is the intent of these evaluations to identify realistic hazards. Failure of non-seismically supported equipment and systems located over a SWEL item should not be arbitrarily assumed. The judgment of the Seismic Walkdown Engineers should be used to differentiate between likely and unlikely interaction hazards.

Mechanical and Electrical Equipment

Equipment such as tanks, heat exchangers, and electrical cabinets that are inadequately anchored or inadequately braced have historically overturned and/or slid due to earthquake excitation. In some cases this has resulted in damage to nearby equipment or systems.

Piping, Raceways, and HVAC Systems

Falling of non-seismically designed piping, raceways, and HVAC systems have been observed in very limited numbers during earthquakes due to unique circumstances. Most commonly reported are falling of inadequately secured louvers and diffusers on lightweight HVAC ducting. Damage from piping systems is less common and usually is limited to component failures that have rarely compromised system structural integrity. Typical damage is attributed to differential motions of systems resulting from movement of unanchored equipment, attachment of systems between buildings, or extremely flexible long runs of unrestrained piping. Very long runs of raceway systems pose a potential falling hazard when the runs are resting on, but not attached to, cantilever supports.

Architectural Features

Architectural features include such items as ceilings, light fixtures, platform grating, unreinforced masonry walls, and non-Seismic Category I structures. The seismic interaction effects for these are described below:

- Ceilings. T-bar suspended tiles, recessed fixtures, and sheetrock are used in some plant areas (such as the control room). Seismic

capabilities of these ceilings may be low. The Seismic Walkdown Engineers should check for details that are known to lead to failure such as open hooks, no lateral wire bracing, etc.

- Light Fixtures. Normal and emergency light fixtures are used throughout the plant. Fixture designs and anchorage details vary widely. Light fixtures may possess a wide range of seismic capabilities. Pendant-hung fluorescent fixtures and tubes pose the highest risk of failure and damage to sensitive equipment. The Seismic Walkdown Engineers should check for positive anchorage, such as closed hooks and properly twisted wires. Typically this problem is not caused by lack of strength; it is usually due to poor connections. Emergency lighting units and batteries can fall and damage SWEL equipment due to impact or spillage of acid.
- Platform Gratings. Unrestrained platform gratings and similar personnel access provisions may pose hazards to impact-sensitive SWEL items or components mounted on these items. Some reasonable positive attachment is necessary, if the grating can fall.
- Masonry Walls. Masonry block walls should be evaluated for possible failure and potential seismic interaction with nearby SWEL items unless the wall has been seismically shown to be adequate as part of the IE Bulletin 80-11 program. The Seismic Walkdown Engineers should review the plant documentation for IE Bulletin 80-11 masonry walls to determine which walls have and which walls have not been shown to be seismically adequate during that program.
- Non-Seismic Category I Structures. If any SWEL item is located in a non-Seismic Category I structure, then potential structural vulnerabilities of the building should be identified.

Operations, Maintenance, and Safety Equipment

Nuclear plant operations and maintenance require specialized equipment, some of which may be permanently located or stored in locations near SWEL items.

Some operations, maintenance, and safety equipment is designed so that it may be easily relocated by plant personnel. Where equipment design or plant operating procedures do not consider anchorage for permanently located equipment, this equipment may slide, fall, overturn, or cause impact with SWEL items. Typically such equipment includes the following:

- Cabinets and Lockers. Inadequately restrained floor and wall-mounted filing cabinets and equipment storage lockers may result in overturning or falling and impact.
- Gas Storage Bottles. Unrestrained or inadequately restrained gas bottles may result in overturning and rolling and cause impact.
- Refueling Equipment. Refueling equipment such as lifting equipment and servicing and refueling tools may be stored in

proximity to SWEL items. Inadequately restrained equipment may pose hazards.

- Monorails, Hoists, and Cranes. Monorails and service cranes are permanently located over heavy equipment requiring movement for service. Falling of service crane appurtenances such as tools and equipment boxes may result from inadequate component anchorage. They should be restrained from falling. Judgment by the Seismic Walkdown Engineers should be used to assess the potential for and consequences of such equipment falling.
- Radiation Shields, Fire Protection, and Miscellaneous Equipment. Temporary and permanent radiation shielding may pose hazards. Miscellaneous maintenance tools, such as chains and dollies, test equipment, and fire protection equipment such as fire extinguishers and hose reels may fall if inadequately restrained. Equipment carts may roll into SWEL items.

Flexibility of Attached Lines

Distribution lines, such as small bore piping, tubing, conduit, or cable, which are connected to SWEL items, can potentially fail if there is insufficient flexibility to accommodate relative motion between the SWEL item and the adjacent equipment or structures. Straight, in-line connections in particular are prone to failure. The scope of review for flexibility of these lines extends from the SWEL item being evaluated to the first support on the building or nearby structure.

Evaluation of Seismic Spatial Interaction Effects

The Seismic Walkdown Engineers should exercise engineering judgment to identify and evaluate significant interactions in the immediate vicinity of the SWEL item. This includes consideration of seismic interactions on the equipment itself and on any connected distribution lines (e.g., instrument air lines, electrical cable, and instrumentation cabling) that are in the vicinity of the item of equipment. Evaluation of interaction effects should consider detrimental effects on the capability of equipment and systems to function, taking into account equipment attributes such as mass, size, support configuration, and material hardness in conjunction with the physical relationships of interacting equipment, systems, and structures. In the evaluation of proximity effects and overhead or adjacent equipment failure and interactions, the effects of intervening structures and equipment that would preclude impact should be considered.

Damage from interaction in earthquakes is from unusual circumstances or from generic, simple details such as open hooks on suspended lights. The Seismic Walkdown Engineers should spend most of their time looking for:

- Unusual impact situations and
- Lack of proper anchorage or bracing.

There should not be much concern with piping and other system or structural component failures.

Summary of Seismic Spatial Interaction Effects Examples

This section briefly summarizes examples of possible seismic spatial interaction effects that may adversely affect an item of equipment on the SWEL.

- Unreinforced masonry walls adjacent to a SWEL item may spall or fall and impact a SWEL item or cause loss of support of equipment.
- Emergency lighting units and batteries used for emergency lighting can fall or overturn and damage a SWEL item by impact or spilling of acid.
- Fire extinguishers may fall and impact or roll into a SWEL item.
- Intercom speakers can fall and impact a SWEL item.
- Equipment carts, dollies, chains, air bottles, welding equipment, etc., may roll into, slide, overturn, or otherwise impact a SWEL item.
- Piping, cable trays, conduit, and HVAC may deflect and impact a SWEL item.
- Cable trays, conduit systems, and HVAC systems, including HVAC louvers and diffusers, may fall and impact a SWEL item.
- Structures or structural elements may deform or fall and impact a SWEL item.
- Anchor movement may cause breaks in piping, cable trays, conduit, HVAC, etc., such that they fall or deflect and impact an adjacent SWEL item.
- Mechanical piping couplings can fail and lead to pipe deflection or falling and impact a SWEL item.
- Electrical cabinets that deflect and impact walls, structural members, another cabinet, etc., may damage devices in a SWEL cabinet or cause devices to trip or chatter.
- Storage cabinets, office cabinets, files, bookcases, wall lockers, and medicine cabinets may fall or tip into a SWEL item.
- The doors on electrical cabinets may swing and impact devices or cause relays to chatter.
- Inadequately anchored or braced equipment such as pumps, vessels, tanks, heat exchangers, cabinets, and switchgear may deflect or overturn and impact a SWEL item.
- Architectural features such as suspended ceilings, ceiling components such as T-bars and acoustical panels, light fixtures, fluorescent tubes, partition walls, and plate glass may deflect, overturn or break and fall and impact a SWEL item.

- Grating may slide or fall and impact a SWEL item.
- Sheetrock may fall and impact a SWEL item if it was previously water-damaged or if there is severe distortion of the building.
- Inadequately anchored room heaters, air conditioning units, sinks, and water fountains may fall or slide into a SWEL item.

Appendix E: Systems to Support Safety Functions

EPRI Report NP-6041 [4], Appendix B includes lists of systems typically used to support PWR and BWR frontline safety functions and the associated support functions. Copies of the following tables from this report are reproduced in this appendix.

- Table B-1, Safety Function-System Matrix for PWRs
- Table B-2, Safety Function-System Matrix for BWRs
- Table B-3, Major Components in Support Systems

Table B-1

SAFETY FUNCTION-SYSTEM MATRIX FOR PWRs

Safety Functions	Frontline Systems That Perform a Safety Function	Important Components in Frontline System
A. Reactivity Control	Reactor Trip System	• Reactor Trip Switchgear • Manual Actuation Circuit • Control Rod Drive Assemblies
	Chemical and Volume Control System (emergency boration)	• Charging Pumps • Boron Injection Tanks (BIT) • Heaters; Heat Tracing • Motor-Operated Valves for Suction and Injection Alignment
B. RCS Pressure Control	Turbine Trip	• Turbine Stops Valves • Turbine Control Valves • Electric Trip Solenoid Valves • Electric Trip Valves • Mechanical Trip Pilot Valves
	Main Steam Isolation Valves	
	Auxiliary Feedwater System	• Turbine-Driven Feedwater Pumps (including turbine auxiliaries and steam supply) • Motor-Driven Feedwater Pumps • Motor-Operated Valves for Suction and Injection Alignment • Condensate Storage Tank
	Steam Generator Power-Operated Atmospheric Relief Valves	
	Pressurizer Power-Operated Relief Valves	
C. RCS Inventory Control	High Pressure Injection System	• High Pressure Safety Injection Pumps • Motor-Operated Valves for Suction and Injection Alignment • Refueling Water Storage Tank (i.e., borated water)

NOTE: This matrix was developed assuming that offsite power is unavailable.

Table B-1 (Continued)

SAFETY FUNCTION-SYSTEM MATRIX FOR PWRs

Safety Functions	Frontline Systems That Perform a Safety Function	Important Components in Frontline System
	Chemical and Volume Control System (operating in the ECCS mode)	• Charging Pumps • Motor-Operated Valves for Suction and Injection Alignment • RWST
	High Pressure Recirculation System	• High Pressure Safety Injection Pumps • Charging Pumps • Motor-Operated Valves for Suction and Injection Alignment • Sump Recirculation Valves • RHR Pumps
	Low Pressure Injection System	• RHR Pumps • Motor-Operated Valves for Suction and Injection Alignment • RWST
	Low Pressure Recirculation System	• RHR Pumps • Motor-Operated Valves for Suction and Injection Alignment • Sump Recirculation Vent
D. RCS Heat Removal	Auxiliary Feedwater	• See Above
	Steam Generator Power-Operated Atmospheric Relief Valves	
	Pressurizer Power-Operated Relief Valves	
	High Pressure Injection or Recirculation System	• See Above
	Residual Heat Removal System	• RHR Pumps • RHR Heat Exchangers • Motor-Operated Valves for Suction and Injection Alignment

NOTE: This matrix was developed assuming that offsite power is unavailable.

Table B-2

SAFETY FUNCTION-SYSTEM MATRIX FOR BWRs

Safety Functions	Frontline Systems That Perform a Safety Function	Important Components in Frontline System
A. Reactivity Control	Reactor Scram System	• Scram Valves • Control Rod Drive Assemblies • Control Rod Drive Pumps • Condensate Storage Tank • Strainers and Filters • Manual Valves • Check Valves
	Standby Liquid Control System (SLCS) (liquid poison)	• SLCS Pumps • Liquid Poison Tanks • Heaters and Heat Tracing • Explosive Actuated Valves
B. RCS Pressure Control	Steam Line SRVs and Automatic De-pressurization System	• Dual Action Safety and Relief Valves
	Main Steam Line Isolation Valves	
C. RCS Inventory Control	High Pressure Coolant Injection System	• Turbine-Driven Pump and Auxiliaries • Motor-Operated Valves for Suction and Injection Alignment • Condensate Storage Tank • Suppression Pool
	High Pressure Core Spray System	• Turbine-Driven Pump and Auxiliaries • Motor-Operated Valves for Suction and Injection Alignment • Condensate Storage Tank • Suppression Pool

NOTE: This matrix was developed assuming that offsite power is unavailable.

Table B-2 (Continued)

SAFETY FUNCTION-SYSTEM MATRIX FOR BWRs

Safety Functions	Frontline Systems That Perform a Safety Function	Important Components in Frontline System
	Control Rod Drive (CRD) Injection	• CRD Hydraulic Pump • Scram Valves
	Feedwater Coolant Injection (FWCI)	(information not available on FWCI)
	Automatic De-pressurization	• See Above
	Low Pressure Coolant Injection	• Electric Driven RHR Pumps • Motor-Operated Valves for Suction and Injection Alignment • Suppression Pool
	Low Pressure Core Spray (LPCS)	• Electric Driven LPCS Pumps • Motor-Operated Valves for Suction and Injection Alignment • Suppression Pool
D. RCS Suppression Pool Heat Removal	Isolation (emergency) Condenser	(information not available on isolation condenser)
	Suppression Pool Cooling Mode of RHR	• Electric Driven RHR Pumps • Motor-Operated Valves for Suction and Injection Alignment • Suppression Pool • RHR Heat Exchangers
	Shutdown Cooling Mode of RHR	• Electric Driven RHR Pumps • RHR Heat Exchangers • Motor-Operated Valves for Suction and Injection Alignment
	Steam Condensing Mode of RHR	• RHR Heat Exchangers • RCICS

NOTE: This matrix was developed assuming that offsite power is unavailable.

Table B-3

MAJOR COMPONENTS IN SUPPORT SYSTEMS

	Support System	Major Components
1.	AC Power	4-kV Buses Diesel Generators Diesel Generator Auxiliaries, Fuel Oil Supply, and Air-Start Systems Transformers Automatic Fast Transfer Switchgear Emergency Power Sequencer Other Switchgear (including relays and breakers) Power Cables Cable Trays 480V Unit Substations 480V Buses Motor Control Centers Load Centers Distribution Panels 120V Instrument Buses Inverters Fuses
2.	DC Power	125V Buses Batteries Battery Racks Battery Chargers Distribution Panels DC Power Cables Cable Trays Ground Detection Equipment
3.	Engineered Safety Features Actuation System	Sensors Cabling from the Sensors to the Signal Processing Equipment Signal Processing Equipment Actuation Subsystems Cabinets (and associated HVAC) Control Boards Relays Bistables Breakers

Table B-3 (Continued)

MAJOR COMPONENTS IN SUPPORT SYSTEMS

	Support System	Major Components
4.	Service Water and Component Cooling Water Systems	Horizontal Pumps Vertical Pumps Motor-Operated Valves Air-Operated Valves Check Valves Manual Valves Relief Valves Piping Heat Exchangers Surge Tanks Makeup Pumps HVAC Systems Traveling Screens and Screen Wash Pumps Strainers Intake Bay Gates Cooling Towers Cooling Tower Pumps Cooling Tower Fans
5.	Compressed Air System	Compressors Receivers Solenoid-Operated Valves Check Valves Dryers Filters
6.	HVAC Systems	Fans Dampers Chillers and Refrigeration Units Heaters Ductwork

Appendix F: Checklist for Peer Review of SSC Selection

This appendix includes a checklist that may be used to document the peer review of the selection of SSCs for the Seismic Walkdown Equipment List (SWEL).

Peer Review Checklist for SWEL

Instructions for Completing Checklist

This peer review checklist may be used to document the review of the Seismic Walkdown Equipment List (SWEL) in accordance with Section 6: Peer Review. The space below each question in this checklist should be used to describe any findings identified during the peer review process and how the SWEL may have changed to address those findings. Additional space is provided at the end of this checklist for documenting other comments.

1. Were the five safety functions adequately represented in the SWEL 1 selection? Y☐ N☐

2. Does SWEL 1 include an appropriate representation of items having the following sample selection attributes:

   a. Various types of systems? Y☐ N☐

   b. Major new and replacement equipment? Y☐ N☐

   c. Various types of equipment? Y☐ N☐

   d. Various environments? Y☐ N☐

Peer Review Checklist for SWEL

e. Equipment enhanced based on the findings of the IPEEE (or equivalent) program? Y☐ N☐

f. Were risk insights considered in the development of SWEL 1? Y☐ N☐

3. For SWEL 2:

a. Were spent fuel pool related items considered, and if applicable included in SWEL 2? Y☐ N☐

b. Was an appropriate justification documented for spent fuel pool related items not included in SWEL 2? Y☐ N☐

4. Provide any other comments related to the peer review of the SWELs.

5. Have all peer review comments been adequately addressed in the final SWEL? Y☐ N☐

Peer Review Checklist for SWEL

Peer Reviewer #1: _____ Date: _____

Peer Reviewer #2: _____ Date: _____

Appendix G: Definition of Terms

Anomaly – SSC or condition identified with deficiencies, e.g., missing or loose anchorage component.

Area Walk-By – A visual examination that considers the overall condition of areas that contain items on the Seismic Walkdown Equipment List.

Area Walk-By Checklist – A generic checklist that can be used to document the results of the Area Walk-Bys.

Current Licensing Basis (CLB) – As defined in NRC Inspection Manual Part 9900, the Current Licensing Basis (CLB) is the set of Nuclear Regulatory Commission (NRC) requirements applicable to a specific plant, plus a licensee's docketed and currently effective written commitments for ensuring compliance with, and operation within, applicable NRC requirements and the plant-specific design basis, including all modifications and additions to such commitments over the life of the facility operating license. Design basis information, defined by 10 CFR 50.2, is documented in the UFSAR as required by 10 CFR 50.71. The design basis of safety-related SSCs is established initially during the original plant licensing and relates primarily to the accident prevention and mitigation functions of safety - related SSCs. The design basis of a safety-related SSC is a subset of the CLB.

Enhancement – SSC, condition, or change to procedure identified as fully meeting design requirements for the SSE, yet strengthened to prevent seismic interaction, e.g., structurally tying electrical cabinets together.

Five Safety Functions – The five safety functions, which are used in the SWEL selection process, include four safe shutdown functions (reactor reactivity control, reactor coolant pressure control, reactor coolant inventory control, and decay heat removal, which includes the ultimate heat sink) and containment functions.

Equipment Selection Personnel – Personnel responsible for identifying the sample of equipment to be examined during the Seismic Walkdowns.

Inaccessible – Inaccessible areas are areas that cannot reasonably be inspected due to significant personnel safety hazard including high radiation.

Licensing Basis Evaluations – Licensing Basis Evaluations are more detailed reviews performed to determine whether an SSC is consistent with the seismic licensing basis if potentially adverse seismic conditions are identified during the Seismic Walkdowns or Area Walk-Bys.

Licensing Basis Reviewer – Personnel responsible for performing the Licensing Basis Evaluations.

Near-Term Task Force (NTTF) – The NRC Near-Term Task Force was established in response to Commission direction to conduct a systematic and methodical review of NRC processes and regulations to determine whether the agency should make additional improvements to its regulatory system and to make recommendations to the Commission for its policy direction, in light of the accident at the Fukushima Dai-ichi Nuclear Power Plant.

NTTF 2.3 Seismic Walkdown Training Course – A 2-day course sponsored by EPRI to prepare plant personnel to perform Seismic Walkdowns and Area Walk-Bys needed to support responding to the March 12, 2012 50.54(f) letter.

Outlier – SSC identified with HCLPF below the Review Level Earthquake (RLE), while meeting the Safe Shutdown Earthquake (SSE)

Rapid Drain-Down – In this document, a Rapid-Drain Down refers to seismically-induced rapid drain-down resulting in spent fuel pool water inventory loss at a rate that could uncover the fuel assemblies within 72 hours.

Seismically-Induced Fire Interactions – Interactions that produce the potential for fires to occur when (1) equipment or systems containing flammable material fails or ruptures in an area where SWEL items could be adversely affected or (2) where busbars between high voltage equipment and nearby structures on different foundations could short out due to relative motion between the equipment and the nearby structure.

Seismically-Induced Flooding/Spray Interactions – Interactions that produce the potential for rupture of vessels or piping systems that could spray, flood, or cascade water into the area where SWEL items are located.

Seismic Review Team – A team consisting of at least two Seismic Walkdown Engineers that perform the Seismic Walkdowns and Area Walk-Bys.

Seismic Spatial Interaction – The physical interaction between a nearby SSC and the item on the Seismic Walkdown List caused by relative motions between the two during an earthquake.

Seismic Walkdown – A visual examination of an item of equipment to identify potentially adverse seismic conditions.

Seismic Walkdown Checklist – A generic checklist that can be used to document the results of a Seismic Walkdown of an item of equipment.

Seismic Walkdown Engineers – Personnel responsible for performing the Seismic Walkdowns and Area Walk-Bys as described in Section 4: Seismic Walkdowns and Area Walk-Bys.

Seismic Walkdown Equipment List (SWEL) – The items to be evaluated during the Seismic Walkdowns.

SQUG Walkdown Training Course – A 5-day training course sponsored by EPRI based on the Generic Implementation Program (GIP).

Vicinity – Vicinity is generally defined as the room containing the SWEL item. If the room is very large (e.g., Turbine Hall), then the vicinity should be identified based on judgment, e.g., on the order of about 35 feet from the SWEL item.

(IPEEE) Vulnerability[15] – SSC identified in IPEEE program as a vulnerability, outlier, anomaly, or enhancement.

[15] In cases where a licensee did not conduct an IPEEE-specific study, the licensee should address the equivalent information from the study that was used to meet the same purpose.

Appendix H: Documentation Requirements in 50.54(f) Letter

Enclosure 3 of the NRC 50.54(f) Letter [1] contains a request for information related to the results of the seismic walkdowns. The purpose of this appendix is to describe how the specific documentation requirements included in Section 2 of the "Requested Information" section of the 50.54(f) Letter are met by the recommended documentation described in this Seismic Walkdown Guidance.

The specific information requested in the 50.54(f) Letter is repeated in the sections below followed by an explanation of approach for fulfilling each requirement as described in detail in Section 8: Submittal Report.

a. Information on the plant-specific hazard licensing bases and a description of the protection and mitigation features considered in the licensing basis evaluation

- Summarize the seismic licensing basis for the SSCs in the plant
- List the codes, standards, and other methods used in the design of the Seismic Category I SSCs for meeting the plant-specific seismic licensing basis

b. Information related to the implementation of the walkdown process

- Summarize the approach used by the licensee to implement the Seismic Walkdown Guidance

c. A description of the actions taken to eliminate or reduce plant-specific vulnerabilities (including any seismic anomalies, outliers, or other findings) identified by the IPEEE program (or equivalent study) and the completion dates for these actions

- A list of the adverse seismic vulnerabilities identified during the IPEEE program will be available for review or inspection
- Describe the actions taken to eliminate or reduce the seismic vulnerabilities identified by the IPEEE program
- Provide the date when these actions were completed

d. Results of the walkdown including key findings and identified degraded, nonconforming, or unanalyzed conditions. Include a detailed description of the actions taken or planned to address these conditions using the guidance in Regulatory Issues Summary 2005-20, Revision, 1, Revision to NRC Inspection Manual Part 9900 Technical Guidance, "Operability Conditions Adverse to Quality or Safety," including entering the condition in the corrective action program

- Summarize key findings and describe the results of the Seismic Walkdowns and Area Walk-bys using the checklists included in Appendix C: Checklists
- Describe each potentially adverse seismic condition identified during the Seismic Walkdowns and the Area Walk-Bys
- Describe the results of the seismic licensing basis evaluations of these potentially adverse conditions including any use of the plant Corrective Action Program (CAP)
- Provide a schedule for completing any licensing basis evaluations not finished by the time the report of this program must be submitted to the NRC

e. Any planned or newly installed protection and mitigation features

- Describe any planned or newly installed changes to the plant as a result of implementing this Seismic Walkdown Guidance

f. Results and any subsequent actions taken in response to the peer review

- Describe how the peer review process affected implementation of the seismic walkdown program conducted to meet the request in the 50.54(f) Letter

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