January 23, 1992

FROM: Patrick Sears, Project Manager
Project Directorate I-3
Division of Reactor Projects I/II

SUBJECT: DAILY HIGHLIGHT - FORTHCOMING MEETING WITH SEISMIC QUALIFICATION UTILITY GROUP (SQUG)

DATE & TIME: February 5, 1992
8:00 a.m. to 5:00 p.m.

LOCATION: Holiday Inn
Regency Room
1750 Rockville Pike
Rockville, Maryland 20850
301-468-1100

PURPOSE: To discuss the attached agenda regarding the SQUG Generic Implementation Procedure, Revision 2, which is being made available to the public for review and comment on proposed staff positions, and any proposed alternatives to staff positions.

PARTICIPANTS:*

NRC	SQUG
P. Sears	Neil P. Smith
T. Chan	et al.
et al.	

Original signed by
Patrick Sears, Project Manager
Project Directorate I-3
Division of Reactor Projects - I/II
Office of Nuclear Reactor Regulation

cc: See next page
Enclosure: Agenda

* Meetings between NRC technical staff and applicants or licensees are open for interested members of the public, petitioners, intervenors, or other parties to attend as observers pursuant to "Open Meeting Statement of NRC Staff Policy," 43 Federal Register 28058, 6/28/78.

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AGENDA

FEBRUARY 5, 1992

SQUG MEETING

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SUPPLEMENTAL SAFETY EVALUATION REPORT NO. 2

ON

SEISMIC QUALIFICATION UTILITY GROUP'S

GENERIC IMPLEMENTATION PROCEDURE, REVISION 2

CORRECTED JUNE 28, 1991

FOR

IMPLEMENTATION OF GL 87-02 (USI A-46)

VERIFICATION OF SEISMIC ADEQUACY OF EQUIPMENT

IN OLDER OPERATING NUCLEAR PLANTS

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SUPPLEMENTAL SAFETY EVALUATION REPORT NO. 2
ON SEISMIC QUALIFICATION UTILITY GROUP'S
GENERIC IMPLEMENTATION PROCEDURE, REVISION 2, CORRECTED JUNE 28, 1991
FOR IMPLEMENTATION OF GL 87-02, USI A-46 PROGRAM

VERIFICATION OF SEISMIC ADEQUACY OF EQUIPMENT IN OLDER OPERATING NUCLEAR PLANTS

BACKGROUND

In December 1980, the Nuclear Regulatory Commission (NRC) designated "Seismic Qualification of Equipment in Operating Plants" as an unresolved safety issue (USI). The safety issue of concern was that equipment in nuclear plants for which construction permit (CP) applications had been docketed before about 1972 had not been reviewed according to the then-current (1980-81) licensing criteria for seismic qualification of equipment (i.e., Regulatory Guide (RG) 1.100; Institute of Electrical and Electronics Engineers (IEEE) Standard 344-1975, and Standard Review Plan (SRP) Section 3.10 (NUREG-0800, July 1981)). Therefore, the seismic adequacy of the equipment in these older plants may be questionable regarding their ability to survive and function in the event of a safe-shutdown earthquake (SSE). Equipment in plants with a CP application docketed after about 1972 were qualified according to the then-current licensing criteria and licensee compliance has been audited by the NRC staff. All operating plants for which equipment seismic qualification could not be verified to meet the intent of then-current licensing criteria are subject to the implementation provisions outlined in Generic Letter (GL) 87-02, "Verification of Seismic Adequacy of Mechanical and Electrical Equipment in Operating Reactors, Unresolved Safety Issue (USI) A-46" (Reference 1). These plants are identified as "USI A-46 plants" and are listed in Table A in Section II.4.2 of this report.

The applicable portions of the NRC's regulations governing the seismic design of nuclear power plants require that structures, systems, and components important to safety be designed to withstand the effects of earthquakes, and that those systems and components be seismically qualified to perform their intended safety functions (Appendix A to 10 CFR Part 50). Appendix A to 10 CFR Part 100, which became effective December 13, 1973 (38 FR 31279) requires that seismic qualification of such equipment be demonstrated by either a suitable dynamic analysis or by a suitable qualification test. No explicit provisions within the regulations permit the use of experience data as a means for seismic qualification. However, the NRC has determined that requiring those older operating plants to comply with the then-current licensing requirements was not practicable because a literal application of those criteria to older operating plants could require extensive modifications of those facilities that could not be justified from the cost-benefit standpoint.

Although no explicit provisions within the regulations permit the use of experience data as a means for seismic qualification, the NRC concluded that the use of earthquake experience data, with appropriate restrictions and caveats, supplemented by some test results to verify the seismic adequacy of equipment within certain specified earthquake motion bounds, represented the most reasonable and cost-effective means of ensuring that the purpose of the NRC regulations related to seismic design can be satisfied for those plants. Therefore, for USI A-46 plants only, rather than requiring compliance with then-current criteria for seismic qualification of equipment, the staff requested the USI A-46 licensees only to verify the seismic adequacy of equipment in these plants as

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reflected in the title and the intent of GL 87-02 (Reference 1). One of the programmatic restrictions excludes using earthquake experience data to verify the seismic adequacy of structures and piping.

To address the USI A-46 issue, some of the affected utilities formed the Seismic Qualification Utility Group (SQUG) in 1982. In 1983, the SQUG proposed the formation of a panel of consultants, the Senior Seismic Review and Advisory Panel (SSRAP), to independently assess and review the viability of using earthquake experience data and test data to demonstrate equipment ruggedness, and to provide expert advice and consultation. The SQUG subsequently developed the "Generic Implementation Procedure (GIP) for Seismic Verification of Nuclear Plant Equipment" for its members to use. The SQUG submitted the GIP, Revision 0 (GIP-0), dated June 1988 (Reference 2) and the related documents and reports supporting GIP-0 to the NRC staff for review. The staff reviewed these documents and issued a Generic Safety Evaluation Report (GSER) on July 29, 1988 (Reference 3), recognizing that not all sections of GIP-0 had been developed at that time.

In contrast to the IEEE Standard 344 qualification approach, which in the past has relied on analysis or testing of <u>each item of equipment</u>, the GIP methodology relies primarily on the use of existing earthquake and test experience data to verify the seismic adequacy of <u>generic equipment groups</u>. By convention, the IEEE Standard 344 procedures have been termed "equipment seismic qualification," while the USI A-46 procedures have been termed "equipment seismic adequacy verification."

In December 1988, Revision 1 of the GIP (GIP-1) (Reference 4) was submitted for NRC staff review. GIP-1 contained essentially the same technical topics as GIP-0 except that a new section was added for evaluating tanks and heat exchangers and some information was added for resolving outstanding issues. While the staff was reviewing GIP-1, the SQUG was making significant changes to Part II which meant that Part II of GIP-1 would be virtually obsolete. Therefore, the staff focused its evaluation of GIP-1 primarily on Part I. This evaluation can be found in the Supplemental Safety Evaluation Report (SSER) No. 1 (Reference 5).

In September 1990, the SQUG submitted Revision 2 of the GIP (Reference 6). The staff reviewed Revision 2 and commented on it in March 1991 (Reference 7). In response to these comments and to subsequent discussions with the NRC staff, the SQUG further revised Revision 2, and resubmitted it with corrected pages in June 1991 (Reference 8). This supplement (SSER No. 2) presents the results of the NRC staff's evaluation of this latest revision. For the remainder of this report, "GIP-2" refers to Reference 8.

Because the criteria and procedures described in GIP-0 and GIP-1 have been significantly changed and improved since the GSER was issued in 1988, the staff has modified its earlier positions on various technical and licensing issues. Therefore, this supplement (SSER No. 2) supersedes all such previous staff documents, i.e, the GSER and SSER No. 1.

This supplement begins with a general discussion and evaluation of the overall GIP-2 document, followed by a detailed discussion and evaluation of specific sections of GIP-2. Where it is applicable, the staff discusses clarifications, interpretations, positions and exceptions. The clarifications, interpretations positions and exceptions are not specifically labeled in the main text of this report, but all exceptions are specifically identified in the final conclusion section.

GENERAL DISCUSSION

GIP-2 is divided into two major parts: Part I discusses the related licensing and implementation issues for the USI A-46 program; Part II contains the technical information necessary for the implementation of the program. Part II has 10 sections. They are:

1. Introduction
2. Seismic Evaluation Personnel
3. Identification of Safe Shutdown Equipment
4. Screening Verification and Walkdown
5. Outlier Identification and Resolution
6. Relay Functionality Review
7. Tanks and Heat Exchangers Review
8. Cable and Conduit Raceway Review
9. Documentation
10. References

GIP-2 provides the general guidelines in these 10 sections with detailed procedures, technical data, and implementation worksheets given in seven appendices. These are:

- Appendix A Procedure for Identification of Safe Shutdown Equipment
- Appendix B Summary of Equipment Class Descriptions and Caveats
- Appendix C Anchorage Data
- Appendix D Seismic Interaction
- Appendix E Preparatory Work Prior to Walkdown
- Appendix F Screening Walkdown Plan
- Appendix G Screening Evaluation Worksheets

Parts, sections, and appendices of GIP-2 are discussed in more detail in this SSER No. 2 in the section "Detailed Discussion and Evaluation."

GENERAL EVALUATION

In general, the NRC staff finds GIP-2 to be a very useful working document for implementing the USI A-46 program. The information contained in GIP-2 is generally acceptable to the staff for a plant-specific implementation of USI A-46.

The staff discusses clarifications, interpretations, exceptions, and positions in the section "Detailed Discussion and Evaluation," by referencing specific parts, sections, or appendices of GIP-2. The staff clarifications and exceptions that are general in nature and that apply to the entire GIP-2 are listed as follows:

1. The staff considers GIP-2 acceptable (with the clarifications, interpretations, exceptions, and positions identified in this SSER No. 2) for verifying seismic adequacy of equipment in USI A-46 plants only. The NRC staff expects that, when weaknesses in existing equipment are identified as a result of the implementation of USI A-46, licensees will take appropriate corrective actions, including modifications or upgrades, if necessary, to ensure that those equipment possess an adequate level of seismic safety.

2. The staff does not agree with any claim, whether explicit or implied, that the GIP-2 approach is conservative or comparable to current qualification requirements. The staff considers GIP-2 to be a method of verifying (but not qualifying) the seismic adequacy of equipment. This is because the criteria and many of the practices proposed in GIP-2 are not comparable to current qualification requirements. Examples include the following: (1) A vast amount of the technical information that is given in GIP-2 was gathered in a very general way rather than for each item of equipment, and was based on many subjective judgments and opinions; (2) The implementation methodology proposed in GIP-2 allows the review engineers to resolve major issues on the basis of their judgments, in some cases without requiring the engineers to justify or document the basis for these judgments, rather than on the basis of such standard engineering practices as calculations and testing; (3) The damping values used in GIP-2 are, in general, higher than those provided in the current version of R.G. 1.61; (4) The practice proposed in GIP-2 for evaluating safe-shutdown paths and identifying safe-shutdown equipment differs from current requirements in that safety grade equipment is not required to be available and it is not necessary to cool the reactor beyond hot shutdown conditions, whereas current designs require safety grade systems to cool the reactor from normal operating conditions to cold shutdown; and (5) The practice of allowing the "rule of the box" (GIP-2, page 3-16) and spot checking of the device mounting in a cabinet also differs from current practice, which requires such activities as testing, inspection, documentation, and corrective actions to be covered by a 10 CFR Part 50, Appendix B, quality assurance program.

   On the basis of the differences between current qualification requirements and criteria and procedures noted in GIP-2, the NRC staff does not consider the USI A-46 methodology given in GIP-2 to be a "seismic qualification" procedure. Rather, the staff considers the USI A-46 methodology to be a seismic adequacy verification procedure, and that the application of all sections of GIP-2 will verify the seismic adequacy of the equipment and satisfy the pertinent equipment seismic requirements of General Design Criterion 2 and the purpose of the NRC regulations relevant to equipment seismic adequacy only for the USI A-46 plants.

3. The term "licensee," as used in GIP-2, refers only to the licensee of a plant in the USI A-46 program.

4. Some statements were made in Reference 5 of Part II of GIP-2 about the aging effects of the database equipment. The NRC staff considers that the scope of the USI A-46 program excludes the issue of environmental qualification of equipment in operating plants, because this issue was addressed by the implementation program under 10 CFR 50.49. GIP-2 does not address the aging effects of equipment by systematic collection of quantitative data on the earthquake experience; therefore, the staff will not accept any claim that the experience data collected by the SQUG for the USI A-46 program adequately addressed the aging effects of equipment, as one might incorrectly interpret from the related statement on page 13, Reference 5 of Part II of GIP-2.

DETAILED DISCUSSION AND EVALUATION

In the details of the staff's evaluation of GIP-2, which follows, parts, sections, or appendices are briefly discussed, and the staff's positions, clarifications, interpretations, and exceptions are presented.

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I LICENSING AND IMPLEMENTATION GUIDELINES

Part I of GIP-2 describes the genesis of the USI A-46 program and discusses the role of the GIP in resolving the unresolved safety issue. This part considers several issues and describes SQUG positions on several aspects related to licensing and implementation guidelines. These aspects include, among other things, the interpretation of GIP-2 guidelines, the compliance with regulations, the selection of equipment, and any future revisions of GIP-2. The staff finds Part I acceptable subject to the following:

I.1.0 Introduction

I.1.1 Background

The second paragraph of Section 1.1 of Part I of GIP-2 states that "the purpose of USI A-46 is to verify this conclusion" which is "that there is adequate seismic capacity of properly anchored equipment in older operating plants." Although this conclusion is expected to be correct in general, there may be some pieces of equipment for which proper anchorage alone does not demonstrate seismic adequacy. For all equipment within the USI A-46 scope, the licensee is responsible for verifying all aspects of seismic adequacy of the equipment in accordance with GIP-2.

I.1.2 Purpose of the GIP

1. Section 1.2 of Part I states that the GIP-2 methodology "... is sufficiently rigorous to provide a level of safety comparable to that achieved by the current requirements...." The staff does not agree that the level of safety provided by the GIP-2 methodology is comparable to that achieved by the current requirements, as explained in item 2 under "General Evaluation" above. The staff does, however, conclude that the implementation of GIP-2 provides an acceptable level of safety (although not the same level that the current seismic requirements provide) regarding seismic adequacy of equipment. Footnote 1 to Part I on page 25 of GIP-2 quoted the staff's initial goal in selecting an alternative for the resolution of USI-A-46. The goal at the time was to provide a reasonable alternative to current requirements for seismic qualification. Note that the quote stated in Footnote 1 and quoted in part above was from NUREG-1030 instead of from NUREG-1211 as incorrectly stated in GIP-2. NUREG-1030 was published in 1987; GIP-0 was issued in 1988. Therefore, because of the significant development of the GIP, some statements contained in NUREG-1030 such as that quoted above may not objectively characterize GIP-0, let alone GIP-2 issued in 1991. Because demonstrating the seismic qualification of existing equipment in these older operating plants by using current requirements was deemed cost prohibitive, the resolution of USI A-46 recommended the use of a more cost-effective, simplified-screening approach, such as that described in GIP-2. The staff considers this approach reasonable and acceptable (with the clarifications, interpretations, and exceptions identified in this supplement) only for verifying the seismic adequacy of equipment in USI A-46 plants. (This is acknowledged to some extent in Section 1.2 of Part II of GIP-2.) Because this approach is not comparable to current requirements, the staff does not consider the GIP-2 methodology appropriate for use as an equipment seismic qualification method.

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2. The third paragraph of Section 1.2 of Part I states that "Because the NRC will document its evaluation of the GIP in a safety evaluation report (SER), the GIP provides an NRC-accepted method to verify the seismic adequacy of equipment...." The staff concurs with this statement, provided that GIP-2 is used in its entirety in conjunction with and supplemented by the clarifications, interpretations, and exceptions identified in this supplement, and that the application of the GIP is limited to USI A-46 plants only.

3. Section 1.2 of Part I states, "Every aspect of the Generic Letter Procedure has been fully considered in development of the GIP. Therefore, licensees will be guided by the GIP. By satisfying the provisions of the GIP, licensees will have fully satisfied the guidance of the Generic Letter...." This is generally acceptable to the staff for GIP-2. However, any deviation from GIP-2 and the SSER No. 2 without the staff's prior approval may result in the licensee not fully satisfying the provisions of GL 87-02.

I.1.3 GIP Commitments and Guidance

1. The second paragraph of Section 1.3 of Part I states that "USI A-46 licensees may use the GIP guidance or may substitute clearly equivalent methods without prior notification of the NRC...." The staff's position is that if licensees use other methods that deviate from the criteria and procedures as described in SQUG commitments and in the implementation guidance of GIP-2 without prior NRC staff approval, the method may not be acceptable to the staff and, therefore, may result in a deviation from the provisions of GL 87-02 as stated in item 3 in Section I.1.2 above.

2. The third paragraph of Section 1.3 of Part I states that "submittals which commit to the entire GIP...shall be regarded as accepted by the Staff upon docketing...." The staff concurs with this statement provided that the licensee commits to the entire GIP-2 as supplemented by the clarifications, interpretations, and exceptions identified in this supplement.

I.2.0 Issues and Positions

I.2.1 Introduction

The third paragraph of Section 2.1 of Part I refers to SQUG documents (e.g. References 9 and 12 of Part I of GIP-2) that summarize the resolution histories of many issues. The staff recognizes the importance of these documents. Although all of these many issues are resolved with or without conditions or clarifications, these documents reflect SQUG's perception of the resolution. The final resolutions of all issues are contained in the GIP-2 as supplemented by this SSER No. 2.

I.2.2 Interpretation and Guidelines

For a meaningful third-party audit (Section 2.2.7 of Part I), the NRC expects that the auditor(s) should have greater and broader experience than the minimum qualification required for a seismic capacity engineer who performed the original walkdown and analyses. This is because the third-party audit will involve substantially less time and effort than the original walkdown and analyses. Thus, the auditor(s) should have sufficient qualification and experience to be able to determine if gross errors have been made in the entire plant-specific implementation program during the limited time of the audit.

I.2.3 Compliance With Regulations

1. Section 2.3.3 of Part I, Revision of Plant Licensing Bases, states that, "a USI A-46 licensee, in accordance with 10 CFR § 50.59, may revise the plant licensing bases to reflect that the USI A-46 (GIP) methodology may henceforth be used as the methodology for verifying the seismic adequacy of mechanical and electrical equipment within the scope of equipment covered by the GIP... " The staff understands the word "henceforth" to mean, based on SQUG GIP-0 (page 5 of Part I), "after issuance of a final, plant-specific SER resolving USI-A-46."

2. In Section 2.3.3 of Part I, Example 2 and Example 4 may imply that the seismic requirements (RG 1.100, Revision 1) for RG 1.97 instrumentation may be changed to the GIP seismic methodology under 10 CFR 50.59. The staff has stated, and the SQUG has previously acknowledged, that any previous commitments, such as for RG 1.97 and TMI Action Plan Item II.F.2, are not superseded by the resolution methods of the GIP. For Category 1 equipment, as described in RG 1.97, the staff agrees that the seismic qualification requirements (RG 1.100, Revision 1) will resolve the USI A-46 requirements for that equipment. The Category 2 and Category 3 equipment as described in RG 1.97 have no specific seismic qualification provisions. Therefore, if that equipment is used as part of the USI A-46 safe-shutdown equipment, it will need to be verified for seismic adequacy using GIP-2 methods or by other acceptable seismic qualification methods.

3. Section 2.3.3 of Part I is acceptable to the staff subject to the addition of the following phrase to the last sentence of Example 5: "... for matters related to verifying the seismic adequacy of electrical and mechanical equipment."

4. Section 2.3.4 of Part I describes the criteria and procedures for future modification and for new and replacement equipment. The staff position is that these criteria and procedures may be applied to new and replacement equipment on a case-by-case (i.e., plant-specific and equipment-specific) basis only and with the provisions that the seismic evaluations are performed in a systematic and controlled manner so as to ensure that new or replacement items of equipment are properly represented in the earthquake experience or generic testing equipment classes, and that applicable caveats are met. In particular, each new or replacement item of equipment and parts must be evaluated for any design changes that could reduce its seismic capacity from that reflected by the earthquake experience or generic testing equipment classes, and these evaluations must be documented. These criteria and procedures as described are acceptable for verifying the seismic adequacy of commercial-grade equipment to be dedicated for safety-related purposes; but, for other (non-seismic) critical characteristics of equipment to be dedicated, licensees are referred to such applicable guidance and requirements as GL 89-09, GL 89-02, and GL 91-05, which include applicable criteria of 10 CFR Part 50, Appendix B.

   The staff normally would require that new or replacement equipment be <u>qualified</u> in accordance with plant-specific licensing commitments or current criteria (e.g., 10 CFR 50.49) unless the licensee can justify the use of other acceptable qualification methods. As a result of the backfit analysis for the USI A-46 program, the staff determined that it was cost prohibitive to demonstrate the seismic qualification of equipment in these older operating plants by using rigorous current qualification requirements. Therefore, the resolution as described in GL 87-02 and NUREG-1211, "Regulatory Analysis for Resolution of Unresolved Safety Issue A-46, 'Seismic Qualification of Equipment in Operating Plants'," was that the criteria and procedures described herein are acceptable for verifying the seismic adequacy of the equipment in USI A-46 plants including future modifications and replacement equipment only for USI A-46 plants.

The backfit analysis described in NUREG-1211 did not specifically address new equipment. However, the staff agrees that it is impractical and inconsistent with the USI A-46 philosophy to require that new equipment shall meet current seismic qualification requirements, whereas the seismic adequacy of all other safe shutdown equipment (which will presumably encompass the large majority of all safe shutdown equipment in the plant) is verified through the USI A-46 procedures. Therefore, the criteria and procedures described herein are acceptable for verifying the seismic adequacy of new equipment in A-46 plants.

I.3.0 Revisions to the GIP

Section 3.0 of Part I mentions that the earthquake experience or generic testing equipment classes will be periodically modified by a cognizant industry organization as new information becomes available. Although the staff does not intend to review every detail of the information collected, the suggested cognizant industry organization should submit, for NRC staff review and approval, a procedure for collecting and documenting the new information.

II GENERIC PROCEDURE FOR PLANT-SPECIFIC IMPLEMENTATION

Part II of GIP-2 which provides the implementation guidelines for the USI A-46 program, contains 10 sections and 7 appendices. These sections and appendices are given below.

II.1 Introduction

Section 1 of Part II describes the purpose, background and approach used in GIP-2. This section also introduces other sections and discusses to some extent the following subjects:

- seismic evaluation personnel
- identification of safe shutdown equipment
- screening verification and walkdown
- outlier identification and resolution
- relay functionality review
- tanks and heat exchangers review
- cable and conduit raceway review
- documentation

II.2 Seismic Evaluation Personnel

Discussion

Section _ of Part II defines the responsibilities and qualifications of the engineers who will perform seismic evaluations of the equipment. The systems engineers will develop the list of equipment required for safe shutdown. The

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systems engineer should be a degreed engineer, or equivalent, and should have had extensive experience with, and broad understanding of, the systems, equipment, and procedures of the plant. The seismic capability engineers will conduct the walkdowns and assess the seismic adequacy of safe-shutdown equipment. The seismic capability engineers should be degreed engineers, or equivalent, who have completed a SQUG-developed training course on seismic adequacy verification of nuclear power plant equipment. These engineers should have at least 5 years of experience in earthquake engineering applicable to nuclear power plants and in structural or mechanical engineering. At least one of the seismic capability engineers on each of the seismic review teams should be a licensed professional engineer to ensure that there is a measure of accountability and personal responsibility in making the equipment seismic adequacy determination. The relay reviewers will perform the functionality review of the relays with the safe-shutdown functions. The lead relay reviewer should be a degreed, or equivalent, electrical engineer with some electrical engineering experience who is familiar with the relay functionality review procedure described in Section 6 of Part II and Reference 8 of GIP-2. The lead relay reviewer should successfully complete the SQUG-developed relay training course. The plant operations staff will review the safe-shutdown equipment list and assist the seismic capability engineers and the relay review team. The plant operations personnel should have experience in the specific plant being seismically verified.

Evaluation and Conclusion

Based on the above discussions, the staff finds the criteria for qualifying those individuals responsible for implementing the GIP-2 procedure acceptable in that the required qualifications are adequate to assure that the GIP-2 is performed in an acceptable fashion.

The staff acknowledges that these responsible individuals must exercise judgment to implement the USI A-46 program. The review engineers should utilize the technical information in the GIP-2 and the reference documents to the maximum extent practicable in determining the seismic adequacy of equipment. Where judgements are needed to make these determinations, the assumptions and basis for the judgmental conclusions should be documented.

II.3 Identification of Safe-Shutdown Equipment

Discussion

Section 3 of Part II describes the overall method for identifying the equipment needed to achieve and maintain safe-shutdown conditions in a nuclear plant. The SQUG commitments, general criteria and governing assumptions, scope of equipment, safe-shutdown functions, safe-shutdown alternatives, identification of equipment, operations department review, and documentation are the major subjects discussed in this section. Loss of offsite power as a result of SSE is assumed, and the systems selected for the safe shutdown should not be dependent on a single piece of equipment whose failure would preclude a safe shutdown. Based on these assumptions and others as specified in GIP-2, the licensee will use the following two-stage approach to identify the equipment needed to achieve and maintain a safe-shutdown condition:

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1. The licensee will select a safe-shutdown path which would ensure that the four essential safe-shutdown functions listed below can be accomplished following an SSE. The functions are:

   - reactor reactivity control
   - reactor coolant pressure control
   - reactor coolant inventory control
   - decay heat removal

2. After identifying the safe-shutdown path, the licensee will identify the individual items of equipment required to accomplish the four essential safe-shutdown functions.

Evaluation and Conclusion

The staff finds the proposed two-stage approach adequate for identifying the equipment needed to achieve and maintain a safe-shutdown condition. Therefore, the staff concludes that Section 3 of Part II and Appendix A of GIP-2 are acceptable subject to the following:

1. Regarding the safe-shutdown equipment list (SSEL), the "safe shutdown" is defined as bringing the plant to, and maintaining it in, a hot shutdown condition during the first 72 hours following an SSE (i.e. within 72 hours, the plant is cooled down to the "hot shutdown" condition in accordance with the plant-specific Technical Specifications). The intent of this position is to have pressurized-water reactors (PWRs) lower their temperature and pressure within 72 hours to the point at which residual heat removal (RHR) equipment could be used, but does not necessarily require RHR equipment to be included on the SSEL. The staff does not intend to require plants to cool down faster than their original design capability or technical specification limits. Therefore, if a licensee cannot achieve hot shutdown at a plant within 72 hours, the licensee should discuss with, and obtain prior written consent from the staff on a case-by-case basis before implementing the USI A-46 program.

2. Most facilities have Emergency Operating Procedures (EOPs) which address actions in the event of an earthquake. The staff expects that operator training in existing normal plant shutdown or symptom-based EOPs will consider scenarios that include the potential loss of the required equipment during and after a severe earthquake. In doing so, this review will ensure that the shutdown path selected for USI A-46 (and equipment included in the SSEL) is a legitimate safe-shutdown path consistent with plant procedures and operator training.

3. Because cast iron components are brittle and are more vulnerable to earthquake damage, any cast iron equipment identified to be in the USI A-46 scope shall be specifically evaluated for seismic adequacy.

4. With regard to Section 3.3.2 of Part II "Exclusion of NSSS Equipment," the staff finds that the technical basis provided in Reference 17 of GIP-2 is acceptable for excluding those items of equipment listed in Section 3.3.2 with the exception of safety-relief valves. All safety-relief valves listed in GIP-2 should be included in the USI A-46 scope because Reference 17 of GIP-2 does not provide a basis for excluding the safety-relief valves from the scope.

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5. Section 3.3.3 of Part II requires that any equipment needed for safe shutdown be evaluated for relay chatter. For example, even if equipment such as a pump is itself seismically rugged, the effects of relay chatter on the electric power and instrumentation and control circuits still need to be evaluated to ensure the equipment functionality.

II.4 Screening Verification and Walkdown

Discussion

Section 4 of Part II describes the screening verification and walkdown procedures that will be implemented to verify the seismic adequacy of the equipment. In summary, the licensee should (1) compare the seismic capacity with the demand, (2) satisfy the caveats of the respective databases, (3) check the anchorages for adequacy, and (4) consider the seismic interactions.

Evaluation

Section 4 of Part II provides the first level of screening of the equipment required for safe shutdown for its seismic adequacy. GIP-2 also provides criteria and screening procedures for five types of anchorages, which have been used extensively in the nuclear power plants to secure equipment. The criteria provide guidance for determining the seismic load acting on, and the allowable load of, individual anchors to be calculated and compared. Anchors will be classified as outliers if the loads acting on the anchors exceed their allowable parameters. Some anchors could be identified as outliers during visual inspection of the screening procedures. The evaluation of screening verification and walkdown follows in Sections II.4.2, II.4.3, and II.4.4 of this supplement.

Conclusion

The staff has reviewed the screening procedures and criteria. Based on the evaluations and findings described in Sections II.4.2, II.4.3, and II.4.4 below, the staff concludes that the screening procedures and criteria are adequate and acceptable only for verifying seismic adequacy of equipment in USI A-46 plants, subject to the staff clarifications, interpretations, exceptions and positions described in the sections that follow.

II.4.0 Introduction

This section provides a summary and organization of Section 4 of Part II of GIP-2. The staff has no comment on this section.

II.4.1 SQUG Commitments

Section 4.1 of Part II provides SQUG general commitments in the areas of screening verification and walkdown procedures. The SQUGs commitments and the implementation guidance of GIP-2 were developed to form an integral part to satisfy the guidance of GL 87-02. Therefore, the staff position is that the licensee must commit to both the SQUG commitments and the use of entire implementation guidance provided in GIP-2, unless otherwise justified to the staff.

II.4.2 Seismic Capacity Compared to Seismic Demand

1. Section 4.2 of Part II maintains that "... the seismic capacity spectrum needs only to envelop the seismic demand spectrum for frequencies at and above the conservatively estimated lowest natural frequency of the item of equipment being evaluated..." (page 4-10 of GIP-2). The NRC staff cautions that because an equipment assembly (e.g., electrical cabinet lineup) may consist of many subassemblies, each manifesting its fundamental mode of vibration at different frequencies, the GIP-2 approach may be nonconservative unless all such frequencies are determined with high confidence. In addition, unless the equipment is tested with a high-level vibratory input, the fundamental frequency is extremely difficult to estimate, especially for complex structured equipment. Therefore, the staff position is that the capacity spectrum should envelope the demand spectrum over the entire frequency range unless the frequency of the equipment and the internal components can be conservatively established (see item 3 of Section III.7 of this supplement).

2. The SQUG proposes in GIP-2 to use 5% damped seismic demand spectra for comparison with the corresponding seismic capacity spectra. The staff has examined the damping values listed in the licensing basis documents of the group of plants with Housner-type spectra. Several of these plants have been licensed with equipment damping values of 2% or less. However, the majority of the plants in this group do not have a clear definition of the damping values for equipment in their safety analysis reports (SARs). The seismic capacity spectra of the equipment in the seismic experience database were established at 5% damping. It would not be practical to require that the 5% damped equipment capacity spectra be compared with seismic demand spectra which were based on damping values much less than 5%. Additionally, although in the amplified range at discrete frequencies the seismic demand spectrum for equipment at 2% is higher than that at 5%, the seismic capacity spectrum at 2% is also higher than that at 5%, and the magnitude of the difference (in the ordinates) between the 2% and 5% spectra is comparable. From a safety standpoint, insofar as verifying seismic adequacy of equipment using the GIP-2 methodology, it is the judgement of the staff that the damping level at which the seismic demand spectra are established is of little significance (for the range of damping values discussed herein, i.e. approximately 1-5%) provided that the corresponding capacity spectra are established at the same damping levels. Therefore, the staff finds that the use of seismic demand spectra at 5% damping is acceptable for all USI A-46 plants for the purpose of verifying the seismic adequacy of equipment.

3. With respect to the "Definition of Terms" in the last paragraph of page 4-18 of GIP-2, the staff positions on the definition of "conservative, design" in-structure response spectra are as follows: "Conservative, design" in-structure response spectra are defined as in-structure response spectra that have been computed in accordance with current NRC regulatory guidelines (such as RG 1.60 and RG 1.61) and the Standard Review Plan (SRP Section 3.7, Rev. 2, August 1989). Alternatively, for post-1976 operating license (OL) plants with non-Housner-type ground response spectra (Category 1 plants without double asterisks , Table A) and plants included in the Systematic Evaluation Program (SEP, Category 2, Table A), the in-structure response spectra included in the licensing-basis (LB) documents such as final safety analysis reports (FSARs), updated safety analysis reports (USARs), and other pertinent commitments related to in-structure

response spectra may be used as "conservative, design" in-structure response spectra. For plants in neither category (Category 1 plants with double asterisks and Category 3, Table A), the plant LB in-structure response spectra may be used, provided that the licensee submits as part of its 120-day response package the detailed information on which procedures and criteria were used to generate those in-structure response spectra (see item 5, Section 2.2.1 of Part I of GIP-2,). The staff will review the acceptability of the proposed usage case-by-case. The staff approval of the proposed in-structure response spectra is necessary before the commencement of the implementation program.

As stated in Section 2.2.1 of Part I of GIP-2, each licensee shall submit its schedule for implementing the resolution of USI A-46 within 120 days after this supplement is issued. The plant-specific implementation schedule shall be such that the affected plant should complete its implementation within 3 years after the issuance of this supplement. For Category 1 plants with double asterisks and Category 3 plants, however, the 3-year period will not commence until the licensee receives staff approval of the in-structure response spectra to be used to resolve USI A-46.

Table A USI A-46 plants categorized according to Instructure Response Spectra*

Category 1	Category 2	Category 3	
Post-1976 OL plants	SEP plants	Pre-1976 OL plants	
(15 units)	(9 units)	(40 units)	
Arkansas 2	Palisades	Robinson 2	Prairie Island 1/2
**Crystal River 3	Ginna	Point Beach 1/2	Duane Arnold
**St. Lucie 1	Oyster Creek	Monticello	Cooper
Hatch 2	Dresden 2	Dresden 3	Arkansas 1
**Calvert Cliffs 2	Millstone Unit 1	Pilgrim 1	Calvert Cliffs 1
**Cook 2	Yankee Rowe	Quad Cities 1/2	Cook 1
**Salem 1/2	Haddam Neck	Surry 1/2	Hatch 1
Brunswick 1	Big Rock Point	Turkey Point 3/4	FitzPatrick
Davis-Besse 1	San Onofre 1	Oconee 1/2/3	Three Mile Island 1
Beaver Valley 1		Vermont Yankee	Brunswick 2
North Anna 1/2		Kewaunee	Trojan
**Browns Ferry 3		Fort Calhoun	Millstone 2
Farley 1		Zion 1/2	Nine Mile Point 1
		Browns Ferry 1/2	Peach Bottom 2/3
		Indian Point 2/3	

* All plants in this table are the USI A-46 plants. All plants except St. Lucie 1 and Turkey Points 3/4 are SQUG members. In case more than one set of in-structure response spectra appear in the LB documents, use the more conservative set of spectra or justify the use of the others.

** Category 1 Plants with Housner-type ground response spectra.

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4. Regarding the scaling of the Individual Plant Examination of External Events (IPEEE) spectra for application in the USI A-46 program (page 4-19 of GIP-2), the staff's position is as follows:

   The in-structure response spectra for some USI A-46 plants may have been or may be developed for the IPEEE based on the realistic, median-center method as described in Section 4.2.4 of Part II of GIP-2. This method uses the NUREG/CR-0098, "Development of Criteria for Seismic Review of Selected Nuclear Power Plants," 1978, median rock or soil spectrum (depending on the primary condition at the site) anchored at the assigned review level earthquake. For these plants, the IPEEE in-structure response spectra may be used to generate realistic, median-centered in-structure response spectra for use in the USI A-46 program by appropriately scaling down the IPEEE spectra.

   If this approach is to be used to resolve USI A-46, the licensee should submit as part of its 120-day response package the procedure and the criteria to be used to generate those realistic, median-centered in-structure response spectra (see item 5, Section 2.2.1 of Part I of GIP-2).

   This staff position is intended to allow the licensee to use seismic input for the IPEEE as described in NUREG-1407, "Procedural and Submittal Guidance for the Individual Plant Examination of External Events (IPEEE) for Severe Accident Vulnerabilities: Final Report," June 1991, for USI A-46.

II.4.3 Equipment Class Similarity and Caveats

The staff interprets Section 4.3 of Part II (as well as Sections 4.1.3 and 4.2.2) regarding the use of caveats to mean that the review engineer will determine whether the equipment meets both the caveats and their intent and will report accordingly (i.e., via the Seismic Evaluation Report to be submitted to the NRC and in Appendix G of the GIP).

II.4.4 Anchorage Adequacy

Regarding anchorage guidelines, GIP-2 provides criteria and screening procedures for five types of anchorages that are used to secure an item or equipment: (1) expansion anchors, (2) cast-in-place bolts and headed studs, (3) cast-in-place J-bolts, (4) grouted-in-place bolts, and (5) welds to embedded or exposed steel. GIP-2 classifies any other types of anchorage as outliers.

1. Expansion Anchors

   For expansion anchors, GIP-2 provides nominal allowable pullout and shear loads for various diameters of single anchors for certain concrete strengths with specified minimum embedments, minimum spacings between anchors, and minimum distances of anchors to a free concrete edge. Also provided in GIP-2 are load reduction factors for specific types of expansion anchors by different manufacturers. GIP-2 requires a tightness check on the anchor head or nut to detect gross installation defects.

   Acceptance criteria are provided to assure a 95-percent confidence level that there are no more than 5-percent nonconforming anchors. GIP-2 also requires a check on the anchor projection above concrete to ensure a minimum anchor embedment in the concrete. Furthermore, checks are required on the spacing between anchors, the distances from anchors to a free concrete edge, concrete strength, and concrete cracking conditions, and reduction factors for nominal allowable loads are specified in the GIP for each condition which does not meet the minimum requirements for anchors having nominal allowable loads. On the basis of this information, the actual allowable load for each anchor can be calculated.

The nominal allowable pullout and shear loads for single anchors in GIP-2 were obtained by dividing the average ultimate loads of test expansion anchors by a minimum safety factor of three. The reduction factors specified in GIP-2 for different manufacturers, for closely spaced anchors, for less edge distance than the specified minimum, for less concrete strength than that of anchors having nominal loads, and for cracked concrete were also obtained from test data. The staff concludes that a minimum safety factor of three in conjunction with appropriate reduction factors for other conditions as specified in GIP-2 gives adequate safety margins for allowable loads of expansion anchors. Furthermore, the staff concludes that the safety margin of expansion anchors is enhanced by the GIP-2 requirements of 100-percent visual inspection and sample tightness checks of expansion anchors.

2. Cast-in-Place Bolts and Headed Studs

As with expansion anchors, GIP-2 provides nominal allowable pullout and shear loads for various diameters of single bolts and studs for certain concrete strengths with specified minimum embedment, minimum spacings between bolts or studs, and minimum distances of bolts or studs to a free concrete edge. GIP-2 requires a check on the actual embedment, spacing between bolts and studs, distances of bolts or studs to a free concrete edge, concrete strength, and concrete cracking conditions for cast-in-place bolts and headed studs, and specifies reduction factors for allowable loads for each condition which does not meet the minimum requirements for bolts and studs having nominal allowable loads. On this basis, the actual allowable load for each bolt or stud can be calculated.

The nominal allowable shear loads for single bolts are based on the nominal bolt area times allowable shear stress of 17 ksi. The staff compared the allowable shear loads of single bolts specified in GIP-2 with test data, and found that safety factors with respect to ultimate failure loads are greater than three, which is adequate. The nominal allowable pullout loads for single bolts or studs are based on the nominal bolt area times allowable tensile stress of 34 ksi, and have a safety factor of two with respect to a 45-degree concrete cone failure mechanism. For anchorages with multiple bolts or studs, a minimum safety factor of one and one-half is provided against a 45-degree concrete cone failure. The 45-degree failure cone was also assumed for the effects of bolts spaced close to each other or located close to the concrete free edge. The 45-degree failure cone shape is hypothetical, and predicts a lower pullout load for bolts with shallow embedment and a higher pullout load for bolts with deep embedment than that of test bolts. The staff has verified that, even for the deepest embedded bolt presented in GIP-2, the actual safety factor provided by GIP-2 is still slightly greater than one and, therefore, the staff accepts the allowable loads as specified in GIP-2. The reduction factor given in GIP-2 for cracked concrete was based on test data and, thus, is also acceptable to the staff.

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3. Cast-in-Place J-Bolts

A J-bolt is a plain steel bar that has a hook (usually in a 90- or 180-degree form) at the end which is embedded in concrete, and is threaded with a nut at the other end. GIP-2 provides nominal allowable pullout and shear loads for various diameters of single J-bolts for concrete strength equal to or greater than 3.5 ksi with specified minimum embedments, minimum spacings between bolts, and minimum distances of bolts to a free concrete edge. GIP-2 specifies reduction factors for bolts that are embedded less than the specified minimum, that are located closer to a free concrete edge than the specified minimum, and that are embedded in concrete with strength less than 3.5 ksi. GIP-2 requires that J-bolts be classified as outliers if the bolts are spaced less than three times the bolt diameter, or if they are embedded in certain cracked concrete.

The nominal allowable pullout and shear loads for single J-bolts are identical to that of cast-in-place bolts and headed studs. Since the J-bolts are embedded in concrete much deeper than the cast-in-place bolts or headed studs, the J-bolts can only fail either in the steel material or if the J-bolt is pulled out upon failure of the concrete bond. The specified minimum embedments for J-bolts provide a safety factor of about two with respect to concrete bond failure, which is acceptable to the staff. The allowable shear loads have safety factors greater than three with respect to ultimate shear failure loads, which is also acceptable to the staff. The reduction factor in GIP-2 for pullout is in proportion to the reduction in the straight portion of J-bolt embedment. This is reasonable because bond force from concrete to bolts is proportional to the embedment length and, therefore, is acceptable to the staff. The reduction factor in GIP-2 for pullout and shear loads due to concrete strength less than 3.5 ksi is proportional to the square root of the ratio of the actual strength to the nominal strength of 3.5 ksi. This is also reasonable because this reduction represents concrete tensile strength reduction, and thus reduces the holding power of bolts. Therefore, the staff concludes that the use of appropriate safety factors for single J-bolts in conjunction with appropriate reduction factors applied to various conditions as specified in GIP-2, would provide adequate safety margins for allowable loads of cast-in-place J-bolts.

4. Grouted-in-Place Bolts

GIP-2 provides nominal allowable pullout and shear loads for various diameters of single, grouted-in-place bolts for concrete strength equal to or greater than 3.5 ksi with specified minimum spacings between bolts, and minimum distances of bolts to a free concrete edge. GIP-2 requires a check on the actual embedment, spacing between bolts, distance of bolts to a free concrete edge, concrete strength, and concrete cracking conditions for grouted-in-place bolts, and specified reduction factors for allowable loads for each condition that does not meet the minimum requirements for bolts having nominal allowable loads. On this basis, the actual allowable load for each bolt can be calculated.

The provisions for grouted-in-place bolts in GIP-2 are identical to provisions for cast-in-place bolts and headed studs if bolts were found to be installed using certain installation procedures. However, if such installation procedures cannot be verified to have been used, GIP-2 reduces the nominal allowable pullout loads to one-tenth of that of cast-in-place bolts and headed studs with other provisions remaining unchanged.

Test results have indicated that grouted-in-place-bolts, installed properly, can develop the same allowable loads as cast-in-place bolts. However, test results also show that pullout loads of grouted-in-place-bolts drop substantially if the bolts were not installed properly. The staff believes that the use of 10 percent of the allowable loads (as specified in GIP-2) of properly installed grouted-in-place-bolts for the bolts for which proper installation procedures cannot be verified is conservative. The staff also believes that the allowable shear loads and other phenomena of grouted-in-place bolts should be similar to that of cast-in-place bolts and headed studs. Therefore, the staff concludes that the provisions in GIP-2 for grouted-in-place bolts are adequate.

5. Welds to Embedded or Exposed Steel

GIP-2 provides allowable loads for welds of various sizes, and requires an inspection of the weld size and quality. The minimum effective length of fillet welds should not be less than four times the nominal size of the weld, or else the size of the weld should be considered not to exceed one-fourth of its effective length. The allowable loads are based on the weld size times an allowable weld stress of 30.6 ksi. The staff concludes that the allowable loads so determined for such weld calculations are conservative and provide adequate safety margins against failure for welds to embedded or exposed steel.

6. Determination of Seismic Load for Individual Anchor

GIP-2 states that the seismic load on anchorages can be calculated by assuming an equivalent static load acting on the center of gravity of the equipment, with the load being equal to the input seismic accelerations times the mass of the equipment. GIP-2 further states that the seismic accelerations can be obtained from any one of the following three types of response spectra: (1) a "conservative, design" horizontal, in-structure response spectrum for SSE as defined in GIP-2, and modified by item 3 of Section II.4.2 of this supplement with no modification factor, (2) a median-centered, horizontal, in-structure response spectrum for SSE as defined in GIP-2, and (3) a 1.5 times SSE horizontal ground response spectrum (as modified by item 2 of Section II.4.2 of this supplement) for equipment mounted 40 feet above the grade and having its lowest natural frequency at about 8 Hz. If option (2) or (3) is selected, the acceleration is increased by a modification factor of 1.25. The vertical component of acceleration is assumed to be two-thirds of the horizontal component of acceleration. The square-root-of-the-sum of-the-squares (SRSS) method is used to combine the load components from three directional accelerations. The final load on each anchor is calculated by adding the combined seismic loads to the equipment deadweight loads and any other loads on the anchor. The staff concludes that the procedures specified in the GIP for determining loads on individual anchors provide adequate safety margin against failure and are, therefore, acceptable.

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7. Modification and Replacement of Expansion Anchors

GIP-2 states the following:

- The GIP-2 criteria may be applied to modification or repair of existing anchorages (e.g., anchor bolts or welds) including one-for-one component replacements (e.g., replacing bolts in one-for-one component replacements).

- For new installations and newly designed anchorages in modifications or replacements, the GIP-2 criteria and procedures may also be applied, except that the factor of safety currently recommended for new nuclear power plants in determining the allowable anchorage loads shall be met.

- It is generally recommended that if expansion anchors need to be used for vibrating equipment, then the undercut type of expansion anchors should be installed.

The staff concurs with these statements because they are practical and reasonably conservative.

8. Identification and Resolution of Outliers

Anchors are classified as outliers if the loads acting on the anchors exceed their allowable loads, or if anchors fail to pass certain screening guidelines specified in GIP-2. GIP-2 requires the licensee to assign qualified persons to the task of outlier resolution. Although GIP-2 provides recommendations on generic methods for resolving outliers, it states that the details for resolving outliers are beyond its scope. GIP-2 further states that the utility is responsible for resolving outliers using its existing engineering procedures as it would resolve any other seismic concern. The staff considers the task of outlier resolution to be plant specific, and agrees that the acceptability of the outlier resolution should be addressed individually by each licensee. The staff will, in its plant-specific SER, present its evaluation of the licensee's resolution of any outliers identified in the plant-specific walkdown inspection summary reports.

9. Verification of Anchorage Capacity by Computer Codes

The Electric Power Research Institute (EPRI) developed two specific digital computer codes for verifying anchorage capacity of equipment in USI A-46 plants: namely, the ANCHOR code (Reference 14 of GIP-2) and the EBAC code (Reference 7 of GIP-2). Both computer codes were written to evaluate the adequacy of equipment anchorages for seismic and gravity loadings.

The EBAC 1.0 and ANCHOR 3.0 anchorage evaluation computer codes use somewhat different analysis approaches to determine the margins of safety for a given anchorage arrangement and postulated seismic loading. Although both codes use a seismic equivalent static load approach to evaluate the equipment anchorages, the application of the equivalent static loads differs between these two codes. The EBAC code applies the seismic equivalent static loads in one direction at a time to an anchorage and then takes the square root of the sum of the squares (SRSS) of the bolt reactions from the three-directional seismic inputs. The ANCHOR code allows an SRSS combination of three-directional seismic equivalent static loads simultaneously and then applies the combined load at the equipment center of gravity. Another major difference is the selection of the equipment overturning axis (i.e., the neutral axis). The EBAC code asks the user to input the equipment overturning axis locations based on perceived equipment base flexibility. The ANCHOR code computes the overturning axis based on the overturing moments being resisted by tensile-only forces in the anchors and compressive-only forces in the concrete, assuming the base plate to be rigid.

Both the ANCHOR and EBAC codes provide for a bilinear tension/shear interaction formulation for anchorage strength evaluation. In addition, the EBAC code provides for an exponential tension/shear interaction formulation. The staff concludes that this exponential tension/shear interaction formulation is not acceptable for expansion anchor bolts because it is inconsistent with Appendix C of GIP-2 (Figure C.2-4, page C.2-28). The ANCHOR code allows selection of tension/shear interaction factors. For both computer codes, the selection of tension/shear interaction formulation must be consistent with those given in Appendix C of GIP-2.

The EBAC code performs a linear elastic analysis by assuming that plane sections remain plane as the overturning moments are applied. This assumption leads to a linear distribution of the tension forces on the anchors due to an overturning moment. In contrast, the ANCHOR code uses an approach which assumes an anchorage to exhibit an elastic-perfectly-plastic behavior for the anchor bolts and the concrete. Neither code provides a limit for concrete crushing strain. This is a concern, since in certain situations, the concrete may exceed its allowable strain limit causing the concrete to crush before the anchor reaches its capacity.

On the basis of these evaluations, the staff concludes both computer codes are acceptable in general, with the following restrictions and cautions, for use in USI A-46 equipment anchorage evaluations:

- EBAC 1.0, Rev. 0, Code:

  Supplementary calculations must be provided to the staff to ensure that compressive strains of the equipment-supporting concrete do not exceed 0.003 inch per inch, e.g., for the case of equipment supported by a concrete pedestal.

  Selection of equipment overturning axes shall be placed at the centerlines of the equipment base plane unless supplementary supporting calculations or documentation are supplied to the staff to justify other locations that would reflect other than flexible equipment.

  The exponential tension/shear interaction formulation shall not be used with expansion-type anchor bolts.

- ANCHOR 3.0, Rev. 0, Code:

  The licensee must provide supplementary calculations to the staff to ensure that compressive strains of the equipment-supporting concrete do not exceed 0.003 inch per inch.

In order to obtain proper answers to the anchorage evaluation, computer codes or charts must be used with great care. The equipment anchorage attributes listed in Section 4.4.1 of Part II and the concerns described on page 49 of Reference 5 in GIP-2 must be taken into consideration in using these computer codes.

Other computer codes may be used for a... ...orage evaluations if demonstrated to be accep[illegible] ... the use of EBAC or ANCHOR code is strictly the choice of the li[illegible]...ee.

10. Anchorage ... ...accessible Areas

Regarding the verification of anchorages in inaccessible areas, GIP-2, states on page 4-28 that "inaccessible anchorages not required for strength...need not be inspected...." This is, in general, acceptable to the staff because, if the inaccessible anchorages are not required for strength, it implies that the structural integrity of the anchorage is already adequate. However, to ensure the relay functionality, the licensee should try all practicable means to inspect all the anchorages of the cabinets having essential relays to avoid impact or excessive cabinet motion.

11. Minimum Spacing Between Anchors

The sentence "The minimum spacings given in Appendix C are for distances between adjacent anchors in which the cones of influence just touch each other at the surface of the concrete...." which starts at the end of page 4-39 in GIP-2, is incorrect. This is because the values of minimum spacing given in Appendix C of GIP-2 were directly taken from Volume 1 of GIP-2 Reference 7, and these values correspond to a 13-percent shear cone overlapping as stated on page 2-81 of Volume 1 of GIP-2 Reference 7. Therefore, this quoted statement should be corrected to be consistent with the statement given in GIP-2 Reference 7.

12. Use of ACI 349

Since the NRC has not endorsed the current version of Appendix B of American Concrete Institute Specification 349 (ACI 349), the entire second paragraph except for the first two sentences on page 4-49 of GIP-2 is not acceptable to the staff. The licensee should use Appendix C to GIP-2 for guidance.

13. Frequency Shifting

On pages 4-10 (fourth paragraph) and 4-56 (2nd from last paragraph), when an unbroadened seismic demand response spectrum is used for comparison, a reference should be provided for methods of "...equency shifting" for addressing the uncertainty in natural frequency ... the building structure.

II.5 Outlier Identification and Resolution

Discussion

Section 5 of Part II defines an outlier as an item of equipment that does not meet the screening guidelines provided in GIP-2. Several generic methods for resolving outliers are summarized in Section 5 of Part II.

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Evaluation

As noted in Section 5.3 of Part II, the details for resolving outliers are beyond the scope of the GIP. It is the responsibility of the utility to resolve outliers, using its existing engineering procedures as it would resolve any other seismic concerns. Therefore, the methods and results of outlier resolutions will be treated on a plant-specific basis.

It should be noted that one of the methods suggested in GIP-2 for resolving outliers is to use the earthquake experience data documented in References 4 and 5 of GIP-2. However, GIP-2 Reference 4 has been modified extensively by the addition of unreviewed new information. Although the staff and GIP-2 Reference 5 (SSRAP report) have used the information contained in a previous draft version (dated February 1987) of GIP-2 Reference 4 to assist the staff in arriving at a decision for resolution of some technical issues, the staff has not reviewed this GIP-2 Reference 4, and the GIP-2 Reference 5 does not endorse the entire GIP-2 Reference 4 (see Reference 9). Therefore, any specific application of the detailed information documented in GIP-2 Reference 4 for the implementation of USI A-46 resolution should be submitted to the NRC staff for review and approval before it is used. Regarding the collection and documentation of new information, the staff position is described in Section I.3.0 of this supplement.

Conclusion

Subject to the above clarifications, the staff concludes that the procedures for outlier identification and the general approach for outlier resolution are adequate and acceptable. However, as stated in item 2 of the "General Evaluation" in this supplement, the staff reiterates that it does not agree with the statement in this section of GIP-2 (page 5-1, second paragraph) regarding the conservative nature of the GIP guidelines in general.

II.6 Relay Functionality Review

Discussion

Section 6 of Part II provides an overview of the relay evaluation procedure and describes the relationships between other GIP activities and the relay evaluation which is contained in a separate reference document, "Procedure for Evaluating Nuclear Power Relay Seismic Functionality," Reference 8 of GIP-2.

This section was revised from GIP-0, primarily to include a multilevel screening approach for comparing relay seismic capacity to demand. The evaluation procedure described in GIP-2 is a summary; the details of the method are contained in the above-referenced SQUG relay procedures.

Evaluation and Conclusion

The relay review requires the use of the generic equipment ruggedness spectra (GERS) to assess the relay ruggedness. The staff had concerns about the amount of relay data that were available in the GERS (open issue C.2.1 of the original GSER). Additional information has been considered in the GERS and data will be added as needed if the walkdowns identify relays not currently addressed. The staff considers the SQUG approach practical and, therefore, acceptable and this issue resolved.

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The GERS were constructed using test data from relays of vintages newer than those that are currently installed in the USI A-46 plants. In the GSER, open issues C.2.2 and E.2.2 described the concern that the testing of newer equipment may not be applicable to the older equipment. The SQUG initiated a program to test a sample of older relays which were of the same type as those covered by the GERS, and compared the results to the more recent test results. The test results demonstrated that the difference in seismic ruggedness between relays of different vintages was not significant. GIP-2 considers this issue resolved, and the staff concurs. If additional testing in the future, by the NRC, SQUG, or others, provides evidence to change this conclusion, the staff will take appropriate action at that time.

Open issue E.2.5 of the GSER discussed the inclusion of relay mountings in the walkdown inspection and the number of relays to be inspected. The staff concurs with the SQUG position to review a sample of the relay mountings to ascertain that the relays are mounted in conformance with the vendors' recommendations. If any abnormality exists, the licensee shall increase the number of samples for inspection.

In conclusion, on the basis of its review of Section 6 of Part II, the staff agrees with the approach of evaluating systems and electrical circuits to determine the effect of relay chatter and endorses the review procedure as given in GIP-2. Therefore, the staff concludes that the procedure, if properly implemented, is an acceptable method of verifying the seismic adequacy of relays for the resolution of USI A-46 subject to the following:

1. Use of Zero Period Acceleration Capacities

   Regarding the acceptability of a relay, because of the important effects of zero period acceleration (ZPA) on relay chatter, the staff position is that in addition to the comparison of the spectral accelerations, the ZPA capacities should be compared and shown to be adequate (page 6-18 of GIP-2.)

2. Development of In-Cabinet Amplification Factors

   Section 6 of Part II includes the use of a single number amplification factor which is applicable to a given class of equipment for what is defined as Screening Level 2. With this concept, an in-cabinet demand spectrum is estimated by multiplying the base excitation demand spectrum by an effective amplification factor that is representative of the given class equipment. The result is then compared with device ruggedness spect[illegible] verify device capability.

   The amplification factors for motor-control-center-type cabinets, for control room benchboards and panels, and for switchgear-type cabinets or similar panels are presented in Table 6-2 of GIP-2. Because these amplification factors were determined based on test data and some empirical parameters specific to a certain type of cabinets or panels, the staff concludes that these amplification factors are reasonable and acceptable. However, the use of the 0.6 reduction factor for narrow peak amplification spectra for other types of cabinets, panels, or enclosures must be justified by the user and documented using procedures described in Reference 2 of Section 4 of GIP-2 Reference 33 because this 0.6 factor is an empirical value derived from specific types of cabinets, panels, or enclosures.

3. Development of In-Cabinet Response Spectra

The use of the in-cabinet amplification factors is intended for initial screening purposes. Should the result not produce a positive equipment seismic verification in a given case, then the next level of screening presents a more definitive methodology developed by EPRI (GIP-2 Reference 33) for generating in-cabinet response spectra. The staff has reviewed the procedures described in GIP-2 Reference 33 and the results specifically applicable to control room benchboards and panels. The staff finds that the approach includes development of conservative estimates for a single generic lowest natural frequency and a corresponding single generic high participation factor for this class of equipment. Therefore, the staff concludes that GIP-2 Reference 33 constitutes an approximate method of generating an in-cabinet demand response spectrum for devices which will be attached to control room benchboards and panels that are subject to a given site-specific floor spectrum.

The EPRI methodology (GIP-2 Reference 33) includes a combination of in situ experimental tests, modal analysis, linear power spectral density (PSD) response prediction, response spectrum/PSD transformation, and statistical methods in various combinations to generate the final, generic, elevated-demand spectrum. The staff finds the use of the computer program GENRS, as documented in Reference 33 of GIP-2 for the calculation of in-cabinet response spectra, acceptable only for control room benchboards and panels because the parametric values, such as those for natural frequency and the corresponding participation factor used in the computer code (GENRS), were derived specifically from the control room benchboards and panels. Therefore, the use of GENRS should not be extended to other classes of equipment without the review and approval of the NRC staff.

The EPRI methodology includes direct generation of a PSD from a required response spectrum (RRS) and vice versa. Because, the current NRC staff position on this approach is that the direct-generation method can be considered only case by case, the staff performed some additional investigation concerning the viability of this approach and its applicability in the GENRS computer code. The results of the staff investigation support the viability of the direct-generation method in general and its application in the GENRS computer code in particular.

II.7 Tanks and Heat Exchangers Review

Discussion

Section 7 of Part II gives guidelines for evaluating the adequacy of tanks and heat exchangers. The SQUG commitments, evaluation methodology, vertical tanks, horizontal tanks, outliers, and documentation are the main topics in this section.

Evaluation

1. Vertical Tanks

The procedure given in Section 7 of Part II of GIP-2 and discussed in the subsequent paragraphs covers the screening guidelines for flat-bottom vertical tanks supported on a concrete pad or floor, and anchored to the pad (or floor) by means of cast-in-place anchor bolts. The screening guidelines are applicable when the tank dimensions, anchor bolt configurations, and materials of fabrication are within the range and assumptions given in Table 7-1 in Part II.

The last paragraph in Section 7 of Part II indicates that the successful completion of the review described in Section 7 has been accepted by the NRC as resolving the seismic issues related to these types of tanks for USI A-40. However, the SQUG commitments in Section 7.1 and evaluation methodology in Section 7.2 do not address the screening guidelines for ensuring the adequacy of the foundation structures of the vertical tanks. As the tank foundation is subjected to higher loads than those determined using the rigid tank assumption, SRP Section 3.7.3.II.14.i recommends that the tank foundation be designed to withstand the seismic forces imposed on it. The SQUG commitments in Section 7.1 are not consistent with the guidelines in SRP Section 3.7.3.II.14.i. Therefore, the staff acceptance of these guidelines is subject to confirmation that the adequacy of the tank foundation is ensured.

Because the screening guidelines are to be used for the as-built vertical tanks, the staff strongly recommends that the input data required in Step 1 of Section 7.3.2 be based on the pertinent as-built drawings and verification through walkdowns of the condition of the tanks and the supporting foundations. Steps 2 through 6 provide the guidelines for determining the seismic demand applied to a specific tank, in terms of the overturning moment and the shear load. The seismic demand is based on the response value of the fluid-structure model at the impulsive modal frequency (Step 4). The calculated frequency is varied by ± 20 percent to account for the uncertainties involved in the calculations. The maximum responses from the applicable ground or floor response spectrum at 4-percent damping are used to calculate the seismic demand. Guidelines are provided to account for soil-structure interaction effects on the frequency and the response. On the basis of its review of procedures described in Steps 1 through 6 of Section 7.3.2 of Part II as summarized above, the staff finds that the seismic demand so determined is adequate and, therefore, concludes that these steps are logical and acceptable.

Steps 7 through 18 of Section 7.3.2 of Part II provide a method for computing the overturning moment capacity of the tank. The method considers the complex interactions between the anchor bolt capacity, the anchorage connection capacity, and the allowable buckling stress. Steps 19 and 20 require the users to compute the shear load capacity provided by the weight of the fluid on the base of the tank, and the frictional resistance between the base of the tank and the foundation surface. The formula to compute shear load capacity also reduces the fluid weight to account for the 40 percent of the vertical component of the earthquake. Steps 21 and 22 require the users to evaluate fluid level against the slosh height computed for the postulated earthquake. Section 7.3.6 of Part II requires the users to check the effect of the flexibility of attached piping.

In reviewing the earlier version of GIP-2 (Reference 5), the staff identified the following concerns:

a. The SQUG commitments do not require the users to check the adequacy of the supporting foundation which are likely to be subjected to higher loads than the original design that was based on a rigid-tank assumption.

b. The allowable buckling stress criteria provided in Step 11 are not sufficiently conservative to account for the out-of-roundness of the tank, local imperfections, material nonlinearities, the secondary effects due to shearing stresses, and rotation of the shell wall at the base. Without considering the uncertainties induced by these inherent characteristics, the seismic adequacy of the tanks cannot be assured.

In order to resolve the concern regarding the adequacy of the tank foundation, the SQUG proposed to include the evaluation requirements for ring foundations of the vertical tanks. The SQUG justified the narrow scope of the requirements by pointing to the experience data regarding tank foundation failures.

The staff agrees that ring foundations, when subjected to loads higher than the design loads, are likely to be more susceptible to failure than other types of foundation such as foundation mats on ground or floors supporting the tanks. Therefore, the proposed resolution is acceptable to the staff, and the concern is resolved with the inclusion of instructions to the users in Section 7.3.7 of Part II to identify ring foundations as outliers.

In order to resolve the concern regarding allowable buckling stress capacity, the staff has proposed to reduce the capacity reduction factor in Step 10 of Section 7.3.2 Part II from 0.9 to 0.72. The SQUG has adopted the staff recommendation in GIP-2. Therefore, this concern is resolved.

During the discussion related to the resolution of USI A-40, "Seismic Design Criteria," the method of analysis of above-ground, flexible, vertical tanks was identified as a topic requiring technical resolution. USI A-40 is resolved in Standard Review Plan (SRP) Sections 2.5.2, 3.7.1, 3.7.2, and 3.7.3 (Revision 2, August 1989). The guidelines related to the seismic analysis of the above-ground vertical tanks are included in SRP Section 3.7.3.II.14. As part of the resolution of USI A-40, a number of tanks at nuclear power plant sites are required to have confirmatory checks to ensure that the safety-related, above-ground, vertical tanks are adequately designed. Most of the licensees of newer plants have incorporated the flexible tank design concept in the design of their above-ground tanks. Some licensees have committed to make confirmatory checks of their design using the procedures developed by the SQUG under the resolution of the USI A-46 program. T implementation of criteria and procedures described in GIP-2, supplem d by the staff evaluations described in this supplement for large, flat-bottom cylindrical, vertical tanks which are needed for safe shutdown and for refueling water storage in PWRs, is considered an acceptable method for resolving the seismic issues related to these types of tanks for both USI A-46 and USI A-40, as it applies to USI A-46 plants.

2. Horizontal Tanks

The screening guidelines provided in Section 7.4 of Part II of GIP-2 are applicable when a horizontal tank or a heat exchanger shell satisfies the following criteria:

- Its longitudinal axis (axis of symmetry) is horizontal.

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- It is supported on its curved bottom by steel saddle plates.
- It is anchored to a stiff foundation having adequate strength to resist the seismic loads applied to the tank.
- All the baseplates under the saddle have slotted anchor-bolt holes in the longitudinal direction except the one for an end saddle support.
- Its layout and dimensions satisfy the range of parameters and assumptions listed in Table 7-6 of Part II

Steps 2 through 7 of the screening guidelines described in Section 7.4 of Part II provide guidelines for evaluating the resistance of the existing tank in terms of the anchorage capacity. Steps 8 through 10 provide guidelines for evaluating the seismic demand of the tank anchorage system. Step 11 provides instructions for evaluating the tank saddle stresses. The staff finds the screening methodology to evaluate the seismic adequacy of horizontal tanks consistent with engineering practice and, therefore, acceptable for existing installations only.

Conclusion

On the basis of its review of Section 7 of Part II of GIP-2, the staff concludes that the methodology provided for the seismic adequacy evaluation of the safety-related horizontal and vertical tanks and heat exchangers existing at the USI A-46 plants is acceptable. However, the criteria for evaluating tanks and heat exchangers, as defined herein, are not acceptable for new installations.

II.8 Cable and Conduit Raceway Review

Discussion

Section 8 of Part II of GIP-2 describes the screening guidelines for cable and conduit raceway review. The screening procedure is based primarily on earthquake experience data and some shake-table test data. Several types of raceway configurations and support systems are covered in this section. The guidelines consist of a set of walkdown guidelines and a set of limited analytical review guidelines.

The walkdown guidelines provide guidance for the seismic review teams (SRTs) to: (1) perform direct in-plant screening reviews of raceway systems against a set of inclusion rules, (2) assess other seismic performance concerns not covered by the inclusion rules, and (3) select, during the walkdown, 10 to 20 representative, worst-case samples of raceway supports for analytical review. The systems which are identified to be within the boundaries of the inclusion rules would be considered to be within the applicability limits of the experience database. If violations of the inclusion rules are observed, the SRT should investigate the specific conditions of the cable tray systems with proper assessment methodology to verify their seismic adequacy.

The purpose of the limited analytical review is to ensure that the selected worst-case, representative samples of the raceway support systems in the plant are at least as rugged under the required seismic loadings as those in the earthquake experience and shake-table test databases that performed well. Section 3.3 of GIP-2 Reference 9 should be used for selecting samples for the limited analytical review. If these samples do not pass this limited analytical review, further evaluations should be conducted and the sample should be expanded as appropriate. The analytical reviews are primarily based on the back-calculated capacities of raceway supports in the seismic experience database. They are formulated with the use of static load coefficients, plastic behavior structural theory, and professional engineering judgment to ensure that cable tray and conduit supports are seismically adequate and as rugged as those in the seismic experience database. The main feature of the reviews is that all supports are checked for deadload (DL) vertical capacity using the working stress criteria given in Part 1 of the American Institute of Steel Construction (AISC) Specification. All supports must pass the DL check, otherwise the supports must be treated as outliers and disposed of as such. However, isolated cases of a support not meeting the one DL criterion could be accepted if the raceway support system has high redundancy; this can be demonstrated by showing that the adjacent supports are capable of satisfying the walkdown guidelines, including the inclusion rules and the analytical review guidelines. In addition to the DL check, all of the cable tray supports suspended from overhead must satisfy three times the DL, otherwise the supports must be treated as outliers. This check is designed to ensure that the anchorage supporting the cable trays and conduit raceway in the USI A-46 plants is as strong as those in the experience database in sustaining the vertical loads.

The raceway hardware becomes an outlier if it does not meet the walkdown guidelines (inclusion rules and other seismic performance concerns), or the limited analytical review guidelines. When an outlier is identified, additional evaluations as described in GIP-2 Reference 9, or alternative methods, are required to demonstrate seismic adequacy of the raceway hardware and to resolve the outlier issue. The evaluations and justifications to be used to resolve the outlier issue should be based on mechanistic principles and sound engineering judgment and should be thoroughly documented for NRC staff review.

Evaluation and Conclusion

The staff has reviewed the guidelines proposed by the SQUG for evaluating the seismic adequacy of cable and conduit raceway systems. The main objective of the proposed guidelines was to develop a cost-effective means of verifying the seismic adequacy of raceway supports in USI A-46 plants. These guidelines were developed on the bases of analytical studies, shake-table experimental model tests, and assessment of the performance of cable and conduit support systems in past earthquakes.

The staff considers that the plant walkdown guidelines represent an acceptable approach for evaluating the seismic adequacy of existing cable and conduit raceways in USI A-46 plants. Also, the staff agrees that the proposed analytical procedure is a reasonable approach to ensure that the cable and conduit raceways and supports in USI A-46 plants, when all the guidelines are satisfied, are as rugged as those observed in the past earthquake experience data. Although the proposed guidelines would not require detailed analyses and, therefore, would not predict the structural response of the raceway support systems, they should provide the needed rationale to judge the seismic adequacy

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of the raceway support systems with a reasonable factor of safety. Therefore, the staff concludes that the proposed guidelines for evaluation of seismic adequacy of cable and conduit raceways and their supports are acceptable subject to the staff evaluations described in this supplement.

II.9 Documentation

Section 9 of Part II describes the documentation that is to be submitted to the staff upon completion of the plant-specific review and includes the documentation available at the plant site for audit. The major document types are:

- safe-shutdown equipment list report
- relay evaluation report
- seismic evaluation report
- completion letter

The staff has reviewed the outlines of each report as given in GIP-2. The information to be submitted to NRC for review will provide overall results of the implementation program. Therefore, the staff finds the proposed plant-specific information to be submitted to the NRC for resolution of USI A-46 acceptable.

However, GIP-2 recommends documentation (not required to be submitted to the NRC) of only the results from several evaluations (e.g., Sections 9.3 and 9.4) and not the assumptions and judgments used for the respective evaluations. The staff recommends documentation of the assumptions and the judgments as previously mentioned in Section II.2 of this supplement. The documentation of assumptions and judgments, in addition to the results of evaluations, will facilitate the reconstruction of relevant basis for the licensee's evaluations.

II.10 References

Section 10 of Part II contains a list of references that are the source of information for the criteria and procedures described in GIP-2. During the course of its review, the staff consulted References 5, 6, 7, 8, 9, 10, 26, 32, and 33, among others, of GIP-2, in order to develop the bases for accepting the criteria and procedures presented in GIP-2, for implementing USI A-46 resolutions.

As noted in Section II.5 of this supplement, Reference 4 of GIP-2 has been modified extensively by the addition of unreviewed new information. Because the staff has not reviewed this particular version of the reference, any specific application of the detailed information documented in Reference 4 for the implementation of USI A-46 should be submitted to the staff for review and approval before it is used. For collection and documentation of new information, see the staff position described in Section I.3.0 of this supplement.

III APPENDICES

III.1 Appendix A, Procedure for Identification of Safe-Shutdown Equipment

Appendix A of GIP-2 amplifies the method described in Section 3 of Part II for identifying safe-shutdown equipment. The staff incorporated its evaluation of Appendix A into its discussion in Section II.3 of this supplement.

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III.2 Appendix B, Summary of Equipment Class Descriptions and Caveats

Appendix B of GIP-2 incorporates information regarding the seismic capacities of 20 equipment classes. This information was extracted principally from GIP-2 Reference 5 and partially from GIP-2 Reference 4 for earthquake experience data, and from GIP-2 Reference 6 for the test data. The staff evaluation of this appendix shall be used in conjunction with the staff evaluations presented in Sections II.4, II.5, and II.6 of this supplement.

In GIP-2 Reference 5, SSRAP documented its review of GIP-2 Reference 4, GIP-2 Reference 6, and other supporting documents. After a detailed and careful review of the full range of the available experience database, combined with the general experience of the SSRAP members, the SSRAP concludes that the equipment (20 classes) presented in Appendix B of GIP-2, when properly anchored, and with some reservations as discussed in GIP-2 Reference 5 and Appendix B of GIP-2, have an inherent seismic ruggedness and a demonstrated capability to withstand seismic motion bound as specified without significant structural damage and malfunction. The staff concurs with this conclusion.

On the basis of the discussion described above and the review of information presented in Appendix B of GIP-2 and other supporting documents, the staff concludes that Appendix B is generally acceptable, subject to the following:

1. Throughout Appendix B, such statements as "equipment determined to be seismically rugged" are repeatedly used. The staff considers such statements ambiguous unless the appropriate vibration level for which the equipment is rugged is given. In addition, the first sentence of each equipment class states that the equipment "has been determined to be seismically rugged...provided the intent of each of the caveats listed below is met...." The staff also finds such statements to be incomplete and misleading because according to Appendix B, a user can simply meet the caveats and declare the equipment to be rugged (and therefore acceptable) for its application without even comparing it with the demand vibration level. The staff takes the position that in addition to meeting the caveats, the user must demonstrate the demand level is appropriately satisfied by the capacity level before the equipment can be considered to be rugged and acceptable for its application.

2. Regarding the attachment weight of 100 pounds, GIP-2 uses the term "a cabinet assembly" (e.g., page B.1-4, MCC/BS caveat 4; page B.?-3, LVS/BS caveat 5). The staff understands this term to mean a combination or lineup of a number of individual cabinets, bays, or frames.

3. GIP-2 includes a caveat for many equipment classes that the sections of the multibay cabinet should be bolted together only "if any of these cabinets contain essential relays...." Since the database cabinets in GIP-2 Reference 6 were bolted during testing, the adjacent cabinets at the plants should be bolted for applicability of the GERS level, even though these cabinets do not contain relays. Otherwise, the responsible review engineer should justify the use of GERS level for those cabinets.

4. The capacity levels for motor operators on valves presented in GIP-2, and in GIP-2 Reference 6, appear to be high compared to the levels reported in NUREG/CR-4659, Vol. 4 (Reference 10). Note that new data from this report

were not available to the SQUG at the time GIP-2 was being prepared. Therefore, the information presented in Reference 10 should be considered in the evaluation of motor operators on valves, especially for some earlier models.

III.3 Appendix C, Anchorage Data

Appendix C of GIP-2 includes information necessary for verifying the adequacy of anchorage. The staff incorporated its evaluation of this appendix in Section II.4 of this supplement.

III.4 Appendix D, Seismic Interaction

Appendix D of GIP-2 describes seismic interaction as the physical interaction of any structures, piping, or equipment with nearby safe-shutdown equipment caused by relative seismic motions. Three seismic interaction effects are covered in the GIP, namely: proximity, structural failure and falling, and flexibility of the attached lines and cables. The staff finds the guidelines for reviewing seismic interaction adequate and, therefore, this appendix is acceptable and should be used with the staff evaluation presented in Section II.4 of this supplement.

III.5 Appendix E, Preparatory Work Prior to Walkdown

Appendix E of GIP-2 describes the experience gained from previous walkdowns to maximize the effectiveness of the walkdown.

The GIP states that most of the equipment "has been shown to be seismically rugged...." As explained in Section III.2 above, the staff considers this statement ambiguous unless the appropriate vibration level is associated with it.

III.6 Appendix F, Screening Walkdown Plan

Appendix F of GIP-2 describes the organization and approach that can be used by the seismic review team, the degree of inspection to be performed, the walkdown logistics to be followed, and the screening walkdown to be completed. The staff finds the screening walkdown plan adequate for accomplishing the objectives of the walkdown inspection and, therefore, the staff concludes that the GIP screening walkdown plan is acceptable.

III.7 Appendix G, Screening Evaluation Work Sheets

Appendix G of GIP-2 provides the worksheets to be used by the walkdown team to document their review. The staff finds these worksheets to be a useful summarized checklist that briefly documents the responses to essential screening questions addressing the seismic adequacy of each piece of equipment and, therefore, the staff concludes that this appendix is acceptable subject to the following staff positions:

1. Since the screening evaluation worksheets in Appendix G contain summary information presented in Appendices B and C, in case there is any conflict between these pieces of information, the information in Appendices B and C should be used. For example, for motor control centers, the weight of 800 pounds should be considered maximum instead of average (pages B.1-7 and G.1-2).

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2. The screening evaluation worksheets do not require documentation of manufacturer, model, etc. For information purposes only, the staff strongly recommends that such information should be recorded if readily available.

3. Since GIP-2 allows the demand level to exceed the capacity level under certain conditions, in response to the question "Does capacity exceed demand?" on the Screening Evaluation Work Sheet (SEWS) for each piece of equipment, the reviewer should also identify whether the exceptions on page 4-10 of GIP-2 are used in the comparison (see item 1 of Section II.4.2 of this supplement).

CONCLUSION

The staff concludes that GIP-2, dated June 1991 (Reference 8), supplemented by the staff positions, clarifications and interpretations, stated herein for each section of GIP-2, constitutes an acceptable method for the implementation of the resolution of USI A-46 as specified in Generic Letter 87-02, subject to the following exceptions:

1. Item 2 under GENERAL EVALUATION

   The staff does not agree with any claim, whether explicit or implied, that the GIP-2 approach is conservative or comparable to current qualification requirements.

2. Section I.1.2, Purpose of the GIP, Item 1

   The staff does not agree that implementation of the GIP-2 methodology will provide the same level of safety as that achieved by the implementation of current seismic qualification methods. The staff does not consider the GIP-2 methodology an acceptable seismic qualification method.

3. Section II.3, Identification of Safe Shutdown Equipment, Evaluation and Conclusion, Item 4

   All safety-relief valves listed in GIP-2 should be included in the scope of USI A-46.

4. Section II.4.1, SQUG Commitments

   If the licensee commits to use GIP-2 for the implementation of USI A-46, it must commit to both the SQUG commitments and the use of the entire implementation guidance provided in GIP-2, unless otherwise justified to the staff.

5. Section II.4.4, Anchorage Adequacy, Item 9, Verification of Anchorage Capacity by Computer Codes

   If the licensee chooses to use either of the following two computer codes for anchorage calculations, then for:

   EBAC 1.0 Rev. 0 Code,

   - The licensee must provide supplementary calculations to ensure that compressive strains of the concrete which supports equipment do not exceed 0.003 inch per inch;

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- Selection of equipment overturning axes shall be placed at the centerlines of the equipment base plane unless supplementary calculations or documentation are supplied to justify other locations that would reflect other than flexible equipment;

- The exponential tension/shear interaction formulation shall not be used with expansion-type anchor bolts; and

ANCHOR 3.0, Rev. 0 Code,

- The licensee must provide supplementary calculations to ensure that compressive strains of the concrete which supports equipment do not exceed 0.003 inch per inch.

6. Section II.4.4, Anchorage Adequacy, Item 10, Verification of Anchorages in Inaccessible Areas

To ensure relay functionality, the licensee should try all practicable means to inspect all of the anchorages of cabinets having essential relays.

7. Section II.4.4, Anchorage Adequacy, Item 11, Minimum Spaci · Between Anchors

On page 4-39 of GIP-2, the sentence, "The minimum spacings given in Appendix C are for distances between adjacent anchors in which the cones of influence just touch each other at the surface of the concrete..." is incorrect. The minimum spacing values in GIP-2, Appendix C correspond to a 13-percent shear cone overlapping. The quoted statement should be corrected.

8. Section II.4.4, Anchorage Adequacy, Item 12, Use of ACI 349

The NRC has not endorsed the current version of ACI 349, Appendix B, and the reference to it on page 4-49 of the GIP-2 is not acceptable.

9. Section II.5, Outlier Identification and Resolution, and Section II.10, References

The staff has not reviewed the current version of GIP-2 Reference 4. Any specific application of this reference for resolving USI A-46 should be submitted to the NRC staff for review and approval before it is used.

10. Section II.6, Relay Functionality Review, Item 1, Use of Zero Period Acceleration Criteria

For the relay functionality review, in addition to the comparison of the spectral accelerations, the ZPA capacities should be compared and shown to be adequate.

11. Section III.2, Appendix B, Summary of Equipment Class Descriptions and Caveats, Item 3

GIP-2 includes a caveat for many equipment classes that states that the adjacent sections of multibay cabinets should be bolted together only "if any of these cabinets contain essential relays." For multibay cabinets,

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all cabinets, regardless of whether or not a cabinet contains essential relays, should be bolted together in order for the GERS to be applicable, unless justification can be provided for applying these GERS to multibay cabinets that are not bolted together.

12. Section III.2, Appendix B, Summary of Equipment Class Descriptions and Caveats, Item 4

The information presented in Reference 10 of this SSER No. 2 should be considered in the evaluation of motor operators on valves, especially for some earlier models.

13. Section III.7, Appendix G, Screening Evaluation Worksheets, Item 1

In any case where the information presented in Appendix G conflicts with the information in Appendices B and C, the information in Appendices B and C should be used.

14. Section III.7, Appendix G, Screening Evaluation Worksheets, Item 3

In response to the SEWS question, "Does capacity exceed demand?", the reviewer should identify if the exceptions described on page 4-10 of GIP-2 were used in the comparison.

REFERENCES

1. Generic Letter 87-02, "Verification of Seismic Adequacy of Mechanical and Electrical Equipment in Operating Reactors, Unresolved Safety Issue (USI) A-46," U.S. Nuclear Regulatory Commission, February 19, 1987.

2. "Generic Implementation Procedure (GIP) for Seismic Verification of Nuclear Plant Equipment," Revision 0, Seismic Qualification Utility Group, June 1988.

3. "NRC Generic Safety Evaluation Report on the Seismic Qualification Utility Group Generic Implementation Procedure, Revision 0, for Implementation of USI A-46," July 29, 1988.

4. "Generic Implementation Procedure (GIP) for Seismic Verification of Nuclear Plant Equipment," Revision 1, Seismic Qualification Utility Group, December 1988.

5. "Supplemental Safety Evaluation Report No. 1 on SQUG Generic Implementation Procedure, Revision 1," by NRC, June 29, 1990.

6. "Generic Implementation Procedure (GIP) for Seismic Verification of Nuclear Power Plant Equipment," Revision 2, Seismic Qualification Utility Group, September 1990.

7. Letter, James A. Norberg, NRC, to Neil P. Smith, dated March 11, 1991, "Comments on Revision 2 of Generic Implementation Procedure (GIP) for Use in USI A-46 Programs, dated September 21, 1990."

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8. "Generic Implementation Procedure (GIP) for Seismic Verification of Nuclear Power Plant Equipment," Revision 2, Corrected 6/28/91, Seismic Qualification Utility Group, June 1991.

9. Letter, W. A. Von Reisemann, SSRAP, to Pei-Ying Chen, NRC, dated July 23, 1991, "EQE Class of Twenty Report."

10. NUREG/CR-4659, Vol. 4, "Seismic Fragility of Nuclear Power Plant Components (Phase II): A Fragility Handbook on Eighteen Components," June 1991.