Section 5
Outlier Identification and Resolution

5.0 INTRODUCTION

The purpose of this section is to define the term outliers, how they should be identified and documented, and how they may be resolved.

An outlier is an item of equipment which does not comply with all of the screening guidelines provided in this Generic Implementation Procedure (GIP). The GIP screening guidelines are intended to be used as a generic basis for evaluating the seismic adequacy of equipment. If an item of equipment fails to pass these generic screens, it may still be shown to be adequate for seismic loading by additional evaluations.

This section describes how outliers should be identified and documented for equipment which does not pass the screening guidelines for:

- Active mechanical and electrical equipment (Section 4),
- Relays (Section 6),
- Tanks and heat exchangers (Section 7), and
- Cable and conduit raceways (Section 8).

Several generic methods for resolving outliers are summarized in this section. Specific methods for addressing the different types of equipment are also discussed in the sections where the screening guidelines are described (Sections 4, 6, 7, and 8).

The remainder of the section is organized as follows:

- The requirements to which SQUG utilities commit in regard to identification and resolution of outliers for resolution of USI A-46 are given in Section 5.1.
- The reasons for classifying an item of equipment as an outlier are described in Section 5.2 along with a description of how outliers should be documented.
- A summary of generic methods for resolving outliers is contained in Section 5.3.
- Suggested methods for grouping and pooling of outliers from several different plants for efficient reconciliation are provided in Section 5.4.

5.1 SQUG COMMITMENTS

Members of SQUG adopting the Generic Implementation Procedure for USI A-46 resolution commit to the following in regard to the identification and resolution of outliers. [1]As specified in GIP, Part I, Section 1.3, any substantial deviations from the SQUG Commitments must be justified to the NRC in writing prior to implementation. Likewise the NRC should be notified of significant or programmatic deviations from the GIP guidance (Sections 5.2 through 5.4) but implementation may begin without first obtaining NRC concurrence (at the licensee's own risk).

5.1.1 Identification of Outliers

When performing the screening evaluations as set forth in Sections 4, 6, 7, and 8, the licensee will classify an item of identified safe shutdown equipment as an outlier if the screening guidelines defined in these sections cannot be met.

5.1.2 Resolution of Outliers

The licensee will assign suitably qualified persons to the task of outlier resolution. If engineering judgment is used to resolve outliers based on the guidelines in this procedure, assigned persons will have the qualifications of a Seismic Capability Engineer (or Lead Relay Reviewer for relay evaluations) as set forth in Section 2. If additional systems evaluations are required, assigned persons will have the qualifications of the Systems Engineers as set forth in Section 2.

5.2 OUTLIER IDENTIFICATION

An item of safe shutdown equipment should be identified as an outlier if it does not meet the screening guidelines covered in the other sections of this procedure. The topics included in these screening guidelines are listed below for the various types of equipment covered by this procedure:

Section 4 - Active Mechanical and Electrical Equipment
(Equipment Class #0 through #20)

- Capacity versus Demand
- Caveats
- Anchorage
- Seismic Interaction

Section 6 - Essential Relays

- Capacity versus Demand
- Spot Check of Relay Mounting, Type, and Location

Section 7 - Tanks and Heat Exchangers
(Equipment Class #21)

- Shell Buckling of Large, Flat-Bottom, Vertical Tanks
- Anchor Bolts and Embedments
- Anchorage Connections Between the Anchor Bolt and the Tank Shell
- Flexibility of Piping Attached to Large, Flat-Bottom, Vertical Tanks

Section 8 - Cable and Conduit Raceways
(Equipment Class #22)

- Inclusion Rules
- Other Seismic Performance Concerns
- Limited Analytical Review

If an item of equipment is identified as an outlier during a screening evaluation in one of these other sections of the GIP, then the reason(s) for failing to satisfy the screening guidelines should be documented on an Outlier Seismic Verification Sheet (OSVS), shown in Exhibit 5-l. A separate OSVS should be completed for each item of equipment classified as an outlier. The information to be included in each of the four sections of the OSVS is described below.

Section 1 of the OSVS describes the item of equipment identified as an outlier. This is the same information as found in the first seven columns of the SVDS, shown in Exhibit 4-l. On the OSVS, however, more space is provided to describe the equipment so that more details can be included to facilitate later resolution of this outlier issue without requiring repeated trips into the plant.

Section 2 of the OSVS defines those conditions which cause that item of equipment to be classified as an outlier. This section should identify which of the conditions is the cause for the item of equipment becoming an outlier. More than one condition may be the cause for the outlier. In addition, the reason(s) for the equipment being an outlier should be described in more detail. For example, the Seismic Capability Engineers could indicate at what frequencies the demand exceeded the capacity.

Section 3 of the OSVS can be used to provide a proposed method for resolving the outlier issue, based on the experience and detailed evaluation of that item of equipment by the Seismic Capability Engineers or the Lead Relay Reviewer. This is an optional part of the outlier identification process. This section also provides space for supplying any additional information which may be used to implement the proposed method of resolution. This may include information such as an estimate of the fundamental natural frequency of the equipment.

For Equipment Classes #0 through #22, as defined in Table 3-1, all the Seismic Capability Engineers on the Seismic Review Team (SRT) should sign the OSVS. Each SRT should have at least two Seismic Capability Engineers; one of whom is a licensed professional engineer. For essential relays, the Lead Relay Reviewer should sign the OSVS. By signing this form, each individual is certifying that once the outlier issue(s) described in Section 2 of the OSVS are satisfied, the item of equipment is considered seismically adequate.

5.3 OUTLIER RESOLUTION

Several generic methods for resolving outliers are summarized below. Additional specific methods for addressing outliers for the different types of equipment are also discussed in the sections where the screening guidelines are described (Sections 4, 6, 7, and 8). The details for resolving outliers, however, are beyond the scope of this procedure. It is the responsibility of the utility to resolve outliers using their existing engineering procedures as they would resolve any other seismic concern.

It is permissible to resolve outliers by performing additional evaluations and applying engineering judgment to address those areas which do not meet the screening guidelines contained in this procedure. Strict adherence to the screening guidelines in the GIP is not absolutely required; however, these additional outlier evaluations and the application of engineering judgment should be based on a thorough understanding of the screening guidelines contained in the GIP and the background and philosophy used to develop these guidelines as given in the applicable references. The justification and reasoning for considering an outlier to be acceptable should be based on mechanistic principles and sound engineering judgment.

The screening guidelines contained in Sections 4, 6, 7, and 8 have been thoroughly reviewed by industry experts to ensure that they are acceptable for generic use in resolving USI A-46; however, the resolution of outliers for individual plants will not likely receive the same level of industry review as the generic screening guidelines. Therefore, it is recommended that the evaluations and judgments used to resolve outliers be thoroughly documented so that independent reviews can be performed if necessary.

Some of the methods summarized below for resolving outliers build upon the earthquake experience and generic testing data used to develop the GIP. The utility may use the Screening Verification and Walkdown procedure described in Section 4 in applying earthquake experience or generic testing data which was not available during the initial walkdown for resolution of outliers, or it may develop an alternative approach which best fits the circumstances of the

specific outlier issue. Outlier issues may also be resolved using current licensing procedures and criteria.

As an alternative, the utility may choose to not perform corrective modifications or replacement of outliers. Instead, the utility must then explain to the NRC the safety implications of not modifying or replacing the outliers as described in Part I, Section 2.3.1. The NRC must then meet the requirements of 10 C.F.R. § 50.109 (backfit rule) in order to require the corrective modifications or replacements be completed.

Methods which can be used to resolve outliers include the following:

1. The earthquake experience equipment class may be expanded to include the equipment or specific equipment features of interest. The scope of the earthquake experience data which is documented in References 4 and 5 represents only a portion of the total data available. (See footnote [1] below.)[2] An expansion of the earthquake experience equipment classes beyond the scope included in Appendix B could include a more detailed breakdown by type, model, or manufacturer of a particular class of equipment, less restrictive requirements for inclusion within a class, or development of a sub-category with higher capacity. Extension of the generic experience equipment classes beyond the descriptions in the GIP is subject to NRC review.
2. The subject equipment or its anchorage may be evaluated more rigorously or modified to strengthen it and bring it within the scope of the GIP or in compliance with some other seismic qualification method. For example, the equipment or its supports may be stiffened so that its resonant frequency is increased to a frequency where the seismic demand is less. Providing an upper lateral support to a floor-mounted item of equipment would typically increase the fundamental frequency to above the 8 Hz cutoff frequency for use of the Bounding Spectrum.
3. The subject equipment may be replaced with equipment which is covered by screening guidelines in the GIP or has been seismically qualified by some other means.
4. Detailed engineering analyses may be performed to more carefully and/or accurately evaluate the seismic capacity of the equipment and/or the seismic demand to which it

[1] The NRC Staff has not reviewed the Twenty Classes Report (Reference 4) in its entirety and SSRAP (in Reference 5) has not endorsed Reference 4 in its entirety. Therefore, any specific application of the detailed information documented in Reference 4 should be submitted to the NRC Staff for review and approval before it is used for resolving outliers.

is exposed. For example, when using more accurate analytical procedures, consideration should be given to using "as-built" rather than specified minimum material properties for the equipment.

5. In-situ tests may be performed on the equipment of interest to determine more accurately the equipment dynamic properties.

6. Shake table tests may be performed on the same or similar equipment to check its seismic capacity or evaluate more carefully its dynamic properties.

7. [3]An alternative method of shutting down the plant may be selected if certain items of equipment selected for safe shutdown cannot be readily verified to be seismically adequate using the GIP criteria and guidelines.

8. Information not available during the Screening Verification and Walkdown may be obtained and used to meet the GIP screening guidelines.

The most appropriate type of outlier evaluation will depend upon a number of factors, including the reason that the equipment failed the screening guidelines, whether the outlier lends itself to additional review of the earthquake experience or generic testing data or an additional analytical evaluation, the cost of design or hardware modifications, and how extensive the problem is in the plant and in other plants.

The NRC should be provided with a proposed schedule for complete resolution or future modifications and replacement of outliers. Documentation of the actual methods selected by the utility for resolution of outlier issues and tracking of their implementation is discussed in Section 9, Documentation.

5.4 METHODS FOR GROUPING AND POOLING OF OUTLIERS

Once an outlier has been identified and an OSVS is prepared for that item of equipment, the OSVS could then be placed in an appropriate outlier category or "basket". There could be one basket for each class of equipment for which there are outliers. Within each basket the outliers could be further divided into the various reasons that the equipment failed the screening verification (e.g., capacity vs. demand, caveats, anchorage, or interactions). The organization of the outliers in this manner can facilitate reconciliation of recurring outlier issues.

One method to efficiently reconcile recurring outliers in SQUG plants is for the members of SQUG to pool the outlier information obtained during walkdowns. One means of pooling this information is to tabulate the outliers, including the information contained on the SVDS and, if available, the method ultimately used to verify the seismic adequacy of the outlier. These tables may be generated and organized, using a database management program. This summary may be distributed to the members of SQUG so that common outliers may be evaluated using the experience obtained from other plants. For example, one utility may have one or several unreconciled outliers that an SRT at another plant was able to verify. The utility with the unreconciled outliers may be able to employ a similar methodology if the detailed information used in the outlier resolution is shared. Also, outliers from several SQUG plants may be resolved more cost-effectively using shared funding.

Exhibit 5-1
Outlier Seismic Verification Sheet (OSVS)
Sheet 1 of 2

1. **Outlier Identification, Description, and Location**

Equipment ID Number _____ Equipment Class _____

Equipment Location: Building _____ Floor Elevation _____

Room or Row/Column _____ Base Elevation _____

Equipment Description _____

_____

2. **Outlier Issue Definition**

a. Identify all the screening guidelines which are not met.
(Check more than one if several guidelines could not be satisfied.)

Mechanical and Electrical Equipment		Tanks and Heat Exchangers	
Capacity vs. Demand	_____	Shell Buckling[1]	_____
Caveats	_____	Anchor Bolts and Embedment	_____
Anchorage	_____	Anchorage Connections	_____
Seismic Interaction	_____	Flexibility of Attached Piping[1]	_____
Other	_____	Other	_____
Essential Relays		**Cable and Conduit Raceways**	
Capacity vs. Demand	_____	Inclusion Rules	_____
Mounting, Type, Location	_____	Other Seismic Performance Concerns	_____
Other	_____	Limited Analytical Review	_____
_____		Other	_____

[1] Shell buckling and flexibility of attached piping only apply to large, flat-bottom, vertical tanks.

b. Describe all the reasons for the outlier (i.e., if all the listed outlier issues were resolved, then the signatories would consider this item of equipment to be verified for seismic adequacy):

_____

_____

_____

_____

_____

_____

Exhibit 5-1 (Cont'd)
Outlier Seismic Verification Sheet (OSVS)
Sheet 2 of 2

3. **<u>Proposed</u> Method of Outlier Resolution (Optional)**

a. Define proposed method(s) for resolving outlier.

_____

_____

_____

_____

b. Provide information needed to implement proposed method(s) for resolving outlier (e.g., estimate of fundamental frequency).

_____

_____

_____

_____

_____

_____

4. **Certification**

The information on this OSVS is, to the best of our knowledge and belief, correct and accurate, and resolution of the outlier issues listed on the previous page will satisfy the requirements for this item of equipment to be verified for seismic adequacy.

Approved by: (For Equipment Classes #0 - #22, all the Seismic Capability Engineers on the Seismic Review Team (SRT) should sign; there should be at least two on the SRT. One signatory should be a licensed professional engineer. For Relays, the Lead Relay Reviewer should sign.)

Print or Type Name	Signature	Date
Print or Type Name	Signature	Date
Print or Type Name	Signature	Date

REASONS FOR CHANGES TO GIP, PART II, SECTION 5

Listed below are the specific reasons for making the changes marked with a vertical line in the margin of this section to create GIP-3A from GIP-3, Updated 5/16/97. The endnote numbers listed below correspond to the bracketed numbers (e.g., [1]) located in the text of this section where the changes are made.

---

[1] SSER No. 2, Sec. II.4.1 – The Staff position is that the licensee 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 as described in GIP-2 and SSER No. 2.

The GIP has been amended in the "SQUG Commitments" sections of Part II to reiterate the requirement contained in the GIP, Part I, Section 1.3 to (1) provide written justification to the NRC for prior approval of any substantial deviations from the SQUG commitments and (2) notify the NRC of significant or programmatic deviations from the GIP guidance no later than the summary report.

[2] SSER No. 2, Sec. II.5 and II.10 – The Staff had not reviewed the Twenty Classes Report (Reference 4) in its entirety and SSRAP (in Reference 5) had not endorsed Reference 4 in its entirety. Therefore, the Staff position is that any specific application of the detailed information documented in Reference 4 for resolving outliers should be submitted to the NRC Staff for review and approval before it is used.

The GIP has been amended in Part II, Sections 5.3 and 10 to add a footnote which describes the Staff position.

[3] Clarification. An additional method for resolving outliers (i.e., selection of an alternative safe shutdown path) was added to the list in Part I, Section 5.3. This method was included in previous revisions of the GIP but unintentionally omitted in the latest revision. Note that several other sections of the GIP already include or discuss this alternative (e.g., Part II, Section 3.5 and Appendix A.4).