January 31, 2002

Mr. Alexander Marion, Director
Engineering
Nuclear Energy Institute
1776 I Street, NW
Suite 400
Washington, DC 20006-3708

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION ON SEQUAL TOPICAL REPORT "BASIS FOR ADOPTION OF THE EXPERIENCE-BASED SEISMIC EQUIPMENT QUALIFICATION (EBSEQ) METHODOLOGY BY NON A-46 NUCLEAR POWER PLANTS"

Dear Mr. Marion:

The staff of the Mechanical and Civil Engineering Branch has completed the review of the Seismic Experience-based Qualification Owners Group (SEQUAL) Topical Report, "Basis for Adoption of the Experience-based Seismic Equipment Qualification (EBSEQ) Methodology by non A-46 Nuclear Power Plants." The staff has identified areas from the Topical Report for which additional information is needed to complete its review. Please transmit the attached request for additional information to SEQUAL.

If you have any questions please contact me at 301-415-2832.

Sincerely,

/RA/

Peter Wen, Project Manager
Policy and Rulemaking Program
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Project No.: 689
Attachment: As stated

cc: Mr. Ralph Beedle
Senior Vice President
and Chief Nuclear Officer
Nuclear Energy Institute
Suite 400
1776 I Street, NW
Washington, DC 20006-3708

Mr. Alex Marion, Director
Engineering
Nuclear Energy Institute
Suite 400
1776 I Street, NW
Washington, DC 20006-3708

Mr. John Butler, Project Manager
Engineering
Nuclear Energy Institute
Suite 400
1776 I Street, NW
Washington, DC 20006-3708

Mr. Gregory Ferguson, Chairman
Seismic Experience-Based Qualification
Owners Group
Waterford 3 SES
17265 River Road
Kilona, LA 70066

January 31, 2002

Mr. Alexander Marion, Director
Engineering
Nuclear Energy Institute
1776 I Street, NW
Suite 400
Washington, DC 20006-3708

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION ON SEQUAL TOPICAL REPORT "BASIS FOR ADOPTION OF THE EXPERIENCE-BASED SEISMIC EQUIPMENT QUALIFICATION (EBSEQ) METHODOLOGY BY NON A-46 NUCLEAR POWER PLANTS"

Dear Mr. Marion:

The staff of the Mechanical and Civil Engineering Branch has completed the review of the Seismic Experience-based Qualification Owners Group (SEQUAL) Topical Report, "Basis for Adoption of the Experience-based Seismic Equipment Qualification (EBSEQ) Methodology by non A-46 Nuclear Power Plants." The staff has identified areas from the Topical Report for which additional information is needed to complete its review. Please transmit the attached request for additional information to SEQUAL.

If you have any questions please contact me at 301-415-2832.

Sincerely,

/RA/

Peter Wen, Project Manager
Policy and Rulemaking Program
Division of Regulatory Improvement Programs
Office of Nuclear Reactor Regulation

Project No.: 689
Attachment: As stated

Distribution:

ADAMS-PUBLIC	RPRP R/F	
DMatthews/FGillespie	CCarpenter	S West
JStrosnider	GImbro	KManoly
PYChen	CMunson	JFair

ADAMS ACCESSION NO: **ML020310056**
Document Name: G:\RGEB\PCW\SEQUAL-RAI.WPD

OFFICE	RPRP:DRIP	EMEB:DE	EMEB:DE	EMEB:DE	RPRP:DRIP
NAME	PWen	CMunson	KManoly	GImbro	SWest
DATE	01/30/02	01/30/02	01/30/02	01/30/02	01/30/02

OFFICIAL OFFICE COPY

REQUEST FOR ADDITIONAL INFORMATION ON SEQUAL TOPICAL REPORT "BASIS FOR ADOPTION OF THE EXPERIENCE-BASED SEISMIC EQUIPMENT QUALIFICATION (EBSEQ) METHODOLOGY BY NON A-46 NUCLEAR POWER PLANTS," REVISION 0

In the acceptance review letter dated August 13, 2001, the staff detailed specific concerns and the SEQUAL response to these concerns on the use of EBSEQ for non A-46 plants in seven areas:

1. Treatment of concurrent loads
2. Accuracy of the GIP-2 reference spectrum
3. Use of GIP-2 Method A
4. Equipment Class Definitions
5. Use of GIP-2 reference spectrum for all equipment classes
6. Evaluation of subassemblies
7. Use of GIP-2 as a seismic qualification document

As stated in the acceptance review, the staff considers issues #2 and #7 to be resolved by the SEQUAL Topical Report. The following discussion covers each of the remaining issues.

Issue #1 - Treatment of Concurrent Loads

For the issue of concurrent loads, Section 5.3.1 of the Topical Report states that the application of the EBSEQ method covers concurrent normal operating loads and that concurrent accident loads must be addressed by supplemental analysis or testing. The staff interprets SEQUAL's preceding statement to mean that the EBSEQ method does not cover the concurrent loading requirements found in Section VI of Part 100. The Topical Report needs to clarify this issue. In addition, Section 2.2 of the Topical Report indicates that the tank and heat exchanger evaluation criteria specified in Part II, Section 7 of the GIP-2 are applicable. The licensing basis for non A-46 plants may require compliance with ASME Code criteria for the design of tanks and heat exchangers as well as other mechanical equipment such as pumps and valves. As indicated in Section 5.3.1 of the report, the EBSEQ method does not address ASME Code pressure boundary acceptance. However, the ASME Code specifies that earthquake loads shall be taken into account in the design of these components. The ASME Code specifies the combination of earthquake loads with pressure loads in determining the pressure boundary acceptance. Describe how the EBSEQ procedure for tanks and heat exchangers, as well as other mechanical components, assures that the ASME Code criteria, applicable to load combinations that include earthquake loads, is satisfied.

Issue #3 - Use of GIP-2 Method A

Regarding the use of GIP-2 Method A in the EBSEQ method, the arguments present in Section 5.3.3, Section 6, and Appendix C are not sufficient to modify the staff's position that non A-46 plants must use their design basis in-structure response spectra (IRS) to define the seismic demand. As stated in the staff's acceptance review letter, dated August 12, 2001, in the event that licensees believe, as shown in Appendix C of the Topical Report, that there were overly conservative assumptions made in the development of their design basis IRS, they may submit, via a license amendment request, less conservative spectra. Then, the appropriate comparison between seismic demand and capacity for a seismic experience-based qualification method would be between the plant's IRS and the equipment class capacity spectrum determined from seismic experience.

Issue #4 - Equipment Class Definitions

The EBSEQ methodology proposes to use the same 20 equipment classes as defined for GIP-2. In its acceptance review, the staff noted that the GIP-2 definitions of equipment classes are too broad for use in an experience-based seismic qualification methodology that would be expected to provide a level of confidence comparable to that established from seismic qualification by testing or dynamic analysis, which is currently required by Part 100. As stated in the staff's letter dated August 13, 2001, "... the equipment class definitions, in terms of the equipment physical and dynamic characteristics, must be justified and presented as part of the EBSEQ methodology. The equipment characteristics for each class should include the number of equipment items as well as the average and variance of the equipment parameters. Furthermore, each individual equipment entry should contain the equipment's physical and dynamic characteristics as well as a list of the earthquakes that the equipment has experienced."

Section 3.3.1 of Appendix A to the SEQUAL Topical Report, states that "... it should be noted that data from earthquakes that occurred after about 1985 were not available at the time that the GIP was being prepared, reviewed, and accepted. Attachment E contains a listing of those earthquakes and database facilities that can be used to establish representation in the GIP earthquake experience equipment classes."

To ensure that the earthquake experience database used for EBSEQ meets the standard and level of confidence required for a seismic qualification methodology, as opposed to seismic adequacy verification, the staff requests that SEQUAL provide the detailed documentation relating to the earthquake experience data for each class of equipment for staff review from those post 1985 earthquakes. The equipment data documentation should consider the staff's comments stated above and the design attributes presented in Table 3-1 of the EBSEQ methodology (Appendix A), to either confirm the validity of the definitions of each earthquake-experience-equipment class given in GIP-2, or redefine the equipment class definition as well as the associated equipment capacity for each type of equipment as appropriate.

In addition to seismic experience data, the EBSEQ method also proposes to use test experience, which are shake table tests by utilities, equipment vendors, and test laboratories. The staff requests further information as to how this test experience will be used in conjunction with the earthquake experience data to define equipment capacity. Specifically, will equipment classes have separate capacities derived from testing experience, as was the case for GIP-2?

Issue #5 - Use of Reference Spectrum for All Equipment Classes

Regarding the continued use of the GIP-2 reference spectrum to represent the seismic capacity of all of the equipment classes for EBSEQ, the staff requests that SEQUAL determine a unique seismic capacity spectrum for each equipment class using the equipment data from post 1985 earthquakes. The seismic capacity spectrum for each class should be determined using the proposed ASME QME methodology. In the event that each equipment class capacity spectrum entirely envelopes the GIP-2 reference spectrum, then the GIP-2 reference spectrum may continue to be used to represent the seismic capacity of all of the equipment classes for EBSEQ.

Issue #6 - Evaluation of Subassemblies

On the issue involving the evaluation of subassemblies, one of the additional requirements for the EBSEQ method in Section 5.3.6 of the Topical Report is that,

> If a part is required to perform a safety function, its seismic adequacy must be verified by demonstrating that it is represented in the GIP equipment classes or else a part-specific evaluation must be performed using GERS or part-specific qualification data. It is specifically required in Section 4.4.1(b) of the EBSEQ procedure that a part-specific design difference evaluation be performed.

Since the staff stated in the acceptance review that the use of Generic Equipment Ruggedness Spectra (GERS) is inappropriate, SEQUAL has informally communicated to the staff its intention of deleting references to the GERS from the topical report. Please clarify SEQUAL's intention on this issue. In addition, regarding the evaluation of subassemblies, the staff requests that SEQUAL

- List the types or classes of equipment that SEQUAL intends to apply the "rule of the box" (e.g., limited to electrical cabinets and enclosures only?) and define the scope of "rule of the box" for each type or class of equipment.

- Provide detailed limitations of the use of "rule of the box" for seismic qualification of parts/subassemblies for each class of equipment where the rule applies. For example, for equipment installed in the same foundation mat (e.g., diesel generators) state how the "rule of the box" applies to the equipment and the subcomponents in the host equipment.

In addition to the above seven issues discussed in the acceptance review, the staff requests the following additional information.

1. Section 2.2 of the report describes the specific limitations of the EBSEQ method. One limitation is that the procedure is not applicable to low-cycle, fatigue-sensitive items (e.g., items shown to be affected by prior Operating Basis Earthquake cycles), as defined in the EBSEQ. The intent of this limitation is not clear. Equipment designed to meet the requirements of 10 CFR Part 100, Appendix A must be capable of withstanding a specified number of Operating Basis Earthquake (OBE) events (generally five OBEs) and a Safe Shutdown Earthquake event and remain functional. Explain the evaluation performed to insure that equipment covered by the EBSEQ procedure are capable of withstanding the number of earthquake events specified in the licensing basis criteria for non A-46 facilities while remaining functional. Provide specific examples for each equipment class that demonstrates that the functionality of the equipment is not sensitive to the number of earthquake events.

   Section 4.2.2.7 of the EBSEQ report indicates that the GIP procedure for the fatigue evaluations of cable tray and conduit rod supports are an integral part of the EBSEQ method. The inclusion of GIP procedure for the fatigue evaluation of cable tray and conduit rod supports is not consistent with the limitation stated in Section 2.2 that the EBSEQ procedure is not applicable to fatigue sensitive items.

2. 10 CFR Part 100, Appendix A requires that structures, systems and components be designed to withstand the vibratory motions associated with the safe shutdown earthquake and operating basis earthquake, including the applicable concurrent accident and operating loads, and remain functional. The GERS spectra presented in the GIP indicate that some equipment may have a lower capacity if it is required to function during an earthquake (e.g., motor control centers). It is logical to conclude that similar functional limitations may exist for non-GERS equipment in the experience database. Although equipment functionality has been discussed in references such as the SSRAP report, no specific criteria have been given for determining whether all of the equipment in the database remained functional during the earthquakes. Discuss the measures taken to assure that all equipment in the experience data base functioned during and after the earthquake. Provide specific procedures for each equipment class that were used to verify the functionality of the equipment included in the experience data base.

3. Appendix B of the EBSEQ report contains an evaluation of the risk significance of seismic qualification using the EBSEQ approach. The risk evaluation is based, in part, on equipment capacity factors presented in the referenced paper by Salmon and Kennedy (1994), "Meeting Performance Goals by the Use of Experience Data." The 1.4 factor used for the testing qualification is applied an assumed site SSE ZPA of .15g in order to derive a median capacity for components qualified by test. This results in a median capacity of the tested components being lower than the median capacity of components that are not tested (capacity based on EBSEQ method). The staff considers this result illogical. Use of equipment capacity factors found in the literature with arbitrary spectra values does not provide a meaningful estimate of median capacity. The median equipment capacity for testing qualification should be based on the enveloped floor response spectra that is used to test the equipment and not the arbitrarily assumed site value used in the study. This would result in a much higher median capacity for most of the tested equipment than for the equipment qualified by the EBSEQ method. This fact is illustrated by Figures 2 and 3 in the referenced Salmon and Kennedy paper. Figure 2 provides the GIP spectra which provides the basis for the median capacity derived from the EBSEQ procedure. Figure 3 provides examples of GERS spectra which are collections of actual test response spectra. It is clearly evident from comparison of the two figures that the tested equipment is qualified to much higher spectral accelerations than the EBSEQ spectra. This is a serious flaw in the risk assessment. The risk study should be revised using estimates of median capacities based on the actual test inputs. Provide the results of a revised risk study based on median capacities for tested equipment derived from actual equipment test spectra. The revised risk study should also consider the cumulative effects of all equipment that may be qualified using the EBSEQ method.

4. Attachments A and B of Appendix A to the SEQUAL Topical Report provide a checklist for seismic qualification of new and replacement equipment (Attachment A) and parts (Attachment B) using the EBSEQ methodology. Checklist item 5 in Attachment A and item 7 of Attachment B address the design differences between the candidate equipment or part and the equipment in the earthquake experience database. However, the design attributes listed for comparison in the Attachment A and B checklists are generally not documented and not available in the earthquake experience database. As such, the comparison and evaluation of the design attributes for the new and replacement equipment or parts is ambiguous. In the absence of adequate equipment attributes in the earthquake experience database, justify the comparisons called for by the checklists for new and replacement equipment and parts.

5. Section 3.2 of the EBSEQ report discusses compliance plant licensing bases. The discussion indicates that, "By adding the EBSEQ methodology to the SAR, it is not the objective that plant specific commitments, related to existing licensing basis SEQ methods would change since the proposed change is to add an alternative, acceptable SEQ method." The licensing basis for non A-46 plants may commit to follow Standard Review Plan (SRP) Sections 3.10 and 3.11, and may require compliance with IEEE Std. 344-1975 and IEEE Std. 323-1974 (endorsed with exceptions by Regulatory Guide 1.89). In accordance with SRP Section 3.10.II.1.c (related to seismic qualification of equipment), for plants whose construction permit SER is dated July 1, 1974, or later, the seismic and dynamic testing portion of the overall qualification of Class 1E equipment should be performed in its proper sequence as delineated in Section 6.3.2 of IEEE Std. 323-1974. Describe how the EBSEQ procedure for Class 1E equipment assures that the IEEE-Std. 344-1975 and IEEE Std. 323-1974 criteria, as related to the seismic qualification of Class 1E equipment in the test sequence, are satisfied.

6. In Section 5 of Appendix A of the Topical Report, References 18, 19, and 20 are missing. In addition, References 10,15, and 16 in Section 4.4.2 are incorrect, Attachment D in Section 3.1.1 should be Attachment C, and Attachment E in Section 3.3.1 should be Attachment D. Provide the appropriate corrections to the Topical Report.