

December 20, 2002

MEMORANDUM TO: Christopher I. Grimes, Program Director  
Policy and Rulemaking Program  
Division of Regulatory Improvement Programs  
Office of Nuclear Reactor Regulation

FROM: Peter C. Wen, Project Manager */RA/*  
Policy and Rulemaking Program  
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SUBJECT: SUMMARY OF DECEMBER 4, 2002, MEETING WITH THE NUCLEAR  
ENERGY INSTITUTE REGARDING EXPERIENCE-BASED SEISMIC  
EQUIPMENT QUALIFICATION METHODOLOGY

On December 4, 2002, the NRC staff held a public meeting with representatives of the Nuclear Energy Institute (NEI) and the Seismic Experience-Based Qualification (SEQUAL) Owners Group to discuss issues related to the experience-based seismic equipment qualification (EBSEQ) methodology. Attachment 1 lists attendees at the meeting.

#### 1. Background

In 1992, under unique licensing basis and licensing commitments, the staff approved industry's submittal of Generic Implementation Procedure, Revision 2 (GIP-2) for licensees to follow in the implementation program for resolution of Unresolved Safety Issue A-46 (Verification of Seismic Adequacy of Mechanical and Electrical Equipment in Operating Reactors). The NRC accepted GIP-2 for A-46 plants as a verification and enhancement program for equipment that had been seismically qualified to the prevailing requirements before these plants received their licenses. USI A-46 program was implemented to correct certain installation deficiencies and to enhance the overall safety of the plant. There are areas in GIP-2 that the NRC staff does not consider acceptable for use as a seismic qualification method that satisfies the requirements of 10 CFR Part 100. GIP-2 used general earthquake experience for demonstrating seismic equipment adequacy. Industry believes that as it gains experience with the GIP-2 application, the same experience-based approach could be extended to the seismic equipment qualification for non-A46 plants (about 45 plants). There have been extensive interactions between the staff and industry groups on the subject of using an experience-based method for non-A46 plants since 1997:

- On April 18, 2001, NEI formally requested the staff to review a SEQUAL topical report, "Basis for Adoption of the Experience-Based Seismic Equipment Qualification Methodology by Non-A46 Nuclear Power Plants" (ADAMS Accession # ML011150260).
- The staff issued a letter dated August 13, 2001, describing the results of the staff's acceptance review of the topical report and areas of concern (ADAMS Accession # ML012260356).
- On January 31, 2002, the staff issued a request for additional information (RAI) to NEI regarding the topical report review (ADAMS Accession # ML020310056).
- NEI/SEQUAL's response to the staff's RAI was documented in a letter to the staff dated April 22, 2002 (ADAMS Accession # ML021130665).
- On May 30, 2002, the staff met with NEI/SEQUAL to discuss the issues raised in the staff's RAI and the industry's response. (Refer to ADAMS Accession # ML021630088 for the meeting summary).

## 2. Meeting Purpose

The purpose of this meeting was for the NRC and NEI/SEQUAL to continue discussion of the SEQUAL topical report. The major discussion topics were: NRC feedback to SEQUAL's April 22, 2002, RAI response, Class Definition and Capacity Spectra for GIP Equipment Class #7 (Fluid Operated Valves - FOVs), and Functionality Assessment of FOVs based on analysis.

## 3. NRC Feedback to SEQUAL's April 22, 2002, RAI Responses

The staff presented its initial assessment of SEQUAL's April 22, 2002, response to the RAI questions. The staff's presentation material is included in Attachment 2. The issues raised by staff are as follows:

- Issue 1: Treatment of Concurrent Loads
- Issue 2: Number of Response Spectra Used to Create Reference Spectrum
- Issue 3: Use of GIP-2 Method A
- Issue 4: Equipment Class Definitions
- Issue 5: Use of Reference Spectrum for all Equipment Classes
- Issue 6: Evaluation of Subassemblies
- Issue 7: Experience-Based Method
- Issue 8: Fatigue-Sensitive Items
- Issue 9: Equipment Functionality During Earthquake
- Issue 10: Risk Significance of EBSEQ Approach
- Issue 11: New and Replacement Equipment
- Issue 12: IEEE 323 Test Sequence Requirements

These issues were discussed to the extent necessary for SEQUAL representatives to understand the issues raised by the NRC staff. It was agreed that detailed discussions of these issues would be deferred to a later time.

## 4. Class Definition and Capacity Spectra for Fluid Operated Valves

Dr. Paul Baughman, a SEQUAL representative, presented the results of SEQUAL's work on GIP Equipment Class #7, Fluid Operated Valves, to demonstrate that this equipment class could be validated using a draft criteria that the staff was involved in its development as part of the revision to the American Society of Mechanical Engineers-Qualification of Mechanical Equipment (ASME-QME) standard. His presentation material is attached as Attachment 3.

Dr. Baughman discussed the general characteristics and failure modes of FOVs and the scope of the characteristics and prohibited features (caveats) of the GIP FOV class definition. He indicated that the earthquake data collected for this evaluation was taken from 180 independent FOV samples at 31 facilities with 3 types of actuators, including diaphragm-operated valves, piston-operated valves, and spring-opposed relief valves. Dr. Baughman discussed the damage or malfunction found at the valves of data samples and showed that the GIP caveats prohibit use of such valves (Slides 21- 23). Dr. Baughman concluded that the FOV data supports the GIP definition of Equipment Class #7. Dr. Baughman then presented the results

of the capacity spectrum calculation for 32 of the FOVs, using the ASME-QME draft criteria. The results indicated that the weighted average ground response spectrum closely matched or was higher than the GIP Reference Spectrum, thus showing the conservatism of GIP Reference Spectrum.

NRC staff indicated that they would review the data presented for the FOV equipment class; however, they also expressed the importance for a similar review of the data for the other 19 GIP equipment classes.

##### 5. Functionality Assessment of FOVs Based on Analysis

Dr. Paul Baughman then presented the functionality assessment of FOVs based on analysis rather than actual earthquake experience data. He described an analytical approach used by SEQUAL to demonstrate the plausibility of valve functionality during seismic events. His presentation material is attached as Attachment 4.

Dr. Baughman showed that for 16 representative FOVs near the bounds of the GIP operator height-to-pipe diameter limits, the seismic loads would not cause the valve stem to bind and that the yoke stresses are low. This analysis was based on applying a 3g static load in three directions that were combined using the square root sum of the square (SRSS) techniques. He stated that the 3g load is well above the peak of the GIP Reference Spectrum (1.2g). The results of SEQUAL's calculation indicate that (1) the calculated yoke stresses were all below yield stress (Slide 23); (2) the fundamental natural frequency of these yoke-supported operators was above 15 Hz (Slide 24); and (3) the clearance between the stem and bonnet bushing was greater than the stem deflection (Slide 25). Therefore, Dr. Baughman concluded that the fluid operated valves that are bounded by the GIP criteria would remain functional during the strong motion of an earthquake, which are generally subject to smaller dynamic loads than 3g over the entire frequency range.

Dr. Baughman also discussed the operating basis earthquake (OBE) aging issue, and stated that OBE aging is not a concern for the FOVs covered by the GIP. This conclusion is based on the following factors:

- The GIP caveats preclude use of low cycle fatigue sensitive material and designs.
- The analyses discussed above show that the stresses for the GIP capacity are below yield stress. Therefore, for OBEs that are 1/2 of the GIP capacity, the stresses are below 1/2 the elastic limits.
- A number of the FOVs covered by the earthquake experience data had been exposed to multiple earthquakes. There were no reports that any of these valves exhibited subsequent failures attributed to fatigue.

The NRC staff indicated that they would review the material presented above to determine if it adequately addresses their concerns.

## 6. Closing Remarks

### SEQUAL:

- SEQUAL believes that the NRC staff's assessment (i.e. Attachment 2) appeared to repeat the RAI questions and did not consider SEQUAL's April 22, 2002, RAI response letter.
- SEQUAL would like to receive feedback on the regulatory position presented in the topical report.
- SEQUAL believes that the conclusions reached for the FOV equipment class study (i.e. the reevaluation of the experience data using the ASME-QME criteria) demonstrates the validity of the existing GIP criteria. The ASME-QME was developed well after the GIP was originally developed. SEQUAL believes that additional efforts to cover the other 19 equipment classes are unnecessary.
- SEQUAL indicated that industry has spent over \$10 million to develop the GIP methodology. This methodology has been approved by the NRC via supplemental safety evaluation report No. 2 (SSER No. 2) for verifying seismic adequacy of equipment in A-46 plants (over half of the nuclear plants in the U.S.). SEQUAL contends that the GIP-2 meets the purpose of the NRC regulations relevant to equipment seismic adequacy including Part 100. Consistent with the NRC goals of maintaining safety and reducing unnecessary regulatory burden, SEQUAL believes that this GIP methodology should also be available for the non-A46 plants.

### NRC:

- The staff will incorporate its overall assessment of the material presented by SEQUAL during the meeting into its response to SEQUAL's April 22 letter. The staff's written response is currently projected for January 2003.
- The staff believes that the demonstration for FOV equipment class should be extended to cover the other 19 GIP equipment classes. Similarly, SEQUAL's use of a single spectrum to represent the capacity for all of the equipment classes should be justified for each of the other 19 GIP equipment classes.
- The staff reiterated that for non-A46 plants, SEQUAL's experience-based seismic methodology should meet the Part 100 criteria, and consistent with the draft criteria in the ASME-QME standard.

Representatives of the NRC and the industry agreed that this meeting had been useful for the exchange of information on the discussion topics. Having completed discussion of the agenda items, the meeting was adjourned.

Project No. 689

Attachments: As stated. (ADAMS Accession # ML023520554)

cc w/atts: See list

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cc w/atts: See list

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**ADAMS Accession Number: ML023570101**

OFFICE	PM:RPRP	SC:EMEB	BC:EMEB	SC:RPRP
NAME	PWen	KManoly	EImbro	SWest
DATE	12/16/2002	12/20/2002	12/20/2002	12/20/2002

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**NRC-NEI/SEQUAL MEETING REGARDING EXPERIENCE-BASED  
SEISMIC EQUIPMENT QUALIFICATION METHODOLOGY**

**LIST OF ATTENDEES  
DECEMBER 4, 2002**

<b><u>NAME</u></b>	<b><u>ORGANIZATION</u></b>
Gene Imbro	NRR/DE/EMEB
Kamal Manoly	NRR/DE/EMEB
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John Fair	NRR/DE/EMEB
Clifford Munson	NRR/DE/EMEB
Gary Hammer	NRR/DE/EMEB
Frank Cherny	RES/DET
Peter Wen	NRR/DRIP/RPRP
John Butler	NEI
James Fisicaro	Duke-Energy
John Richards	Duke-Energy
Richard Starck	MPR
Paul Baughman	ABS Consulting
Deann Raleigh	Scientech LIS
Mostafa Ahmed	Westinghouse