Enclosure 9

Edwin I. Hatch Nuclear Plant
Request to Implement an Alternative Source Term

Unit 1 Seismic Verification of Potential Secondary Containment
Bypass Leakage Paths Terminating at the Main Condenser

EDWIN I. HATCH NUCLEAR PLANT UNIT 1

Seismic Verification of Potential Secondary Containment Bypass Leakage Paths Terminating at the Main Condenser

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SUMMARY

As part of a full scope implementation at Plant Hatch of an alternative source term (AST) in accordance with Regulatory Guide (RG) 1.183, it is necessary to credit holdup and deposition in the main condenser of any primary containment leakage that bypasses the secondary containment and is routed to the main condenser. Such crediting of deposition for bypass leakage is allowed on a case-by-case basis per section 4.5 of RG 1.183 Appendix A.

As part of the Plant Hatch Unit 1 MSIV Alternate Leakage Treatment Path Seismic evaluation the main condenser is credited for holdup and deposition of MSIV leakage in accordance with BWROG Topical Report NEDC-31858P-A (Reference 1). In order to credit deposition for bypass leakage in the main condenser, it is assumed the piping routing the bypass leakage to the main condenser is capable of performing its required function during and after a safe shutdown earthquake, which is for this plant the Plant Hatch Unit 1 Design Basis Earthquake (DBE).

This report documents the seismic adequacy review of piping which routes secondary containment bypass leakage to the main condenser. Given the similarity of the application, the review was performed in accordance with NEDC-31858P-A (Reference 1) and its associated NRC SER (Reference 2). The review consists of earthquake experience data comparison, field walkdowns to screen for known seismic vulnerabilities and undesirable conditions that could lead to damage or failure in an earthquake and analytical review of selected piping systems and supports.

The results of the database comparisons, walkdowns and analytical review are that the evaluated bypass leakage piping and supports meet the seismic criteria. The piping is concluded to have sufficient seismic margin to maintain pressure integrity during and following a seismic event at the plant.

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1. INTRODUCTION

This report describes the work performed for seismic verification of bypass leakage piping at Hatch Unit 1. The work is in accordance with recommendations by the General Electric BWR Owner's Group (BWROG) Report for increasing MSIV leakage rate limits, and eliminating leakage control systems (Reference 1) and the associated NRC SER (Reference 2). The seismic verification includes seismic experience database comparisons; walkdown evaluation of piping, components and supports, and analytical review of selected piping systems and supports. The intent of the walkdowns is to identify specific conditions that might be associated with poor piping and/or component seismic performance. Walkdowns are focused toward identification of the following areas:

- Piping, pipe support and equipment seismic vulnerabilities, such as excessive span, heavy unsupported components, non-ductile piping or support material, high localized stresses, severe corrosion, and poor anchorage,

- Seismic interaction caused by failure and falling (II/I) or by displacement and proximity impact

- Differential displacement and anchor displacement of structures, equipment and piping

- Seismic verification of boundary components, if any

- Seismic verification of valves, if any required to operate to establish the flowpath or isolate a boundary.

The scope of the effort is described in Section 2. Results of the work are described in Sections 3 through 8.

The seismic verification followed the guidelines of BWROG Report NEDC-31858P-A (Reference 1), the NRC Safety Evaluation Report (SER) (Reference 2), and previous MSIV Leakage submittals by similar vintage BWR plants, including Plant Hatch Unit 2.

The Plant Hatch Unit 1 MSIV Alternate Leakage Treatment Path Seismic evaluation uses this method to support increasing the allowable MSIV leakage rate for Hatch Unit 1. That MSIV evaluation provides the seismic evaluation of the Unit 1 condenser and the Unit 1 Turbine Building and therefore is not explicitly covered in this report other than by reference.

2. SCOPE

The bypass leakage piping in the scope consists of the following lines:

- 1E41-1"-EME, HPCI steam drain in the turbine building, from TA line wall penetration (1T43-H010A) at elevation 122'-0" in the East Cable Way, through the condenser bay, through check valve F500 to the main condenser nozzle at elevation 129'-4".

- 1E51-1"-EEE, RCIC steam drain , from TA line wall penetration at elevation 118'-9" (penetration 1T43-H015A) in the control building, through the East Cable Way in the turbine building, through the condenser bay, through check valve F500 to the main condenser nozzle at elevation 129'-4".

- 1G31-4"-HEE , RWCU blowdown line to condenser in the turbine building, from the TA line wall penetration at elevation 156'-2", through the condenser bay to the main condenser nozzle at elevation 122'-2"

The majority of the piping scope of work is located in the Unit 1 turbine building, primarily in the condenser bay below the operating floor. However, the RCIC line extends into the Control Building just above the elevation 112' floor.

The bypass leakage piping in the scope of work provides a direct flowpath to the main condenser of any primary containment leakage that bypasses the secondary containment. The piping does not have any branch lines. Therefore, there are no boundary components or isolation valves requiring seismic verification. Also, the piping does not contain any valves that must operate (open or close) in order to provide a flowpath to the main condenser.

3. SEISMIC EXPERIENCE DATABASE COMPARISONS

The seismic experience data were derived from an extensive database on the performance of power plants and industrial facilities in past strong-motion earthquakes. These performance data have been compiled by ABS Consulting (formerly EQE) for the Seismic Qualification Utility Group (SQUG), the Electric Power Research Institute (EPRI) and others, and include over 100 facilities in more than 60 earthquakes that have occurred around the world from 1934 to present. Of particular interest for the scope of work herein is the performance of non-seismically analyzed main steam piping, related components and supports, and condensers.

The BWROG Report (Reference 1) summarizes data on the performance of main steam piping and condensers in past strong-motion earthquakes and compares these piping and condensers with those in typical U.S. GE Mark I, II, and III nuclear plants. The earthquake experience data and similarity comparisons are then used to draw conclusions on how the GE piping and condensers would perform in a Design Basis Earthquake (DBE).

This section presents experience database comparisons that are plant specific to Plant Hatch Unit 1. The purpose of this review is to ensure the vibratory ground motion experienced at each of the facilities with piping and equipment being used as a surrogate for similar piping and equipment at Hatch, met or exceeded the Hatch ground motion.

3.1 Hatch Ground Response

Seismic demand for the piping system evaluation is taken as one-half of the turbine building Seismic Margin Earthquake (SME) in-structure response spectra (ISRS) from Reference 12. The full SME ISRS are for an SME ground motion having a pga of 0.3g and a spectrum shape based on NUREG/CR-0098 median centered spectra. The ISRS accepted for resolution of USI A-46 for Plant Hatch was the ½ SME ISRS. Therefore the acceleration values from turbine building spectra in Reference 12 have been multiplied by ½ for input to the piping system evaluation. The Hatch ½ SME median centered ground response spectrum is plotted in Figure 3-1. It should be noted that the Hatch Unit 1 Design Basis Earthquake is enveloped by the Hatch ½ SME ground spectrum as shown in Figure 3-1.

3.2 Seismic Ground Motions

Ground motion estimates of 13 database sites have been reviewed and accepted by the NRC staff for inclusion in the BWROG earthquake experience database, and are presented in the associated NRC SER (Reference 2). Comparisons of the ground response spectra of selected database facilities with the Hatch ½ SME ground spectrum (Section 3.1) were made to establish applicability of the BWROG experience-based methods for demonstrating seismic ruggedness of the in-scope bypass leakage piping.

A composite comparison of the ground response spectra of selected earthquake experience database facilities (as accepted and shown in Reference 2) with the Hatch Unit ½ SME ground spectrum (from Section 3.1) is shown in Figure 3-1. The selected ground motions include the following nine sites from among the thirteen database facilities reviewed and accepted in the NRC SER (Ref 2).

- Grayson Power Plant (Glendale) – Horizontal direction
  1971 San Fernando Earthquake (M6.6)

- Las Ventanas Power Plant – Horizontal direction
  1985 Chile Earthquake (M7.8)

- Commerce Refuge to Energy Plant (LA Bulk Mail) – Horizontal direction
  1987 Whittier Narrows Earthquake (M5.9)

- Coolwater Power Plant – Horizontal direction
  1992 Landers Earthquake (M7.3)

- Burbank Power Plant – USGS estimate
  1971 San Fernando Earthquake (M6.6)

- PALCO Cogeneration Plant (Rio Dell) – Horizontal direction
  1992 Petrolia Earthquake (M6.9)

- El Centro Steam Plant – Horizontal direction
  1979 Imperial Valley Earthquake (M6.6)

- Moss Landing Power Plant – PG&E estimate
  1989 Loma Prieta Earthquake (M7.1)

- Valley Steam Plant – USGS estimate
  1971 San Fernando Earthquake (M6.6)

In general, the earthquake experience database sites have experienced strong ground motions that are in excess of the Hatch Unit 1 ½ SME and DBE in the frequency range of interest. All the database site ground motions shown in Figure 3-1 envelope the Hatch Unit 1 ½ SME and DBE ground spectrum by large factors in the frequency range above slightly less than 1 Hz.

Based on the above observations and comparisons, the Hatch Unit 1 ½ SME and DBE is generally bounded by those of the earthquake experience database sites at the frequencies of interest. Hence, the use of the earthquake experience-based approach at Hatch Unit 1 for demonstrating seismic ruggedness of non-seismically analyzed bypass leakage piping is appropriate.

3.3 Piping

Main steam piping and condensers in the earthquake experience database have exhibited substantial seismic ruggedness, even when they are typically not designed to resist earthquakes. This is also a common conclusion in studies of this type on other plant commodities such as welded steel piping in general, anchored equipment such as motor control centers, pumps, valves, structures, etc. With limited exceptions, normal industrial construction and equipment typically have substantial inherent seismic ruggedness, even when not designed for earthquakes.

No failures of main stream piping have been seen. Anchored condensers have also performed well in past earthquakes with damage limited to minor internal tube leakage.

The BWROG Report (Reference 1) contains detailed discussions and comparisons of main steam piping and condenser design in several earthquake experience database sites and example GE Mark I, II and III plants in the U.S. The general conclusions of these comparisons are as follows:

- GE plant designs are similar to or more rugged then those in the earthquake experience database that exhibited good earthquake performance.
- The possibility of significant failure in GE BWR main steam piping or condensers in the event of an eastern U.S. design basis earthquake is highly unlikely.
- Any such failure would also be contrary to a large body of historical earthquake experience data, and thus, unprecedented.

Plant-specific comparisons of the condensers at Hatch with those in the selected earthquake experience database are discussed in detail in Reference 3, and discussed in Section 6.0 of this document. Plant-specific comparisons of the Hatch Unit 1 in-scope bypass leakage piping with piping included in the selected earthquake experience database are described below.

The piping at Hatch was fabricated and installed using industry standard practice generally complying with the standards of the B31.1 piping code (Reference 8). Thus the bypass leakage piping at Hatch is consistent in design practice and construction with the piping results from facilities in the earthquake experience database. Table 3-1 presents a summary of piping data (sizes, schedules, materials, etc.) for the in-scope bypass leakage piping. The materials of construction for this Unit 1 piping are carbon steel of A106 Grade B or A53 composition, or low to intermediate alloy steel of A335 Grade P22 composition. All the materials of construction are consistent with piping materials found within the experience database. Table 3-2 presents similar data for facilities in the earthquake experience database. Table 3-3 presents a summary comparison of the same data for Hatch Unit 1 and facilities in the earthquake experience database.

Table 3-3 shows that pipe sizes and D/t ratios[1] for the Plant Hatch bypass leakage piping fall within the limits of the pipe sizes and D/t ratio for the earthquake experience database piping.

The pipe materials, and associated allowable stress values from B31.1 (Reference 8), which represent the Hatch in-scope bypass leakage piping are presented in Table 3-3. Associated materials and allowable stresses for representative piping within the earthquake database are presented in Table 3-3. From Table 3-3 it can be seen that the piping materials used for the fabrication of the Hatch bypass leakage piping are comparable with piping within the earthquake database.

[1] Ratio of pipe diameter (D) to pipe wall nominal thickness (t).

Therefore, piping results from the database, with consideration of specific installation configuration concerns addressed through detailed walkdown (Section 4), can reasonably be applied to Plant Hatch Unit 1 bypass leakage piping.

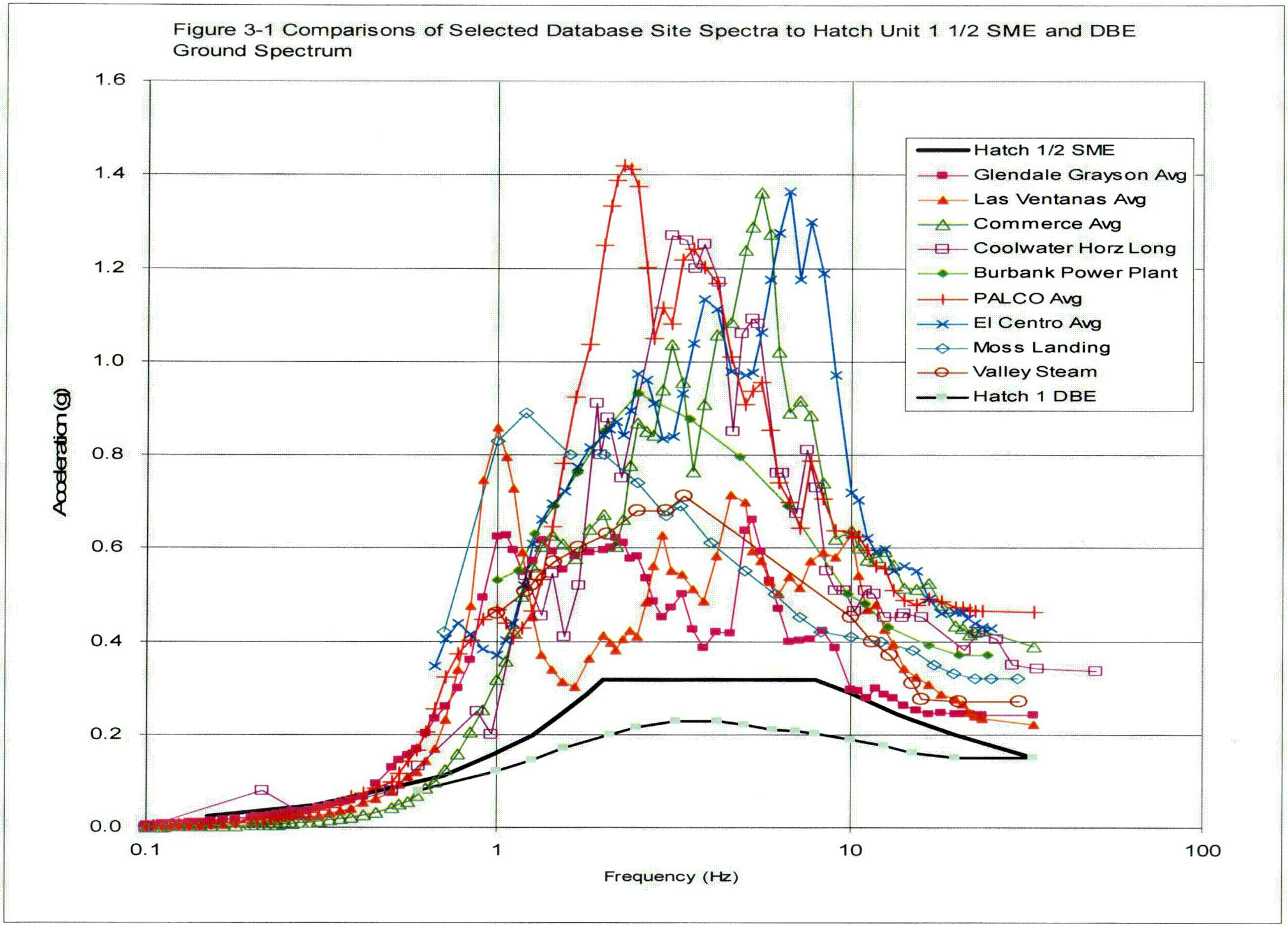

Figure 3-1 Comparisons of Selected Database Site Spectra to Hatch Unit 1 1/2 SME and DBE Ground Spectrum
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Acceleration (g)
0.1
1
10
100
Frequency (Hz)
Hatch 1/2 SME
Glendale Grayson Avg
Las Ventanas Avg
Commerce Avg
Coolwater Horz Long
Burbank Power Plant
PALCO Avg
El Centro Avg
Moss Landing
Valley Steam
Hatch 1 DBE

Figure 3-1 Comparisons of Selected Database Site Spectra to Hatch Unit 1 1/2 SME and DBE Ground Spectrum

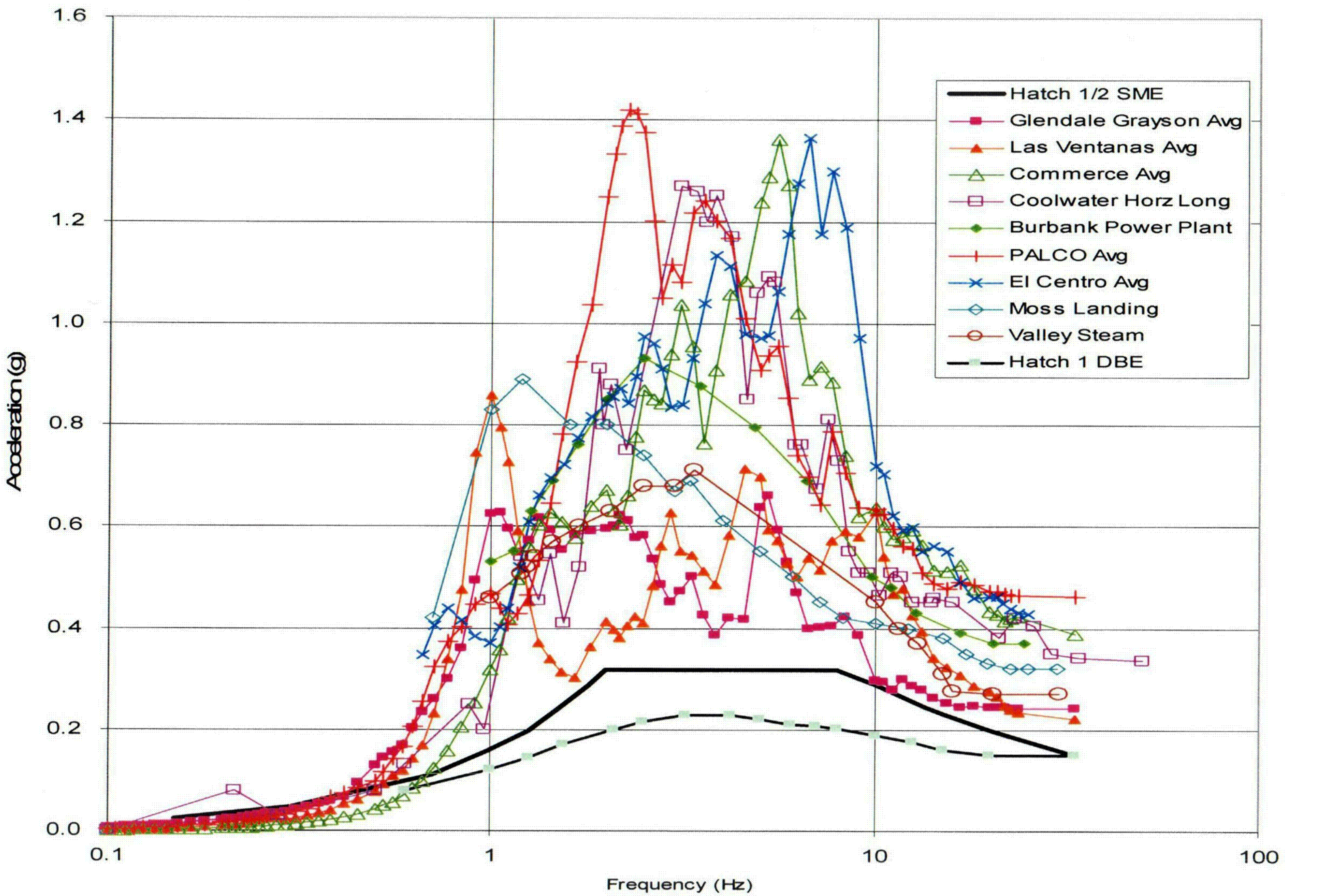

Table 3-1
Design Basis Data at Hatch Unit 1 for Bypass Leakage Piping

Piping Description	Pipe Size (NPS)	Pipe O.D. (in)	Pipe Sch	Wall thick (in)	D/t	Piping Material	Piping Design Code
HPCI System	1	1.315	160	0.25	5	A335 Gr. P22	B31.1
RCIC System	1	1.315	80	0.179	7	A335 Gr. P22	B31.1
RWCU System	4	4.5	40	0.237	19	A106 Grade B or A53	B31.1

Table 3-2
Seismic Experience Database Design Data

Facility	Pipe Size (NPS)	Pipe O.D. (inch)	Pipe Schedule	Wall Thickness (inch)	D/t
Valley Steam Plant Units 1 & 2	24	24.0	20	0.375	64
	20	20.0	20	0.375	53
	18	18.0	30	0.437	41
	16	16.0	30	0.375	43
	14	14.0	30	0.375	37
	12	12.75	40	0.406	31
	12	12.75	30	0.330	39
	10	10.75	160	1.125	10
	8	8.625	160	0.906	10
	6	6.625	40	0.280	24
	4	4.5	160	0.531	8
	4	4.5	40	0.237	19
	3	3.5	160	0.437	8
	3	3.5	80	0.300	12
	3	3.5	40	0.216	16
	2	2.375	160	0.343	7
	2	2.375	40	0.154	15
	1 ½	1.90	160	0.281	7
	1 ½	1.90	40	0.145	13
	1	1.315	40	0.133	10
	¾	1.05	160	0.218	5
	¾	1.05	40	0.113	9

Table 3-2
Seismic Experience Database Design Data
(cont'd)

Facility	Pipe Size (NPS)	Pipe O.D. (inch)	Pipe Schedule	Wall Thickness (inch)	D/t
El Centro Steam Plant	20	20.0	STD	0.375	53
	18	18.0	160	1.781	10
	18	18.0	XS	0.500	36
	18	18.0	STD	0.375	48
	14	14.0	40	0.437	32
	14	14.0	STD	0.375	37
	12	12.75	160	1.312	10
	12	12.75	STD	0.375	34
	10	10.75	40	0.365	29
	8	8.625	160	0.906	10
	8	8.625	120	0.718	12
	8	8.625	40	0.322	27
	6	6.625	120	0.562	12
	6	6.625	40	0.280	24
	4	4.50	80	0.337	13
	4	4.50	40	0.237	19
	3	3.50	160	0.437	8
	3	3.50	80	0.300	12
	3	3.50	40	0.216	16
	2	2.375	160	0.343	7
	2	2.375	80	0.218	11
	2	2.375	40	0.154	15
	1 ½	1.90	160	0.281	7
	1 ½	1.90	80	0.200	10
	1 ½	1.90	40	0.145	13
	1	1.315	80	0.179	7
	1	1.315	40	0.133	10
	¾	1.05	80	0.154	7
	¾	1.05	40	0.113	9

Table 3-2
Seismic Experience Database Design Data
(cont'd)

Facility	Pipe Size (NPS)	Pipe O.D. (inch)	Pipe Schedule	Wall Thickness (inch)	D/t
Moss Landing Units 1, 2 & 3	16	16.0	--	1.394	11
	12	12.75	--	1.148	11
	8	8.625	160	0.906	10
	8	8.625	30	0.277	31
	6	6.625	160	0.562	12
	6	6.625	40	0.280	24
	4	4.50	160	0.531	8
	4	4.50	80	0.337	13
	4	4.50	40	0.237	19
	3	3.50	160	0.437	8
	3	3.50	80	0.300	12
	3	3.50	40	0.216	16
	2	2.375	160	0.343	7
	2	2.375	80	0.218	11
	2	2.375	40	0.154	15
	1 ½	1.90	160	0.281	7
	1 ½	1.90	80	0.200	10
	1	1.315	160	0.250	5
	1	1.315	80	0.179	7
	¾	1.05	160	0.218	5
	¾	1.05	80	0.154	7

Table 3-2
Seismic Experience Database Design Data
(cont'd)

Facility	Pipe Size (NPS)	Pipe O.D. (inch)	Pipe Schedule	Wall Thickness (inch)	D/t
Moss Landing Units 4 & 5	24	24.0	40	0.687	35
	24	24.0	--	1.066	23
	--	18.8	--	2.287	8
	16	16.0	40	0.500	32
	16	16.0	--	0.902	18
	--	13.2	--	1.668	8
	8	8.625	160	0.906	10
	8	8.625	40	0.322	27
	6	6.625	160	0.562	12
	6	6.625	40	0.280	24
	4	4.50	160	0.531	8
	4	4.50	80	0.337	13
	4	4.50	40	0.237	19
	3	3.50	160	0.437	8
	3	3.50	80	0.300	12
	3	3.50	40	0.216	16
	2	2.375	160	0.343	7
	2	2.375	80	0.218	11
	2	2.375	40	0.154	15
	1 ½	1.90	160	0.281	7
	1 ½	1.90	80	0.200	10
	1 ½	1.90	40	0.145	13
	1	1.315	160	0.250	5
	1	1.315	80	0.179	7
	1	1.315	40	0.133	10
	¾	1.05	160	0.218	5
	¾	1.05	80	0.154	7
	¾	1.05	40	0.113	9

Table 3-2
Seismic Experience Database Design Data
(cont'd)

Facility	Pipe Size (NPS)	Pipe O.D. (inch)	Pipe Schedule	Wall Thickness (inch)	D/t
Moss Landing Units 6 & 7	30	30.0	--	0.632	47
	26	26.0	--	1.128	23
	18	18.0	--	3.444	5
	12	12.75	--	2.444	5
	12	12.75	--	0.601	21
	8	8.625	--	1.650	5
	8	8.625	40	0.322	27
	6	6.625	--	1.268	5
	6	6.625	40	0.280	24
	4	4.50	--	0.861	5
	4	4.50	80	0.337	13
	4	4.50	40	0.237	19
	3	3.50	80	0.300	12
	3	3.50	40	0.216	16
	2 ½	2.875	--	0.550	5
	2 ½	2.875	80	0.276	10
	2 ½	2.875	40	0.178	16
	2	2.375	--	0.519	5
	2	2.375	80	0.218	11
	2	2.375	40	0.154	15
	1 ½	1.90	--	0.428	4
	1 ½	1.90	80	0.200	10
	1 ½	1.90	40	0.145	13
	1	1.315	--	0.301	4
	1	1.315	80	0.179	7
	1	1.315	40	0.133	10
	¾	1.05	160	0.218	5
	¾	1.05	80	0.154	7
	¾	1.05	40	0.113	9
	½	0.84	--	0.210	4
	¼	0.54	--	0.153	4

Table 3-3
Comparison of Hatch Unit 1 Bypass Leakage Piping and Selected Database Piping Parameters

Parameter	Plant Hatch Unit 1	Database Sites
Pipe Diameter (in)	1.315 – 4.5	1.05 – 30.0
Wall Thickness (in)	0.179 – 0.250	0.113 – 3.444
Ratio, Diameter to Thickness (D/t)	5-19	4 to 64
Materials of construction	A106 Grade B A 53 A 335 Grade P22	A 106 Grade B A 182 Grade P22 A 335 Grade P22 Chrome Moly.
Typical B31.1 Allowable Stress Value, S_h (Note1)	12,000 to 15,000 psi	15,000 psi

Notes:

1. Material allowable values presented at room through maximum operating temperatures of the in-scope bypass leakage piping.

4. SEISMIC VERIFICATION WALKDOWN

Very few components of nuclear plant systems are unique to nuclear facilities. Nuclear plant systems include piping, tubing, conduit and many other items that are common components of conventional power plants and industrial facilities. Seismic experience data based methods have been developed that address the question of adequacy of seismic performance of equipment and commodities not designed, procured and installed to current nuclear seismic criteria. By reviewing the performance of facilities that contain equipment similar to that found in nuclear plants, conclusions can be drawn about the performance of nuclear plant equipment during and after earthquake events. Extensive work has been performed documenting the performance of power plant equipment performance and the common sources of seismic damage to equipment and piping (References 1, 6).

Equipment, piping and tubing systems in the seismic experience database have performed very well in earthquakes, even though they have typically been designed for deadweight and operating loads only, with little or no consideration for seismic loads (References 1, 6). Earthquake experience database methods combined with limited analytical review provide the basis for seismic verification of the bypass leakage piping systems identified in Section 2.

The Seismic Review Team (SRT) performing the field walkdown first reviews the installed scope of piping and associated components. Evaluation of piping and equipment designs are performed to assure that installations are representative of database design practice and that components are free of known seismic vulnerabilities. Earthquake experience has identified conditions that have resulted in failure of piping systems and components. The conditions evaluated in this walkdown review include:

- Piping, pipe support and equipment design attributes
- Seismic anchor motion issues
- Seismic interaction issues (II/I and proximity)
- Valve design attributes
- Potential external corrosion indication

4.1 Piping, Pipe Support and Equipment Design Attributes

As part of the walkdown process, the Seismic Review Team reviews the various piping configurations and supports that make up the bypass leakage piping to ensure that the design attributes and conditions are consistent with good design and industry standard practices. The systems are also screened to ensure that they are free from known seismic vulnerabilities identified from earthquake experience data. These design attributes include:

- Piping with dead weight support greatly in excess of B31.1 suggested spans, or tubing with excessive sagging

- Unsupported in-line components.

- Piping constructed of non-ductile materials such as cast iron or PVC.

- Non-standard fittings, or unusual attachments that could cause excessive localized stresses.

- Pipe supports that exhibit non-ductile behavior.

- Presence of severe corrosion.

In addition, anchorage of terminal equipment to piping systems are reviewed for adequacy.

4.2 Seismic Anchor Movement Issues

The experience database includes instances of seismic damage to piping, tubing and supports that were attributed to seismic anchor movement. Damage was the result of excessive movement of terminal and equipment, differential movement between supports in adjacent buildings, and excessive movements imposed on branch lines by flexible headers. These attributes are evaluated during the piping walkdowns.

4.3 Seismic Interaction Issues (II/I and Proximity)

The seismic interaction review is a visual inspection of structures, piping, or equipment adjacent to the components under evaluation. The seismic interaction review evaluates conditions where seismically induced failure (II/I) and displacements of adjacent structures, piping, or equipment (proximity) could adversely affect the required seismic performance of the system and components under consideration.

4.4 Valve Design Attributes

Screening guidelines are provided for active valves that are relied upon to establish the bypass leakage paths or are part of the seismic verification boundary. The guidelines are consistent with the SQUG Generic Implementation procedure (GIP, Reference 5). For the Hatch Unit 1 bypass leakage piping in the scope of this review, there are no active valves.

4.5 Representative Bounding Analytical Review

The team selects representative supports and anchorages to be addressed in a plant-specific seismic evaluation following the walkdown. Special consideration is given to heavily loaded supports or those for which anchorage capacity appears marginal. For piping, the team determines if an enveloping analytical assessment would be appropriate and beneficial. Such a review entails consideration of diversity, complexity and extent of the piping and the areas that comprise the walkdown efforts.

5. BUILDING QUALIFICATION

The bypass leakage piping in the scope of work is located within the Unit 1 turbine building. As part of the seismic verification process of the piping, assurance must be provided that the building will not become a seismic interaction hazard relative to the structural capability and continuing function of the piping.

The documentation of the seismic adequacy of the Hatch Unit 1 Turbine Building is provided in the Unit 1 MSIV Leakage Treatment Path Description and Seismic Evaluation Report (Ref. 3).

The Plant Hatch Control Building is a Seismic Category 1 structure designed for the Hatch DBE and therefore seismically adequate.

6. CONDENSER QUALIFICATION

The condenser is the main collection point for bypass leakage and, as such, forms an integral part of the bypass leakage piping boundary. The condenser is the anchor point for the HPCI, RCIC and RWCU piping in the scope of work. The condenser is required to remain intact and maintain position retention during and after a seismic event.

The documentation of the seismic adequacy of the Hatch Unit 1 Condenser is provided in the Unit 1 MSIV Leakage Treatment Path Description and Seismic Evaluation Report (Ref. 3).

7. WALKDOWN RESULTS AND REVIEW

A walkdown of the piping and support systems described in Section 2 was performed the week beginning February 20, 2006. The results are described below.

The walkdown requirements are specified in ABS Consulting Procedure 1302241-P-002 (Reference 4) which were used in the previous Unit 2 seismic verification of the secondary containment bypass leakage paths terminating at the main condenser. This procedure is included in this report as Attachment A. The seismic review team (SRT) was made up of two SNC personnel who meet the SRT requirements of References 5 and 7. The SRT qualification sheets are included as Attachment B.

The results are documented on walkdown data sheets and compiled into a Southern Nuclear internal calculation. Photographs of typical piping, and support configurations encountered during the walkdowns are included in Attachment C.

The piping and supports are constructed in a manner of similar configuration to piping within the earthquake experience database. The piping supports and anchorage are consistent with good design practice. Supports are in good condition with no evidence of excessive corrosion or missing parts. Piping spans are, generally, in accordance with requirements for B31.1 deadweight spans, and no design attributes of the piping were noted which have resulted in poor seismic performance. One support for the HPCI/RCIC lines had physical damage, was identified as an outlier, and evaluated as such. Two potential interactions were identified for the RWCU line and one for the RCIC line. Outliers identified during the walkdown and their resolution, are discussed in the following section and are listed in Table 7-1. The piping and supports were concluded to meet the walkdown criteria with resolution of the outliers.

The in scope piping does not include any active valves. The HCPI and RCIC lines each have self-actuated check valves near the condenser nozzle. Self-actuated check valves are inherently rugged and seismically adequate based on Section 3.3.5 of Reference 5.

The HPCI and RCIC lines run together for the majority of their paths and are supported on common supports in most areas. The RCIC line does extend further than the HPCI line along the TA column line going into the Control Building before entering a wall penetration to the Reactor Building. The seismic differential displacement between the Turbine Building and Control Building is very small and the walkdown verified the piping system can easily accommodate this relative displacement. For a portion of the runs, the lines are insulated together in a common sheet metal jacket. The piping is generally rigidly supported with U-bolts attached to structural angle support members. Angle supports are anchored to concrete structures with concrete expansion anchors or welded to structural steel members.

The RWCU piping is butt-welded steel pipe with insulation. The piping is supported on a mixture of vertical rod hanger supports and rigid supports attached to concrete structures. Since portions of the piping is hung on rod hangers with no lateral restraint capacity, attention was given to potentially damaging seismic interactions between the piping and its supports, and the nearby structures, systems and components. Seismic movements of up to six inches in any horizontal direction were assumed.

The three piping systems were evaluated as discussed in Section 8. In addition, pipe supports were selected for analytical review to ensure seismic adequacy of the support system. The selected supports were chosen to represent (1) the most heavily loaded supports, and (2) supports that were judged to be significantly different than supports analyzed for the previously performed seismic verification of the Unit 2 bypass piping.

7.1 Outliers

During the walkdown four outliers were noted (as documented in Table 7-1).

Outlier labeled "RWCU - 1" involved interaction with a trapeze support for a pipe above the RWCU line. A review by SNC Pipe Stress Engineers determined both the RWCU pipe and the interaction piping are fairly flexible at the point of contact, therefore, a pressure boundary failure would not occur due to seismic contact at that location. The interaction is judged to be acceptable. No plant modifications are necessary.

Outlier labeled "RWCU - 2" involved interaction with pipe insulation for a pipe above the RWCU line. A review by SNC Pipe Stress Engineers determined the RWCU pipe to be fairly flexible at that location and could experience significant displacement without failure. The interaction was judged to be acceptable. No plant modifications are necessary.

Outlier labeled "HPCI/RCIC - 3" involved a notch cut out of a support angle leg. SNC Civil Engineers responsible for pipe supports determined the support to be acceptable as-is. The supports on either side can carry the additional piping load. No plant modifications are necessary.

Outlier labeled "RCIC – 4" involved the RCIC pipe being routed through a concrete masonry unit (CMU) wall. CMU walls are considered potential interactions due to failure/falling effects. However, all CMU walls in seismic category I buildings were evaluated for the resolution of NRC Inspection and Enforcement Bulletin 80-11, Masonry Wall Design. This involved classifying the walls based on their potential effect on safety-related equipment, performing detailed walkdowns to determine their existing loading conditions, analyzing their structural capability, and installing modifications on deficient walls. The RCIC pipe was part of the original walkdown for this CMU wall and included in the original IEB 80-11 wall evaluation. The structural integrity of this CMU wall has been maintained and is not an interaction concern for the RCIC line. The wall is acceptable "as is" and no plant modifications are necessary.

Table 7-1 is a listing of the outliers identified during the walkdown and their resolution.

Table 7-1: Outlier Identification and Resolution

System Description	Outlier Description	Outlier Type (Potential Failure Mode)					Resolution Status	Required Action
		A	F	P	D	V		
RWCU - 1	Interaction			X			Acceptable as-is. Resolved by analysis.	
RWCU - 2	Interaction			X			Acceptable as-is. Resolved by analysis.	
HPCI/RCIC -3	Angle support has notch cut out of leg	X					Acceptable as-is. Resolved by analysis.	
RCIC - 4	Block wall Penetration 1Z43-H102C Concrete block wall at T10		X				Acceptable as-is. Resolved by analysis.	

<u>Key to Outlier Types in Table 7-1:</u>

A Anchorage or Support Capacity

F Failure and Falling

D Differential Displacement

P Proximity and Impact

V Valve Operator Screening

8. ANALYTICAL ASSESSMENT

Analytical assessment of selected piping and supports are performed to address potential piping concerns or assess conditions found during the seismic verification walkdown that do not meet the walkdown screening guidelines or which were judged by the Seismic Review Team (SRT) to require further review to verify seismic adequacy (i.e., identified as outliers).

Analytical criteria for the evaluation of piping and supports are selected to address the primary concern of ensuring the ability of the piping to remain structurally intact and act as a holdup volume for fission products during and after a seismic event. The analysis criteria are selected to be consistent with analyses accepted in previous leakage control system license amendment applications. The previous analytical review of the Unit 2 bypass piping lines and their supports were reviewed to aid in the Unit 1 limited piping and pipe support evaluations. Structural evaluation of the Unit 2 supports and their anchorage provided insight for selecting Unit 1 bounding (less safety margin) support configurations.

8.1 Evaluation of the RWCU, HPCI and RCIC Piping

An evaluation of the RWCU, HPCI and RCIC piping runs was performed, focusing on differences between the previously analyzed Unit 2 systems and any outliers. The analysis criteria used are consistent with the criteria for seismic verification of non-qualified piping in support of leakage control system license amendments for plants of the same vintage as Hatch. The Unit 1 and 2 RWCU piping systems have similar routing and differences are not significant. The HPCI and RCIC systems were routed and supported using the small bore piping guidelines in accordance with B31.1. Based on the walk down information and limited analytical review, the Unit 1 RWCU, HPCI and RCIC piping systems are seismically adequate. The analysis criteria and results are summarized below.

The Hatch RWCU piping is 4-inch diameter ASTM A53 or A106 Grade B Schedule 40 wall thickness with butt-welded joints. The pipe is assumed empty during normal operations. Piping capacity is determined using ANSI B31.1 code requirements (Reference 8) and an allowable stress intensity limit of 3 S_h (S_h is the material allowable stress at maximum operating temperature, as listed in B31.1), not to exceed twice the yield stress.

Seismic demand is taken as one-half of the turbine building Seismic Margin Earthquake (SME) in-structure response spectra (ISRS). Seismic demand is the peak spectral acceleration at 5% damping for the ISRS at support location of the piping.

The Unit 1 and Unit 2 RWCU piping properties are the same. The Unit 2 piping system, though not as well supported as that of Unit 1, has stress ratio of actual to allowable of less than 0.3.

Based on the analysis for Unit 2 in References 10 and 14, in addition to the Unit 1walkdown results, the RWCU, HPCI and RCIC piping are judged to be seismically adequate.

8.2 Evaluation of RWCU, HPCI and RCIC Supports

Just as with the piping systems, the analytical review of the bypass leakage piping supports was a combination of comparison to the previously analyzed Unit 2 supports, evaluation of

representative Unit 1 supports, and evaluation of any outliers. That evaluation is compiled in a Southern Nuclear Civil calculation. The analysis criteria and results are summarized below.

Four HPCI and RCIC pipe supports and two RWCU pipe supports were selected for analytical evaluation. All six supports were either single angle or angle frame supports and were judged to be the bounding of the other supports.

Support loads for the RWCU, HPCI and RCIC supports are determined using the equivalent static load method. Seismic demand is the estimated realistic median-centered amplified floor response spectrum including a factor of conservatism of 1.25 in accordance with the SQUG GIP Section 4.4.3. This method for determining the demand is consistent with the approved A-46 program for Plant Hatch. The peak of the response spectrum is used since natural frequencies are not calculated. Seismic loads on the RWCU, HPCI and RCIC supports are calculated as the tributary span length times the seismic demand acceleration applied in the directions of restraint.

The supports evaluated considered the load combination of dead load plus seismic applied in the directions of restraint. The seismic response is determined using the worst case combination of responses due to horizontal and vertical earthquake input.

Concrete expansion anchors and welded connections are evaluated using allowable stresses from Appendix C of the GIP. Allowable stresses for structural members are determined (per the GIP Section C.6.5) in accordance with Chapter N or AISC (Reference 13). Load capacities for U-bolts are based on limit analysis per Appendix F of ASME Section III. Capacities equal to 1.67 times the rated value are used for standard pipe support components loaded in tension, bending or shear.

The results of the analysis show that the Hatch Unit 1 bypass leakage pipe supports required to support the piping meet the analysis criteria. These supports are seismically adequate for the defined seismic input.

9. CONCLUSIONS

This report documents the seismic adequacy review of Hatch Unit 1 bypass leakage piping. The boundaries of the piping included in the review are described in Section 2. The review was performed in accordance with BWROG Topical Report NEDC-31858P-A and the associated NRC SER. The review consisted of earthquake experience data comparisons, field walkdowns to screen for known seismic vulnerabilities and undesirable conditions that could lead to damage or failure in an earthquake, and analytical review of selected piping and supports.

The results of the database comparisons, walkdowns and analytical review show that the evaluated bypass leakage piping systems and supports meet the BWROG/NRC seismic criteria. The piping systems are concluded to have sufficient capacity margin to maintain pressure integrity during and following the Plant Hatch ½ SME seismic event.

Additionally, the following summary is provided that describes how the plant-specific evaluation described herein for Plant Hatch Unit 1 bypass leakage piping addresses the nine limitations listed in the NRC Safety Evaluation Report (Reference 2) for the BWROG Topical Report (Reference 1):

1. Individual licensees should provide a detailed description of the ALT drain path (Note: for this report the path is bypass leakage piping) and the basis for its functional reliability, commensurate with its intended safety-related function. The licensees should also describe their maintenance and testing program for the active components (such as valves) in the ALT path.

   Discussion: A detailed description of the bypass leakage piping is provided in Sections 2 and 3 of this report. Since there are no active components associated with the bypass leakage piping, a description of the maintenance and testing program is not applicable.

2. Individual licensees should provide plant-specific information for piping design parameters (e.g., uniqueness of piping configurations, pipe span between supports, and diameter-to-thickness ratios for each pipe size) to demonstrate that they are enveloped by those associated with the earthquake experience database.

   Discussion: Plant-specific information is provided in Section 3 that demonstrates that the bypass leakage piping is enveloped by the earthquake experience database, by the Unit 2 bypass evaluations, and by the Unit1 MSIV ALT path evaluations.

3. Individual licensees should demonstrate that the plant condenser design falls within the bounds of the design characteristics found in the earthquake experience database. This should include review of as-built design documents and/or a walkdown to verify that the condenser has adequate anchorage.

   Discussion: As discussed in Section 6, the Hatch main condenser design characteristics and anchorage have been demonstrated to be adequate and enveloped by the earthquake experience database in previous evaluations (Reference 3).

4. Individual licensees should perform a plant-specific evaluation for representative supports and anchorages associated with affected piping and condenser.

   Discussion: Plant-specific seismic evaluations were performed of representative pipe supports and anchorage as described in Section 8.2. The condenser and its anchorage are discussed in Section 6.

5. Individual licensees should confirm that the condenser will not fail due to seismic II/I type of interaction (e.g., structural failure of the turbine building and its internals).

   Discussion: Confirmation that the condenser will not experience seismic II/I interaction was done as part of the previous seismic walkdowns (Reference 3). The turbine building not being a seismic II/I hazard is discussed in Section 5.

6. Individual licensees of plants whose FSARs or UFSARs reference Appendix A to 10 CFR Part 100 should perform a bounding seismic analysis for the ALT path piping. Those licensees committed to Part 100 should discuss the basis for selecting a particular portion of the bypass/drain line for the bounding analysis.

   Discussion: Due to the vintage of Plant Hatch Unit 1 (the NRC included Plant Hatch Unit 1 in the USI A-46 program), it is not considered a requirement to perform a piping seismic analysis for the seismic verification of the bypass leakage piping. Nonetheless, an evaluation of the RWCU, HPCI and RCIC piping was performed, focusing on differences between the previously analyzed Unit 2 systems and any outliers. As discussed in Section 8.1, the piping evaluation demonstrated adequate safety margin.

7. The methodology and criteria used for the analytical evaluation should be those which are in compliance with the design basis methodology and criteria, or those which are acceptable to the staff.

   Discussion: The methodology and acceptance criteria for the system evaluation of the piping systems are provided in Section 8.1. These criteria are considered consistent with the criteria accepted by the staff for seismic verification of non-qualified piping in support of MSIV leakage rate limits and elimination of leakage control systems license amendments for plants of the same vintage as Plant Hatch.

8. The facility ground motion estimates shown in figures 1 through 13 of the attachment have been reviewed and accepted by the staff for inclusion in BWROG's earthquake experience database. These 13 facility ground motion estimates may be used to verify the seismic adequacy of equipment in the alternative MISV leakage pathway for plants referencing the BWROG's Topical Report, NEDC-31858P, Revision 1.

   Discussion: Sections 3.1 and 3.2 as well as Figure 3-1 demonstrate that the use of the earthquake experience database is appropriate for Plant Hatch Unit 1 based on the comparison of the Hatch ½ SME ground motion (note the Hatch Unit 1 Design Basis Earthquake is enveloped by the ½ SME) to the experience database facility ground motions that have been reviewed and accepted by the NRC.

9. At the present time, there is no standard, endorsed by the NRC, that provides guidance for determining what constitutes and acceptable number of earthquake recordings and their magnitudes and for determining the required number of piping and equipment items that should be referenced in the earthquake experience database when utilizing the BWROG methodology. Therefore, individual licensees are responsible for ensuring the sufficiency of the data to be submitted for staff review and determination. When a revision to the QME Standard that incorporates specific criteria for use of experience data in the qualification of mechanical equipment is endorsed by the NRC, such criteria should be followed in future applications involving MSIV ALT pathway evaluations.

   Discussion: The facility ground motions that have been reviewed and approved per the NRC SER, Reference 2, for inclusion in the BWROG's earthquake experience database are representative and sufficient to apply in the seismic evaluation of the bypass leakage piping.

10. REFERENCES

1. General Electric Report No. NEDC-31858P-A, "BWROG Report for Increasing MSIV Leakage Rates and Elimination of Leakage Control Systems", August 1999.

2. U.S. Nuclear Regulatory Commission Safety Evaluation of GE Topical Report NEDC-31858, Revision 2, "BWROG Report for Increasing MSIV Leakage Rate Limits and Elimination of Leakage Control Systems", March 3, 1999.

3. Edwin I. Hatch Nuclear Plant Unit 1 Main Steam Isolation Valve Alternate Leakage Treatment Path Description and Seismic Evaluation Report, July 28, 2006.

4. ABS Consulting Procedure 1302241-P-002, "Walkdown Procedure Seismic Adequacy Review of Alternate Source Term Leakage Path Piping, Tubing and Equipment," Revision 0, February 25, 2005.

5. Seismic Qualification Utility Group (SQUG), "Generic Implementation Procedure (GIP) for Seismic Verification of Nuclear Plant Equipment," Revision 3A, December 2001.

6. EPRI Report No. NP-7149D, "Summary of the Seismic Adequacy of Twenty Classes of Equipment Required for Safe Shutdown of Nuclear Plants," prepared by EQE Inc. for the Electric Power Research Institute, Palo Alto, CA, March 1991.

7. EPRI NP-6041, "A Methodology for Assessment of Nuclear Power Plant Seismic Margin," Electric Power Research Institute, prepared by NTS Engineering and RPK Consulting, July 1991.

8. ASME, USA Standard Code for Pressure Piping, ANSI B31.1, "Power Piping," 1973.

9. American National Standard No. ANSI/MSS MSS SP58, "Pipe Hangers and Supports – Materials, Design and Manufacture."

10. ABS Consulting Calculation 1302241-C-005, "Seismic Evaluation of AST Piping, RWCU Piping 2G31-4"-HEE in the Turbine Building," Revision 0.

11. ABS Consulting Calculation 1302241-C-004, "Seismic Evaluation of AST Piping, Pipe Supports," Revision 0.

12. EQE Correspondence No. 50190-O-001, "Transmittal of Final Seismic Margins In-Structure Response Spectra for the Hatch Unit 2 Turbine Building," November 10, 1995

13. American Institute of Steel Construction (ASIC), "Manual of Steel Construction – Allowable Stress Design," Ninth Edition, 1989.

14. ABS Consulting Report 1302241-R-002, "Hatch Nuclear Plant Unit 2 Seismic Verification of Potential Secondary Containment Bypass Leakage Paths Terminating at the Main Condenser", Revision 0, October 17, 2005.

ATTACHMENT A
ABS Procedure 1302241-P-002 (44 pages)

Attachment A

ABS Consulting Procedure 1302241-P-002, "Walkdown Procedure Seismic Adequacy Review of Alternate Source Term Leakage Path Piping, Tubing and Equipment," Revision 0, February 25, 2005.

(44 pp including this page)

WALKDOWN PROCEDURE

SEISMIC ADEQUACY REVIEW

OF ALTERNATE SOURCE TERM LEAKAGE PATH

PIPING, TUBING AND EQUIPMENT

PLANT HATCH UNIT 2

PROCEDURE NO.: 1302241-P-002

REVISION NO.: 0

DATE: February 25, 2005

PREPARED BY/DATE: VLW 2-25-15

REVIEWED BY/DATE: [signature] 2-25-05

APPROVED BY/DATE: [signature] 2/25/05

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TABLE OF REVISIONS

Revision	Description of Revision	Date Approved
0	Original Issue	February 25, 2005

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ATTACHMENTS

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1.0 SCOPE

This procedure describes the activities and required procedures for implementation of a data gathering and screening walkdown for seismic adequacy review of the Alternate Source Term (AST) leakage path piping, tubing and equipment. The scope includes seismic verification of piping that will provide a path for AST leakage to reach the condenser.

The purpose of this activity is to gather and document the information required to verify that pressure and functional integrity of this piping and equipment will be maintained during and after a seismic event.

2.0 RESPONSIBILITIES

The project manager shall be responsible for ensuring the implementation of this procedure.

The project manager shall be responsible for ensuring that the seismic review team members are trained in accordance with this procedure prior to performing the walkdown. This will be documented on the training verification form included as Attachment C to this procedure.

The project manager shall be responsible for organizing and directing the walkdowns in accordance with this procedure. The individual seismic review team members shall be responsible for the actual performance of the walkdowns and documentation of the results.

3.0 DEFINITIONS

A. SEISMIC REVIEW TEAM

The Seismic Review Team (SRT) engineers performing the walkdowns, evaluation and analysis must be degreed engineers, with considerable experience in structural and/or earthquake engineering applicable to nuclear power plants. The SRT engineers shall successfully complete a training course on the background for, the philosophy behind, and the use of these seismic evaluation guidelines. At least two SRT engineers shall comprise a team of which at least one shall be a licensed professional engineer.

As a group, the SRT shall possess knowledge in the performance of equipment, systems, and structures during strong-motion earthquakes in industrial process and power plants. They shall also understand conduct of nuclear plant walkdowns; nuclear design codes and standards; and seismic design, analysis, and test qualification practices for nuclear power plants.

The core SRT may be supplemented by additional personnel for the purpose of documenting field conditions not shown on plant drawings. The qualifications for these personnel will be determined by the project manager.

Each engineer involved in the walkdown or evaluation shall submit a resume of qualifications and experience per Attachment B. In addition, documentation of having completed the required training shall also be on file.

B. EVALUATION

An assessment of the seismic adequacy of the as-installed piping, pipe supports, tubing and equipment will be performed using the Walkdown Data Sheets included as Attachment A. These worksheets were developed based on the observed failure modes of piping and equipment in power and industrial facilities resulting from actual strong motion earthquakes.

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C. OUTLIER

As-installed piping, tubing and equipment that do not meet the review criteria of this procedure shall be documented as outliers. Outliers may require further detailed evaluation using analysis, seismic experience data, testing or other methods.

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4.0 METHODOLOGY

Very few components of nuclear plant systems are unique to nuclear facilities. Nuclear plant systems include electrical panels and switchgear, air compressors, tanks, piping, conduit, and many other items that are common components of conventional power plants and industrial facilities. The seismic experience database was developed to address the problem of seismic qualification for equipment that was purchased as common "off the shelf" items or for commodities that require an upgrade in seismic classification. By reviewing the performance of facilities that contain equipment similar to that found in nuclear plants, conclusions can be drawn about the performance of nuclear plant equipment during and after a design basis earthquake. Typical sources of seismic damage for different classes of equipment and piping have been obtained and are explained in detail in References 6 and 9.

Visual and design document review examination of piping systems are to be performed to assess valve and other component vulnerabilities and potential for pipe failure. Seismic inertial effects in welded steel piping systems are not considered to be primary failure initiators. Inadequate piping system flexibility and excessive relative support deflections are the more likely contributors to seismically-induced failures than dynamic shaking effects for welded steel pipe. Impact of valve operators on adjacent structures or equipment is the only credible valve failure mode of concern for seismic loads. Items to be observed in the walkdown are:

1. Preferably, the piping systems should not be fabricated with threaded or Victaulic or other mechanical friction-type of connections. These details produce a non-ductile system that is sensitive to inertia loads and certain support configurations for strong motion earthquakes. When observed, these details need to receive special attention.

2. The use of cast iron pipe is a potential problem since it does not have the strength or ductility of steel, and usually has low capacity connections.

3. Branch lines out to their first support could be a potential concern if they do not have adequate flexibility. The necessary flexibility can come from either the supports or the pipe routing. Short, straight branch lines that are connected to

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relatively rigid anchor points are candidates for failure if the major run pipe is not restrained from motion close to the branch.

4. The connection of pipe into vessels, heat exchangers, and other equipment anchor points could be of concern if the details used could transmit excessive loads to the nozzles. This situation could result from

   a. Flexibility in the equipment support with the pipe system being rigidly supported near the equipment.

   b. Long unsupported runs of pipe adjacent to the equipment, particularly if heavy in-line components are mounted near the equipment.

   c. Pipe support failure near the equipment. Any indication of potential weak links in these supports should be noted for further evaluation.

5. Proximity of valve operators to structures, components, or other subsystems should be examined. The principal concern for active valves is that the operator support may be bent so that the valve will not change position on demand. For active and passive valves, an additional concern is fracture of the top works that could breach the pressure boundary.

6. Multiple failure of threaded rod supports (unzipping) on non-seismic piping could, in instances of long runs of pipe, potentially result in piping failure and subsequent flooding problems.

7. The use of vibration or shock isolation systems on equipment to which piping attaches could adversely affect the seismic performance of the piping system if the pipe segments to the first support on either side of this component are not flexible enough to accommodate the equipment motion.

8. The piping details across seismic gaps or between two buildings should be reviewed. Insufficient flexibilities in the routing detail could affect the pipe integrity for seismic differential building motions.

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9. The increased pipe seismic responses may produce seismic interaction concerns. The following conditions should be reviewed during the walkdowns:

a. Supports should be reviewed to ensure they can accommodate motions in directions other than the primary load path. This concern is applicable to the clevis ends of struts and snubbers, and is not a concern unless there exist follow-on consequences, such as seismic missles or seismic interaction.

b. Relatively flexible piping spans should be reviewed for potential seismic interaction ramifications.

c. Supports that only restrain dead weight loads and do not restrict the pipe from sliding off should be evaluated.

5.0 PROCEDURE

5.1 EQUIPMENT, PIPING, TUBING AND SUPPORTS

Equipment, piping and tubing systems in the seismic experience database have performed very well in earthquakes, even though they were typically designed for dead weight and operating loads only, with little or no consideration for seismic loads (Reference 7). Earthquake experience database methods provide the basis for review of the AST leakage path piping and equipment.

Application of earthquake experience data for evaluation of piping and equipment must: (1) demonstrate database representation, and (2) address known seismic vulnerabilities of piping and components. Earthquake experience has identified conditions that have resulted in failure of piping and tubing systems and components. Instances of seismic damage to database piping have been the result of seismic anchor movement (SAM), seismic systems interaction (and impact), and corrosion. The database has demonstrated that inertial failures of piping are not credible as long as standard industrial or better design practices are employed.

5.1.1 Database Representation of Piping

In order to assure database representation of piping systems, the following conditions must be met:

1. The design basis ground spectra for the nuclear facility must be less than the *bounding spectrum per Reference 2.*

2. Piping installations must follow industry-standard practices (e.g., ANSI B31.1, Reference 11). Spans between supports should meet the ANSI recommended spans given in Table 5-1.

3. The piping system must not display known seismic vulnerabilities or employ seismically sensitive characteristics, such as brittle joints or mechanical couplings that could be adversely affected by differential movement.

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Piping and pipe supports should be reviewed for the following to assure database representation:

- The piping configuration must have adequate flexibility to accommodate its thermal loading. The concern is that piping that appears highly stressed due to normal operating loads may perform poorly under an additional seismic load.
- Visible damage to piping or supports (e.g., broken supports, loose U-bolts) may adversely affect piping seismic performance.
- Unusual conditions (non-standard fittings, unusual pipe attachments, unusual support design, customized parts used in place of catalog parts, pipe supports that have been modified) should be considered as potential outliers. Judgment should be used to evaluate if these conditions represent a deviation from piping systems in the experience database.
- Brittle connections (e.g., threaded joints, cast iron fittings) should be considered as potential outliers. The experience database has demonstrated the seismic vulnerability of these connections. Un-reinforced branch connections should be reviewed since they may represent a deviation from normal industrial installation practices.
- The adequacy of pipe support installation (e.g., spring hanger settings, sliding supports which may have been restrained to preclude pipe sliding, one-way guide supports which may not restrain the pipe from sliding off under lateral seismic loads) should be reviewed by the SRT.
- Friction clamps should not be oriented in such a way that only the clamping or frictional forces developed by the clamps resist gravity loads.

5.1.2 Seismic Anchor Movement

The experience database includes several instances of seismic damage to piping and supports that were attributed to seismic anchor movement. Damage was the result of excessive movement of terminal end equipment, differential movement between pipe

supports in adjacent buildings, and excessive movements imposed on branch lines by flexible headers.

As a result of these instances of damage, the following attributes must be evaluated by the seismic review team during their piping walkdown.

- Piping configurations at building joints and between buildings should have adequate flexibility to accommodate seismically-induced differential building movement.
- Fittings which can be adversely affected by seismically-induced differential movement (e.g., bellows, flexible hoses) should be evaluated for adequate flexibility.
- Piping attached to unanchored or poorly anchored equipment should be considered an outlier. Stiff piping attached to flexible equipment should be evaluated to verify that the piping will not act as an equipment anchorage. In addition, the piping configuration should have adequate flexibility to accommodate equipment that may vibrate significantly during normal operation.
- Conditions where stiffly supported branch lines are attached to flexibly supported (e.g., rod-hung) main lines or headers should be considered as potential outliers. The seismic review team should evaluate this configuration for potential damage due to seismically induced differential movement.

5.1.3 Seismic Interaction Concerns for Piping

Guidelines for evaluating potential interaction hazards to items, including piping systems, are presented in Section 6. Particular attention should be given to hazardous interactions to piping with threaded or bolted connections for possible breach of pressure boundary. In addition, interactions involving impact of valve operators, vents and drains, and fragile appurtenances, should be evaluated in detail.

5.1.4 Pipe and Pipe Support Corrosion

The experience database includes instances of seismic damage to piping and supports that were attributed to excessive corrosion. Therefore, the seismic review team should

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evaluate piping and pipe supports for rust or corrosion deterioration. The seismic review team should review the piping system for both internal and external corrosion.

The seismic review team should visually inspect the piping and supports to ensure they are free of significant external corrosion. Significant corrosion refers to metal thickness loss of more than about 20%. A surface discoloration or thin layer of rust does not harm structural integrity. The seismic review team should look for metal flaking, scaling, evidence of pipe leakage, pipe repair, rust staining on insulation and similar features that could indicate significant external corrosion.

Flow-induced vibrations, erosion, water hammer, metallurgical conditions and other factors can cause internal degradation and corrosion of piping systems. Significant degradation can make the piping system vulnerable to seismic damage. The seismic review team should review existing plant documentation for evidence of significant internal degradation. The review team should check for ongoing inspection and evaluation programs at the plant that address potential internal degradation issues.

5.1.5 Active Valves

Valves required to function to establish pressure boundaries shall be reviewed using the guidelines of Reference 3. The walkdown data sheets in Attachment A shall be used to document the review. Screening guidelines for air-operated valves, spring-operated pressure relief valves and piston-operated valves of light weight construction are provided in Figure 5-1. Screening guidelines for motor-operated valves and substantial piston-operated valves are provided in Figure 5-2. Evaluation of active valves should include review of all power and control utilities (such as solenoid valves and supply tubing) to ensure adequate slack is provided to accommodate anticipated seismic motions. Supports located on the valve operator should be accompanied by supports on the valve body or piping adjacent to the valve body. The valve body and operator should be supported by a common structure to prevent differential displacement. Piping or tubing less than 1 inch in diameter with in-line eccentric masses such as motor or air operated valves should be supported at or near the valve.

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5.1.6 Equipment Verification

Equipment that requires seismic verification includes the main condenser and equipment within the pressure boundary of the piping and tubing being reviewed. This includes equipment that acts as terminal anchor points (such as instrument racks and panels), transmitters, gauges and instrumentation. Equipment shall be reviewed using the general guidance of References 3 and 8, as applicable. The following general procedure shall be used for equipment review:

- The functional requirements for the component being evaluated shall be established. The required function may be pressure boundary retention, active change of state, structural integrity, etc.
- Review the equipment to establish representation in the earthquake experience database, using References 3, 6 and 10 as applicable. This includes a check that the equipment is typical of equipment in industrial and power applications.
- Review the equipment for known failure modes and sources of seismic damage that may affect the functional requirement established for the equipment and subcomponents.
- Check for unusual or non-typical arrangements of the devices within the equipment or of items external to the equipment.
- Assess the anchorage and presence of an adequate load path. Where judged appropriate, prepare field data on component anchorage.
- Check for seismic interaction hazards (such as proximity impact, failure and falling of components and un-reinforced block walls) in the vicinity of the equipment. Guidelines for evaluating seismic interaction hazards are presented in Section 6.

The details of the procedure vary according to the type of equipment and location within the plant. The extent of review and information gathering for active components, pressure boundary components and equipment required for structural integrity shall be determined based on the judgment and experience of the seismic review team.

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5.1.7 Selective Analytical Review

A sampling of the piping configurations and pipe supports shall be selected for analytical review if it is considered appropriate by the SRT.

The sample size shall be determined by the SRT, based on the diversity, complexity and extent of the systems or areas being evaluated. Supports which are heavily loaded or which appear to have marginal anchorages shall be selected.

Detailed sketches of the sample piping and supports shall be included in the field walkdown notes. Sketches shall include the location, support configuration, dimensions, connection details, anchorage attributes, member sizes, and tributary lengths. The data sheet shall include notes describing the basis for selection of each sample. Any additional information that may be considered relevant to the seismic ruggedness of the sample support shall be noted.

5.2 ANCHORAGE

Anchorage of pipe supports shall be visually inspected in accordance with the guidelines of Reference 3. The extent of tightness testing to be performed for expansion anchor bolts shall be determined by the SRT based on accessibility of equipment and the extent of estimated loadings.

5.2.1 Expansion Anchor Bolts Inspection Guidelines

Expansion anchors shall be evaluated in the plant to ensure that proper installation has been obtained. The sample size of this evaluation shall be of sufficient quantity to satisfy the SRT engineers that proper installation has been achieved. This visual inspection shall include the following:

- A washer is installed between the equipment base and the bolt head or nut. If the equipment base is made of structural steel plate, then a washer is not needed if the bolt-hole diameter in the structural steel plate appears to be no greater that the nominal bolt diameter plus 1/16 inch.
- The concrete is sound with no significant cracks in the vicinity of the anchor bolt.

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- The gap between the equipment base and the concrete surface is less than or equal to 1/4 inch
- The bolt spacing is greater than about 10 times the bolt diameter.
- The distance between the bolt and any free concrete surface is greater than approximately 10 time the bolt diameter.
- The bolt is installed with at least the minimum embedment.

For shell type anchors, the minimum embedment is ensured if the shell does not protrude above the surface of the concrete. For non-shell type anchors, the minimum embedment is ensured if the projection of the bolt above the surface conforms with the following:

Bolt Diameter (Inches)	Allow. Bolt Projection (Inches)
3/8	1/2 to 3/4
1/2	1/2 to 3/4
5/8	1/2 to 7/8
3/4	7/8 to 1-1/2
1	1-1/2 to 2

5.2.2 Cast-In-Place Anchor Bolts Inspection Guidelines

Cast-in-place bolts shall be evaluated to ensure that proper installation has been obtained. This visual inspection shall include the following:

A washer is installed between the equipment base and the bolt head or nut. If the equipment base is made of structural steel plate, then a washer is not needed if the bolt-hole diameter in the structural steel plate appears to be no greater than the nominal bolt diameter plus 1/16 inch.

The concrete is sound with no significant cracks in the vicinity of the anchor bolt.

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The gap between the equipment base and the concrete surface is less than or equal to 1/4 inch.

The bolt spacing is greater than about 10 times the bolt diameter.

The distance between the bolt and any free concrete surface is greater than approximately 10 times the bolt diameter.

5.2.3 Welded Anchorages Inspection Guidelines

Welded anchorages shall be evaluated to ensure that proper installation has been obtained. This visual inspection shall include the following:

- Check for weld burn-through on thin sections.
- Limit weld thickness, t, to thickness of thinner part being connected.
- If plug welds are found and required to take tension loads, they are to be considered as an outlier.

TABLE 5-1

NOMINAL SUGGESTED SPANS PER ANSI B31.1

Nominal Pipe Size (inch)	Outside Pipe Diameter (inch)	Nominal Suggested Maximum Span (feet) Water Service	Steam, Gas or Air Service
1	1.315	7	9
2	2.375	10	13
3	3.50	12	15
4	4.50	14	17
6	6.625	17	21
8	8.625	19	24
10	10.75	21	26
12	12.75	23	30
16	16.00	27	35
20	20.00	30	39
24	24.00	32	42
30	30.00	33	44

Note: Does not apply where there are concentrated loads between supports such as flanges, valves, etc.

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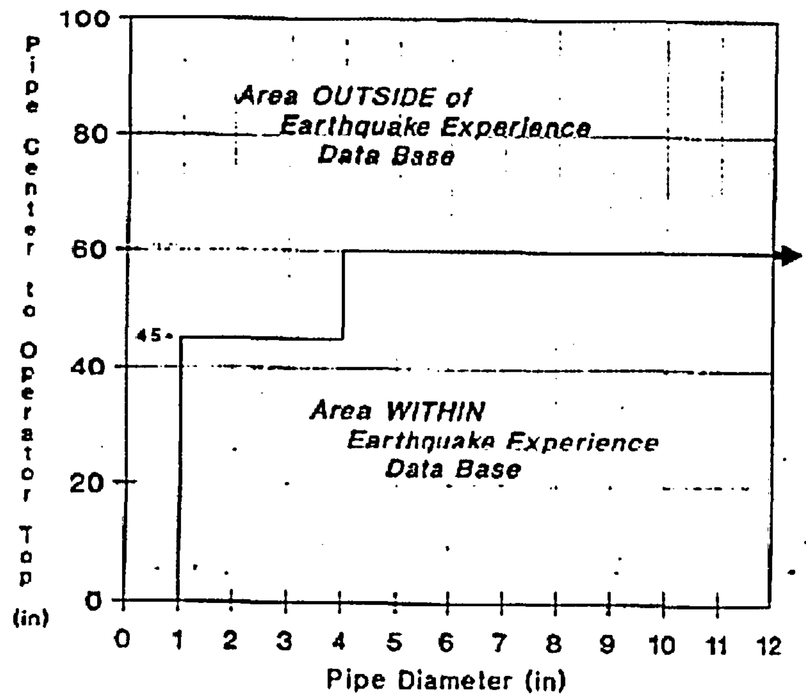

Figure 5-1: Limits of experience data for air-operated diaphragm valves, spring-operated pressure relief valves and piston-operated valves of light weight construction.

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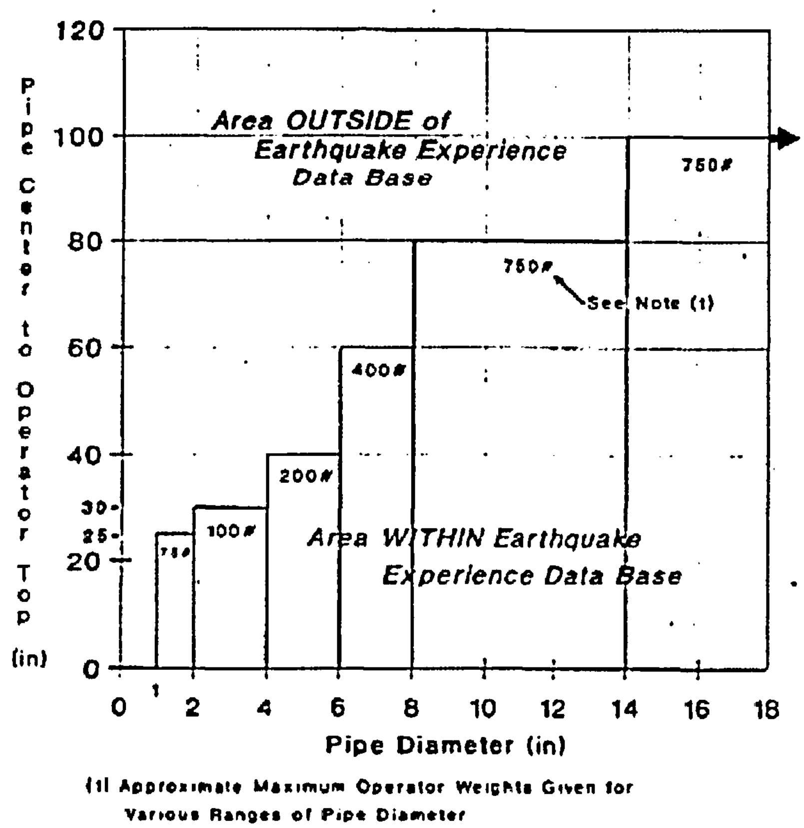

Figure 5-2: Limits of experience data for motor operated valves, and substantial piston-operated valves.

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6.0 SEISMIC INTERACTION REVIEW

Guidelines for evaluating seismic interaction are included in Appendix D of the SQUG GIP (Reference 3). The seismic interaction review is a visual inspection of structures, piping, or equipment adjacent to the equipment under evaluation. The seismic interaction review also includes the identification of all seismically induced failures or displacements of any adjacent structures, piping, or equipment that could adversely affect the capability of the equipment under consideration. Particular attention should be given to adjacent non-safety-related structures, piping, and equipment.

The review team should identify and evaluate all credible and significant interaction hazards in the immediate vicinity of the equipment being evaluated. Evaluation of interaction effects shall consider detrimental effects on the capability of equipment and systems to function, taking into account equipment attributes such as mass, size, support configuration, and material hardness in conjunction with the physical relationships of interacting equipment, systems, and structures. In the evaluation of proximity effects and overhead or adjacent equipment failure and interactions, the effects of intervening structures and equipment that would preclude impact should be considered.

Damage from interaction in earthquakes results from unusual circumstances or from generic, simple details such as open hooks on suspended lights. In the interaction review, the SRT should look for (1) unusual impact situations, and (2) lack of proper anchorage or bracing of adjacent equipment.

The seismic review team should identify and evaluate all credible interactions that may result in damage to pressure boundary components and result in loss of function of the piping, tubing and equipment under review.

7.0 REQUIRED DOCUMENTATION

The results of the walkdown shall be documented by notes and observations recorded on the Walkdown Data Sheets from Attachment A. The Walkdown Data Sheets shall be signed and dated by all members of the seismic review team.

The qualification and training of the individual seismic review team members shall be documented on Attachments B and C.

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8.0 QUALITY ASSURANCE

All work performed for this walkdown shall be done in accordance with the latest revision of the ABS Consulting Quality Assurance Manual (Reference 4).

9.0 REFERENCES

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

2. SSRAP Report, "Use of Seismic Experience Data to Show Ruggedness of Equipment in Nuclear Power Plants," Senior Seismic Review and Advisory Panel, Revision 4.0, February 28, 1991.

3. Bishop, Cook, Purcell, and Reynolds; EQE Incorporated; MPR Associates, Inc.; Stevenson and Associates; URS Corporation/John A. Blume and Associates, "Generic Implementation Procedure (GIP) for Seismic Verification of Nuclear Plant Equipment," Revision 2 Corrected 2/28/91.

4. ABS Consulting, "Quality Assurance Manual," Revision 7, December 8, 2004.

5. EPRI Report NP-5228, "Seismic Verification of Nuclear Plant Equipment Anchorage," Electric Power Research Institute, Palo Alto, CA, prepared by URS Corporation/John A. Blume & Associates, Engineers, Revision 1, June 1991.

6. EPRI Report NP-7149, "Summary of the Seismic Adequacy of Twenty Classes of Equipment Required for Safe Shutdown of Nuclear Plants," Electric Power Research Institute, Palo Alto, CA, prepared by EQE, Inc., March 1991.

7. EPRI Report, "Experience-Based Seismic Verification Guidelines for Piping Systems," Volumes 1 (Seismic Review Procedure) and 2 (Performance of Piping Systems in Strong-Motion Earthquakes), Electric Power Research Institute, Palo Alto, CA, prepared by ABS Consulting, Draft November 2004.

8. EPRI NP-604, "A Methodology for Assessment of Nuclear Power Plant Seismic Margin," Electric Power Research Institute, Palo Alto, CA, prepared by NTS Engineering, Long Beach, California, and RPK Consulting, Yorba Linda, CA, Revision 1, July 1991.

9. EQE Incorporated. "Power Piping During and After Earthquakes," Vol. 1. Prepared for the Electric Power Research Institute, San Francisco, CA, 1986.

10. GE Nuclear Energy Document NEDIC-31858P-A, "BWROG Report for Increasing MSIV Leakage Rate Limits and Elimination of Leakage Control Systems," August 1999.

11. ASME/ANSI B31.1, "Power Piping," 1967, 1977 & later Editions.

ATTACHMENT A

WALKDOWN DATA SHEETS

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WALKDOWN DATA SHEET

SHEET __ OF __

System ______________________________

Equip. Class _Piping and Tubing Systems_ Line Identifier ______________________________

____

Bldg. ______________________ Floor El. ______________________

P&ID No ______________________ Spec. No ______________________

Isometric No. ______________________________

____

Pipe/Tubing O.D. ______________ Wall Thickness ______________

Material ______________________________

Insulation Type/Thickness ______________________________

Piping System Boundary

Description ______________________________

____

____

Functionality Requirement

		Y	N		N/A
1.	Pressure Boundary Integrity	Y	N		N/A

Review Criteria - Piping and Tubing

1.	Is piping specified to a recognized piping code?	Y	N	U	N/A
2.	No visible damage	Y	N	U	N/A
3.	Is piping free from excessive distortion?	Y	N	U	N/A
4.	No unusual or temporary repairs	Y	N	U	N/A
5.	No missing or loose parts (such as nuts or bolts)	Y	N	U	N/A
6.	No evidence of interference resulting in damage or distortion	Y	N	U	N/A
7.	No piping dislodged from its supports	Y	N	U	N/A
8.	No deformation of thin vessel wall at pipe attachment point	Y	N	U	N/A
9.	Is equipment to which piping is attached free from damage?	Y	N	U	N/A
10.	No restricted operation of pipe rollers or slide plates	Y	N	U	N/A
11.	No significant visible rust/corrosion deterioration	Y	N	U	N/A
12.	No signs of leakage (discoloration, dripping, wet surface)	Y	N	U	N/A
13.	No potentially brittle connections (threaded joints, expansion joints, etc.)	Y	N	U	N/A
14.	Piping material has adequate ductility (no cast iron, aluminum, PVC)	Y	N	U	N/A
15.	Do the support spans appear to follow requirements (ANSI B31.1 for piping, 6'-0" max. for tubing)	Y	N	U	N/A
16.	No unusual pipe or tubing attachments	Y	N	U	N/A

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WALKDOWN DATA SHEET

SHEET __ OF __

System ______________________ Equip Class Piping and Tubing Systems

Line Identifier ______________________

17.	No heavy valves, flanges etc. supported by small bore vent and/or drain pipes	Y	N	U	N/A
18.	Does the piping configuration at building joints appear to have adequate flexibility to accommodate seismic induced differential movement	Y	N	U	N/A
19.	Are flexible joints (expansion, bellows, etc.) adequate for the anticipated seismic movement	Y	N	U	N/A
20.	Are flanged joints adequate, with no indication of leakage	Y	N	U	N/A
21	No mechanical joints that rely on friction to hold the joint tight	Y	N	U	N/A
22.	Does branch piping have adequate flexibility to accommodate the anticipated seismic movement of the main header	Y	N	U	N/A
23.	No stiff piping attached to flexible equipment	Y	N	U	N/A
24.	Are tanks and equipment (to which piping is attached) properly anchored to prevent sliding, rocking or overturning	Y	N	U	N/A
25.	No excessive sagging, crimping or damage to tubing	Y	N	U	N/A
26.	No large concentrated loads, eccentric branch lines or eccentric weights	Y	N	U	N/A
27.	No heavy in-line equipment such as inadequately supported strainers coils or heaters	Y	N	U	N/A
28.	No heavy valves supported by small bore lines with inadequate strength	Y	N	U	N/A
29.	No lead blankets, heavy shielding or connections for rigging or scaffolding	Y	N	U	N/A
29.	Have you looked for and found no other adverse concerns	Y	N	U	
	Are the criteria met?	Y	N	U	

Review Criteria - Supports

1.	No seismically vulnerable supports details: One-way stanchions, brackets, etc. allowing piping to slide off Friction beam clamps without restraining straps Short fixed end threaded rods, riser clamps positively attached with lugs	Y	N	U	N/A
2.	No visible rust/corrosion deterioration	Y	N	U	N/A
3.	No unusual design	Y	N	U	N/A
4.	No customized parts used in place of catalog parts, which appear inadequate	Y	N	U	N/A
5.	Free of support details that appear to have been inappropriately altered	Y	N	U	N/A
6.	No visible damage, broken parts or significant distortion	Y	N	U	N/A
7.	No inappropriate support settings (bottomed spring hangers, etc.)	Y	N	U	N/A
8.	Do concrete anchors appear to be adequate (embedment, edge distance, spacing to adjacent bolts, abandoned holes, etc.)	Y	N	U	N/A
9.	Does the load path appear adequate	Y	N	U	N/A
10.	No insecure attachment of brackets and beams to supports	Y	N	U	N/A
11.	No stiff supports or system hard spots in long flexible piping runs	Y	N	U	N/A
12.	No short fixed ended heavily loaded rod hangers subject to potential fatigue failure	Y	N	U	N/A
13.	Have you looked for and found no other adverse concerns	Y	N		
	Are the above criteria met?	Y	N	U	

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WALKDOWN DATA SHEET

SHEET __ OF __

System ____________________ Equip Class Piping and Tubing Systems

Line Identifier ____________________

Interaction Effects

1.	Is piping free from impacts that could breach pressure boundary	Y	N	U	N/A
2.	No collapse of overhead equipment, distribution systems, masonry walls or structures	Y	N	U	N/A
3.	Have you looked for and found no other adverse concerns	Y	N	U	N/A

Is equipment free of interaction effects? Y N U

IS THE PIPING SYSTEM SEISMICALLY ADEQUATE? Y N U

Comments ____________________

All aspects of the equipment's seismic adequacy have been addressed.

Evaluated by: ____________________ Date: ____________________

Evaluated by: ____________________ Date: ____________________

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WALKDOWN DATA SHEET

SHEET __ OF __

System________________________ Equip Class Piping and Tubing Systems

Line Identifier ________________________________

Comments/Outliers ________________________________

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WALKDOWN DATA SHEET

SHEET __ OF __

System ______________________ Equip Class Piping and Tubing Systems

Line Identifier ______________________

Comments/Outliers ______________________

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WALKDOWN DATA SHEET

SHEET __ OF __

System ______________________ P&ID No. ______________

Valve. ID No. ______________________ Equip. Class ___Valves___

Valve Description ______________________ Isometric No. ______________

Valve Location: Bldg. ____________ Floor El. ________ Room, Row/Col ______

Manufacturer, Model, Etc. ______________________

Drawing No. ______________________

Functionality Requirement

1. Valve state change required Y N U

Review Criteria

1. Does valve operator meet pipe centerline dimension restriction Y N U N/A
2. Do valve power and control utilities have adequate slack Y N U N/A
3. Valve operator is not supported independently of pipe Y N U N/A

Are the criteria met? Y N U

Interaction Effects

1. Vulnerable valve components free from impact by nearby equipment or structures Y N U N/A
2. No collapse of overhead equipment, distribution systems, or masonry walls Y N U N/A
3. Are any required electrical controls free of water spray interactions Y N U N/A
4. No other concerns Y N N/A

Is equipment free of interaction effects? Y N U

Is equipment seismically adequate? Y N U

Comments ______________________

____

____

All aspects of the equipment's seismic adequacy have been addressed.

Evaluated by: ______________________ Date: ______________

Evaluated by: ______________________ Date: ______________

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SHEET __ OF __

System ________________________________

Equipment ID No ________________________ Equip. Class ________________

Comments/Outliers ____

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WALKDOWN DATA SHEET

SHEET __ OF __

Pump ID No. ______________________ Equip. Class __Pump__

Pump Description ______________________

Pump Location: Bldg ____________ Floor El. ________ Room, Row/Col. ________

Functionality Requirement

1. Function required Y N U

Review Criteria

1. Is pump of good seismic design for function above (driver/pump on common base, shaft restraint, nozzle loadings, utility line slack etc.) Y N U N/A
2. No other concerns Y N

Are the criteria met? Y N U N/A

Interaction Effects

1. Vulnerable pump components free from impact by nearby equip. or structures Y N U N/A
2. No collapse of overhead equipment, distribution systems, or masonry walls Y N U N/A
3. Are any required electrical controls free of water spray interactions Y N U N/A
4. No other concerns Y N U

Is equipment free of interaction effects? Y N U N/A

Anchorage

1. Does strength appear adequate Y N U N/A
2. No vibration isolators Y N U N/A
3. Does load path appear adequate Y N U N/A
4. No other concerns Y N
5. Prepare and attach a sketch. Y N

Are anchorages adequate based on judgment? Y N U

Comments ______________________

____

____

____

All aspects of the equipment's seismic adequacy have been addressed

Evaluated by: ______________________ Date: ______________

Evaluated by: ______________________ Date: ______________

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WALKDOWN DATA SHEET

SHEET __ OF __

Support/Anchorage Sketch ______________________________

Equip. ID No. ____________________ Equip. Class __________

Equipment Description ______________________________

Equipment Location: Bldg. ______ Floor El ______ Room, Row/Col. ________

Sketch By: ____________________ Date: ________

Verified By: ____________________ Date: ________

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WALKDOWN DATA SHEET

SHEET __ OF __

Vessel ID No.__________ Equip. Class Horizontal Vessels

Vessel Description __________

Vessel Location: Bldg __________ Floor El. ____ Room, Row/Col ____

Manufacturer, Model, Etc. __________

Drawing No. __________

Functionality Requirement

1. Pressure Boundary Integrity — Y N U

Review Criteria

1. Is vessel of good seismic design for function above (Vessel to support connections, support system design, differential story support etc.) — Y N U N/A
2. No other vessel concerns — Y N

Are the criteria met? — Y N U N/A

Anchorage

1. Does strength appear adequate — Y N U N/A
2. Does load path appear adequate — Y N U N/A
3. No other concerns — Y N N/A
4. Prepare and attach a sketch — Y N

Are anchorages adequate based on judgment — Y N U

Interaction Effects

1. Vulnerable pressure boundary appurtenances free from damaging impact by nearby equipment, structures, etc. — Y N U N/A
2. No collapse of overhead equipment, distribution systems, or masonry walls — Y N U N/A
3. No other concerns — Y N

Is equipment free of interaction effects? — Y N U

Comments __________

____

All aspects of the equipment's seismic adequacy have been addressed.

Evaluated by: __________ Date: __________

Evaluated by: __________ Date: __________

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WALKDOWN DATA SHEET

SHEET __ OF __

Equipment ID No. ____________________ Equip. Class Instruments on Racks

Equipment Description ____________________

Equipment Location: Bldg. ____________ Floor El. _____ Room, Row/Col _____

Manufacturer, Model, Etc. ____________________

Drawing No. ____________________

Functionality Requirement

1. Function Required Y N U

Review Criteria

1. Is instrument rack of good seismic design for function above (mounting details, load paths, steel frame and sheet metal structurally adequate, etc.) Y N U N/A
2. No other instrument rack concerns Y N

Are the criteria met? Y N U N/A

Anchorage

1. Does strength appear adequate Y N U N/A
2. Does stiffness appear adequate Y N U N/A
3. No other concerns Y N N/A
4. Prepare and attach a sketch Y N N/A

Are anchorages adequate based on judgment Y N U

Interaction Effects

1. Vulnerable components free from damaging impact by nearby equipment, structures, etc. Y N U N/A
2. No collapse of overhead equipment, distribution systems, or masonry walls Y N U N/A
3. No other concerns Y N

Is equipment free of interaction effects? Y N U

Comments ____________________

____

____

All aspects of the equipment's seismic adequacy have been addressed.

Evaluated by: ____________________ Date ____________________

Evaluated by: ____________________ Date ____________________

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WALKDOWN DATA SHEET

SHEET __ OF __

Equipment ID No. ______________________ Equip. Class __________

Equipment Description ______________________

Equipment Location: Bldg. ______________ Floor El. _____ Room, Row/Col ____

Manufacturer, Model, Etc. ______________________

Drawing No. ______________________

Functionality Requirement

1. Function Required(Specify)______________________ Y N U

Review Criteria

1. Is component of good seismic design for function above Y N U N/A

(specify)______________________

Are the criteria met? Y N U N/A

Anchorage

1. Does strength appear adequate Y N U N/A
2. Does stiffness appear adequate Y N U N/A
3. No other concerns Y N N/A
4. Prepare and attach a sketch Y N

Are anchorages adequate based on judgment Y N U

Interaction Effects

1. Vulnerable components free from damaging impact by nearby equipment, structures, etc. Y N U N/A
2. No collapse of overhead equipment, distribution systems, or masonry walls Y N U N/A
3. No other concerns Y N

Is equipment free of interaction effects? Y N U

Comments ______________________

____

____

All aspects of the equipment's seismic adequacy have been addressed.

Evaluated by: ______________________ Date: ______________

Evaluated by: ______________________ Date: ______________

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Sheet 1 of ____

PIPING SYSTEM OUTLIER SHEET (PSOS)

OUTLIER NO.________

1. OUTLIER IDENTIFICATION AND LOCATION

Piping System I.D. ________________________________

Location________________________________

2. OUTLIER ISSUE DEFINITION

a. Identify the screening guidelines that are not met, or indicate if the analytical review selection fails the analysis criteria.

Piping and Tubing Review Criteria ____ Support Review Criteria ____
Interaction Effects ____ Other (specify) ____

b. Describe all the reasons for the outlier:

3. PROPOSED METHOD OF OUTLIER RESOLUTION (OPTIONAL)

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

b. Provide information needed to implement proposed method(s) for resolving the outlier:

CERTIFICATION: (Signatures of at least two Seismic Capability Engineers are required, one of whom is a licensed professional engineer.)

Print or Type Name/Title ____ Signature ____ Date ____

Print or Type Name/Title ____ Signature ____ Date ____

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ATTACHMENT B

SEISMIC REVIEW TEAM QUALIFICATION SHEET

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Seismic Review Team Qualification Sheet

1.0 Name: ______________________

2.0 Company: ______________________

3.0 Position: ______________________

4.0 Education: ______________________

5.0 Professional engineers registration: ______________________

6.0 Engineering discipline: ______________________

7.0 Areas of expertise: ______________________

	Experience	Years Experience
7.1	Knowledge of failure modes	________
7.2	Knowledge of nuclear design standards & nuclear seismic design practice	________
7.3	Seismic capability evaluations	________
7.4	Knowledge of equipment	
	- Nuclear	________
	- Heavy industrial process plants	________
	- Fossil fuel power plants	________
7.5	Conduit/Cable tray evaluations	________

8.0 Training Courses ______________________

9.0 Other qualifications ______________________

____

Signature: ______________________ Date: ______

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ATTACHMENT C

TRAINING SESSIONS RECORDS

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Training Sessions Records

Instructor:

Designated Attendees:

Print or Type Name	**Initial ***	**Signature ***	**Date**

* My signature/initials attest to my having read the training materials and having a general understanding of the subject matter. As of now, any questions I might have had regarding session subject matter have been answered to my satisfaction.

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ATTACHMENT B
Seismic Review Team Qualification Sheets (2 pages)

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Seismic Review Team Qualification Sheet

1.0 Name: DONALD P. MOORE

2.0 Company: SOUTHERN NUCLEAR

3.0 Position: CONSULTING ENGINEER

4.0 Education: BS CE, MS CE

5.0 Professional engineers registration: AL No 10722

6.0 Engineering discipline: CIVIL / STRUCTURAL

7.0 Areas of expertise:

	Experience	Years Experience
7.1	Knowledge of failure modes	37
7.2	Knowledge of nuclear design standards & nuclear seismic design practice	37
7.3	Seismic capability evaluations	37
7.4	Knowledge of equipment	
	• Nuclear	37
	• Heavy industrial process plants	–
	• Fossil fuel power plants	5
7.5	Conduit/Cable tray evaluations	37

8.0 Training Courses SQUG SCE TRAINING

9.0 Other qualifications

Signature: Donald Phillips Moore Date: 6/22/06

REGISTERED No. 10722 PROFESSIONAL ENGINEER DONALD PHILLIPS MOORE

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Seismic Review Team Qualification Sheet

1.0 Name: MELANIE H. BROWN

2.0 Company: SOUTHERN NUCLEAR

3.0 Position: SENIOR ENGINEER

4.0 Education: BS CE, MBA

5.0 Professional engineers registration: —

6.0 Engineering discipline: CIVIL/STRUCTURAL

7.0 Areas of expertise: STRUCTURAL ENGINEER, SEISMIC QUAL, SQUG

	Experience	Years Experience
7.1	Knowledge of failure modes	25
7.2	Knowledge of nuclear design standards & nuclear seismic design practice	25
7.3	Seismic capability evaluations	20 (~5 USING SQUG)
7.4	Knowledge of equipment • Nuclear • Heavy industrial process plants • Fossil fuel power plants	 25 — 3
7.5	Conduit/Cable tray evaluations	5

8.0 Training Courses SQUG SCE TRAINING (JAN 2002)

9.0 Other qualifications

Signature: Melanie Brown Date: 6-22-06

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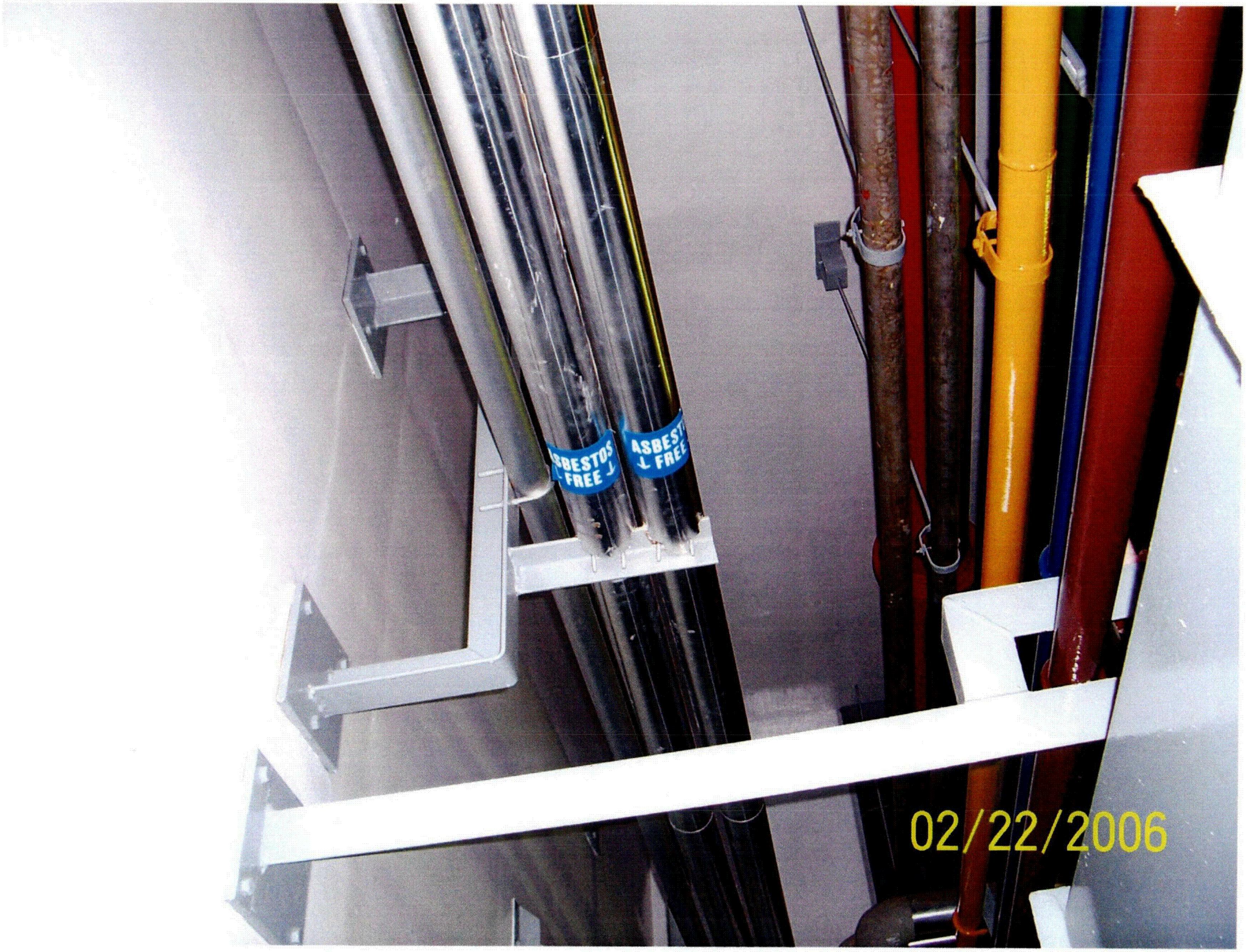
ATTACHMENT C
Representative Walkdown Photographs (4 photos)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02/22/2006


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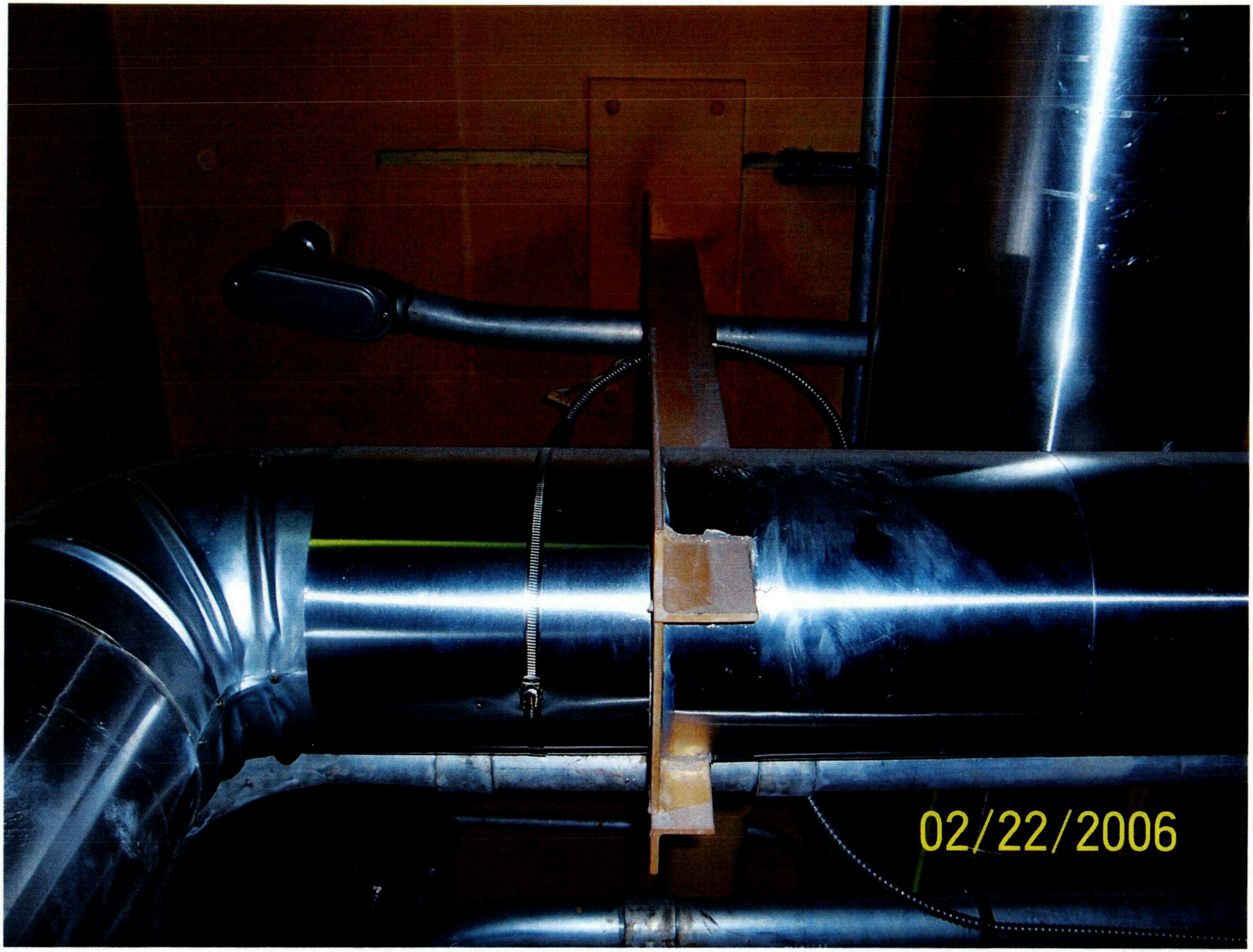
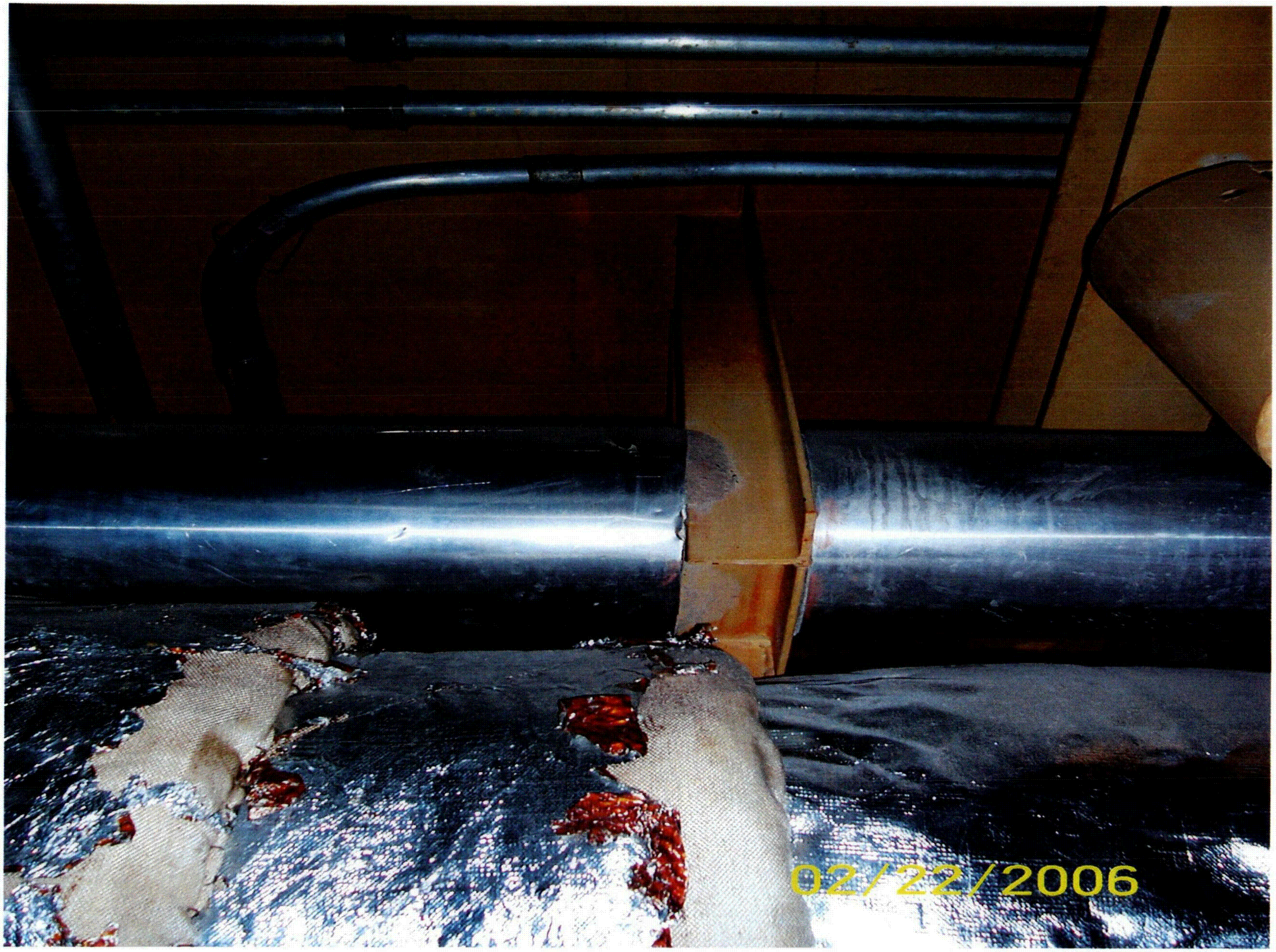
↓ FREE ↓
02/22/2006

RWCU

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