Enclosure 8

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

Unit 1 Main Steam Isolation Valve Alternate Leakage Path Seismic Evaluation

EDWIN I. HATCH NUCLEAR PLANT UNIT 1
MAIN STEAM ISOLATION VALVE
ALTERNATE LEAKAGE TREATMENT PATH
DESCRIPTION AND SEISMIC EVALUATION

JULY 28, 2006

INTRODUCTION

The primary components to be relied upon for pressure boundary integrity in resolution of the BWR MSIV leakage issue are: (1) the main turbine condenser, (2) the main steam lines from the MSIVs to the turbine stop and bypass valves, and (3) the main steam turbine bypass and drain line piping to the condenser. Earthquake experience has demonstrated that the welded steel pipe in these systems is seismically rugged. Based on post-earthquake reconnaissance, the BWROG seismic experience study has identified limited realistic seismic hazards, including support design attributes and proximity interaction issues, as potential sources of damage on a limited number of components. A review and evaluation were performed for Hatch Unit 1 to ensure that no such issues are present, thus providing reasonable assurance of the integrity of these systems and components. Seismic hazard issues identified during the review and evaluation are identified in this report, along with the required corrective action. This document summarizes the results of the review and evaluation.

PATH DESCRIPTION AND SCOPE OF REVIEW

Alternate Leakage Treatment Pathway

The Plant Hatch alternate leakage treatment (ALT) pathway for Unit 1 utilizes the large volume of the main steam lines (MSL) and the main condenser to provide holdup and plate-out of fission products that may leak through the closed MSIVs. The primary components of the ALT pathways are the main condenser, the main steam lines from the MSIVs to the turbine stop and bypass valves and the drain piping which originates downstream of the outboard MSIVs and terminates at the main condenser. The condenser forms the ultimate boundary of the ALT pathway. Existing valves upstream of the condenser are used to establish the flow path and isolate the boundaries of the path and to limit the extent of the seismic verification walkdown. Figure 1 shows a schematic of the ALT pathways. The model for evaluating reduction of MSIV leakage is provided in General Electric Topical Report NEDC-31858P-A, Rev. 2, "BWROG Report for Increasing MSIV Leakage Limits and Elimination of Leakage Control Systems."

The ALT pathway utilizes MSL drains to direct MSIV leakage to the main condenser. The ALT path is from the downstream side of the MSIVs through four 2-inch lines which join a 3-inch drain line to the main condenser. The path to the condenser is through MOVs 1B21-F020 and 1B21-F021. 1B21-F020 is normally open and will remain open. Valve 1B21-F021 is normally closed and must be opened. Class1E power has been restored to 1B21-F021 to assure the ability to open the valve. This valve was de-energized for Appendix R hi/low pressure boundary concerns. It will be opened by operator action from the Main Control Room (MCR) to initiate the flow path to the condenser. Valve 1B21-F019 is a normally closed MOV in the drain line upstream of 1B21-F020 and F021. It is a primary containment isolation valve (PCIV) and will close or remain closed to maintain the upstream boundary. 2-inch drain valve, MOV 1B21-F038, upstream of valve 1B21-F021 and downstream of valve 1B21-F019 is normally closed and will remain closed. As the flow path is via a 3-inch line without an orifice, even in the case of loss of offsite power (LOSP), the drain path to the condenser is open and would be available.

For additional assurance that the ALT pathway boundary is isolated and the release is via the condenser, automatic and operator actions will be taken to close boundary valves downstream of the MSIVs and upstream of the condenser. In the event of a LOCA, the MSIVs, the turbine stop valves and the turbine bypass valves will automatically close. Also, the reactor feed pump turbine (RFPT) stop valves, 1N11-F177 and 1N11-F178, which are hydraulic operated, will close on an automatic or manual trip of the RFPTs.

Operator action will be taken to isolate steam to the 2nd stage MSRs by closing MOVs 1N38-F101A and 1N38-F101B from the MCR. Steam to the steam jet air ejectors (SJAE) will be isolated by closing MOVs 1N11-F001A and 1N11-F001B at local panel 1H21-P216 and manual drain valves 1N11-F039 and 1N11-F041 locally. The seal steam line which comes off of MSL "C" will be isolated by closing MOVs 1N33-F012 and 1N33-F013 from the MCR. Finally, two manual drain valves, 1N11-F043 and 1N11-F044, on the steam lines to the RFPTs will be closed locally by operators.

The ALT pathway must be capable of performing its post-LOCA function during and following a Design Basis Earthquake (DBE), assuming offsite power is not available. For Plant Hatch, the valves required to open to establish the path to the condenser and boundary valves required to be closed to establish the path boundary are included in the plant's Inservice Inspection Program. The only active valve required to open to establish the ALT pathway, 1B21-F021, is powered from Class 1E sources and can be opened from the MCR in the event of LOSP.

In the unlikely event that 1B21-F021 fails to open, a secondary passive path with an orifice also exists. In this case, part of the flow would go through a normally open bypass with a 0.103" dia. orifice around 1B21-F021. The remainder would go to the condenser via the main steam stop and control valves before seat drain lines which contain a 0.850" dia. restricting orifice.

A seismic verification walkdown was performed to assure that the main condenser and steam piping systems in the ALT pathway fall within the bounds of the good seismic performance characteristics of the seismic experience data base contained in Appendix D to the BWROG Report for Increasing MSIV Leakage Rate Limits and Elimination of Leakage Control System (Reference 1). The seismic experience data base piping and equipment designs have demonstrated good seismic performance, and the piping and equipment designs at Plant Hatch, Unit 1 are equivalent to those represented in the seismic experience data base. Conditions that might lead to piping configurations that are outside the bounds of this conventional piping were noted during the walkdown. These conditions include anchorage or support capacity, failure and falling, proximity and impact, differential displacement, and valve operator screening (based on SQUG guidelines of Reference 8). These issues could create seismic hazards. The portions of the piping that are part of the ALT but were originally designed for seismic were also walked down to identify any seismic vulnerabilities. Table 2 summarizes the identified conditions (termed "outliers"), and their resolution. Note that some outliers were resolved by demonstrating analytically that the outlier did not create hazards. Other outliers required corrective action, as noted in Table 2.

Where analysis was used to resolve outliers, estimates of the realistic median-centered in-structure response spectra (IRS) were employed. These IRS are more representative of the actual response of the building during the Plant Hatch DBE seismic event than the original calculated DBE IRS due to better definition of the dynamic soil properties at the site. Estimation involved a comparison of the Hatch Unit 1 turbine building and control building structural models, and frequency shifting and scaling based on the median-centered response spectra generated for the control building Seismic Margin Assessment (SMA) for Unit 1. Note that Unit 1 and Unit 2 share the same control building. Details of the development of the estimate of the realistic median-centered in-structure response spectra are found in References 9 and 10.

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).

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 12). Comparisons of the ground spectrum were made to establish applicability of the BWROG experience-based methods for demonstrating seismic ruggedness of main steam piping, attached leakage path piping, other ALT pathways and boundary components, and associated supports/anchorages at Hatch Unit 1.

The majority of the ALT pathways and boundaries piping and components and the condensers at Hatch Unit 1 are located in the lower elevations of the Turbine Building. Portions of specific lines initiate within the main steam tunnel, and pass through the Reactor Building.

A composite comparison of the ground response spectra of selected earthquake experience database facilities (as accepted and shown in Reference 12) with the Hatch Unit 1 DBE ground spectrum is shown in Figure 2. The selected ground motions include the following nine sites from among the thirteen database facilities reviewed and accepted by the NRC in the Reference12 SER.

- 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)

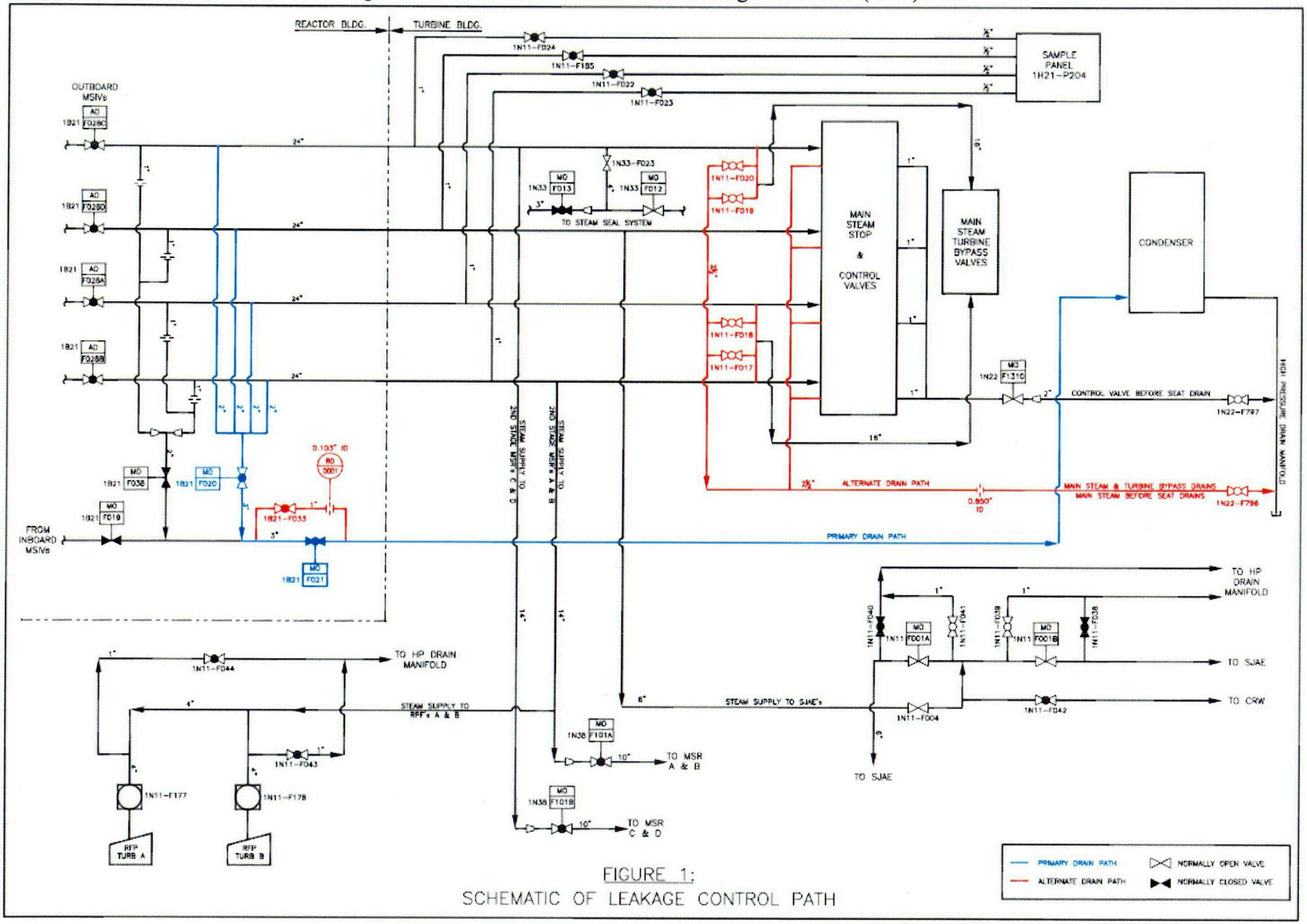
- Valley Steam Plant – USGS estimate
  1971 San Fernando Earthquake (M6.6)

In general, the earthquake experience database sites have experienced strong ground motions that are in excess of the Hatch Unit 1 DBE in the frequency range of interest. All the database site ground motions shown in Figure 2 envelope the Hatch Unit 1 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 spectrum 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 piping, related components and supports, and condensers – applied consistent with BWROG recommendations and SER limitations – is appropriate.

The following sections present experience database comparisons that are plant-specific to Plant Hatch Unit 1.

Figure 1: Schematic of the Alternate Leakage Treatment (ALT) Path



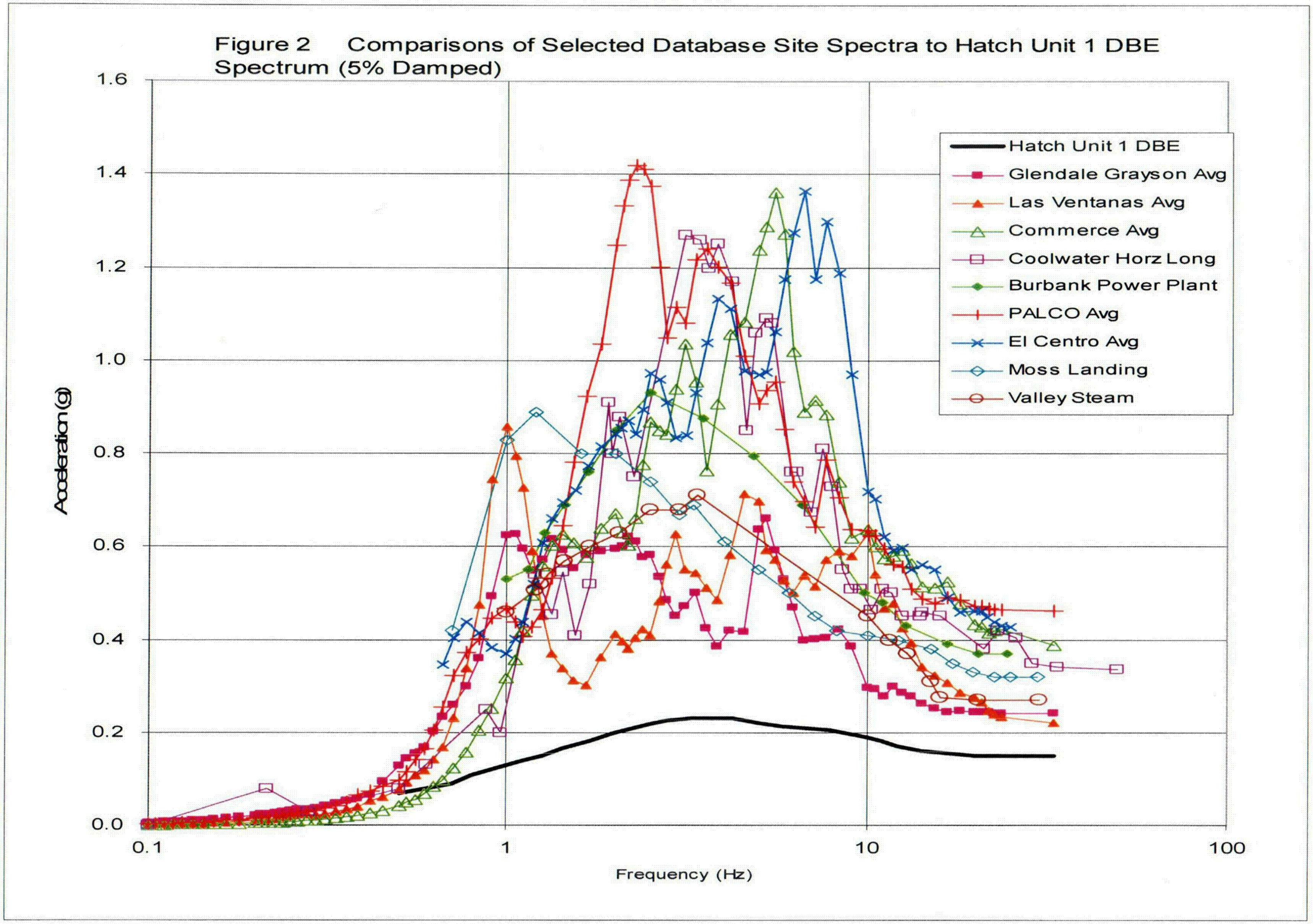


Figure 2 Comparisons of Selected Database Site Spectra to Hatch Unit 1 DBE Spectrum (5% Damped)
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Acceleration (g)
0.1
1
10
100
Frequency (Hz)
Hatch Unit 1 DBE
Glendale Grayson Avg
Las Ventanas Avg
Commerce Avg
Coolwater Horz Long
Burbank Power Plant
PALCO Avg
El Centro Avg
Moss Landing
Valley Steam

1.0 **TURBINE BUILDING**

Performance of the turbine building during a seismic event is of interest to the issue of MSIV leakage only to the extent that the structure and components should survive and not degrade the capabilities of the selected main steam and condenser pathways. A BWROG survey of this type of industrial structure has in general confirmed that excellent seismic capability exists. There are no known cases of structural collapse of either turbine buildings at power stations or structures of similar construction. Appendix D, Section 4.4, of Reference 1 summarizes the earthquake data of turbine buildings of similar construction to that of the Hatch Unit 1 turbine building.

To provide further documentation of the seismic ruggedness of the Hatch Unit 1 turbine building, reference is made to the Hatch Unit 1 Seismic Margin Assessment (SMA) (Ref. 2). As part of the Hatch Unit 1 SMA, the seismic margin of the turbine building was evaluated. The evaluation was performed using an earthquake ground motion of 0.3g peak ground acceleration (pga) tied to a NUREG 0098 median centered spectrum which is at least twice the Plant Hatch Unit 1 Design Basis Earthquake ground response spectrum. The Hatch Unit 1 DBE has a pga of 0.15g. The EPRI SMA methodology (Ref. 3) was used to perform this assessment. Using this methodology allows Category II structures such as the Hatch Unit 1 turbine building to be screened out at a high-confidence-of-low-probability of failure (HCLPF) of 0.3 pga if the structure is capable of meeting the 1985 UBC Zone 4 seismic requirements. The HCLPF is defined as the 95% confidence of less than 5% probability of failure. The turbine building was not explicitly designed to Zone 4 but it was designated for tornado wind forces due to wind speeds of 300 mph. The lateral loads due to the tornado winds used in the design and the ductile detailing of the structural connections used in the construction of the turbine building were compared to the requirements of Zone 4 of the 1985 UBC. This comparison demonstrated that the turbine building more than met the intent of the requirements of the 1985 UBC Zone 4 and therefore could be screened out with a HCLPF of at least 0.3g pga. The Plant Hatch Unit 1 SMA, of which this turbine building evaluation was a part, was carefully reviewed by the NRC and was found acceptable (Ref. 4, 5, and 6).

Thus, the turbine building at Hatch Unit 1 is a seismically robust structure, and there is no significant risk of damage to the structure that would degrade the capability of the main steam and condenser fluid pathways. Specific parameters involved in the design of the turbine building and the type of construction are provided in the following subsections.

1.1 Design Basis

1.1.1 Lateral Force Resisting System Superstructure Type (above turbine floor) is a braced or rigid frame structure depending on the direction of lateral load consisting of the following:

a. Column lines TA and TI comprise vertical, alternating bays of cross-bracing resisting N-S wind or seismic lateral loading conditions.

b. E-W lateral forces are resisted by rigid frame bents from column line T1 to column line T9.

c. The end bays at column line T1 resist lateral loads by a braced frame

d. The turbine floor and roof bottom cord bracing at elevation 225'-8" serve as diaphragms to distribute lateral loads to adjoining rigid frame bays in the E-W direction, or the braced bays in the N-S direction.

1.1.2 Lateral Force Resisting System Substructure Type (turbine floor elevation 164' and below)

a. This reinforced concrete structure, elevation 112'-0" to 164'-0", consists of reinforced concrete pilasters that support the rigid frame bents above the turbine floor. These pilasters carry the loads to the base mat.

b. Concrete walls serve as shear walls for lateral loads in the N-S and E-W direction.

1.1.3 Design Codes

All category II structures are designed to conform to:

a. 1967 Edition of the Uniform Building Code (UBC)

b. American Institute of Steel Construction (AISC) Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings, Sixth Edition.

c. American Concrete Institute (ACI) Building Code Requirements for Reinforced Concrete (ACI 318-63).

d. American Welding Society (AWS) Standard Code for Arc and Gas Welding in Building Construction (AWS D1.0-69 or AWS D2.0-69 as applicable).

e. Southern Standard Building Code.

1.1.4 Seismic Design Basis

Note that wind loading was demonstrated to dominate design over the UBC requirements (see Section 1.1.5).

a. UBC requirements for seismic zone 1.

b. Comparison of lateral force magnitudes showed tornado loads governed over earthquake loads.

c. See section 1.1.6 for load combinations.

1.1.5 Wind Design Basis

a. Wind Loads

The dynamic pressures used in the design of this plant are derived from ASCE Publication #3269 as it applies to the Hatch Nuclear Plant.

$$q = 0.002558V^2$$

where q is the velocity pressure in psf, and V is the wind velocity (mph). It was assumed that 80% of q is acting as pressure on windward side and 50% as suction on leeward side.

$$p = 1.3q = 0.0033V^2$$

Wind Loads:

Height (ft)	Class II Structures: 50 Year Recurrence				
	Velocity		Pressure	Suction	Total
	(mph) v	(psf) q	(psf) .8q	(psf) .5q	(psf) p
0-50	100	26	21	13	34
50-100	125	40	32	20	52
150-400	156	62	50	31	81

(1) Siding and girts were designed for the wind pressures shown in the previous table. One third increase in allowable stresses was permitted. Siding and girts were designed to remain in place with tornado loading.

(2) Roof deck was designed for DL plus applicable LL and was checked for pressures acting upward normal to the surface equal to three-fourths of the values of q set forth in the wind loads table above combined with DL only. For wind load and internal pressure, one third increase in allowable stress was permitted.

b. Tornado effects included in design consideration

(1) The velocity components applied as dynamic pressures normal to the walls of the building correspond to a 300 mph wind. ASCE paper 3269 was used to determine the proper drag and slope coefficients to be used for design. Maximum translational velocity of 60 mph was considered only for the purpose of computing depressurization.

(2) The tornado induces differential pressures between the inside and outside non-venting compartments, reaching a maximum bursting pressure of 3 psi (432 psf). For those compartments that are vented, either of the following was assumed: Hoecker's pressure profile for the Dallas Tornado of 1954, extrapolated to a 60 mph maximum translational velocity; or a simplified, idealized version of it where a constant pressure-drop rate of 1 psi/sec was assumed.

(3) A missile impingement at any height on the structure equivalent to a 4" x 12" x 12' long wood plank (108 pounds) traveling end-on at 300 mph or a 4000 pound passenger auto flying through the air at 50 mph, at not more than 25 feet above the ground with a contact area of 20 sq. feet was used.

(4) A torsional moment resulting from applying the wind specified in 1.1.5b(1) above on one-half the structure and wind velocity equal to one-half that specified in 1.1.5b(1) above applied to the other half of the building in the opposite direction was used.

(5) Blow-out panels designed to open at 50 psf internal differential pressure were considered in building design. The air flow and rate of depressurization depend upon the location and size of these panels. Exterior precast concrete panels were used either by themselves or in conjunction with poured-in-place concrete. These structural elements and their supports were designed to withstand the combined tornado loads discussed in 1.1.5b(1), (2), and (3) above without exceeding permissible stresses of 90% f_y for reinforcing steel and 75% f^1c the concrete per applicable WSD formulae and 100% f_y for structural steel.

1.1.6 Load Combinations

D = Dead Loads
L = Live Loads
W = Wind Loads
W^1 = Tornado Loads
E = Earthquake Loads

Load Combinations	Allowable Stress
D + L + E	WSD – in accord. w/UBC
D + L + W	WSD – 1/3 increase in stress
1.0D + 1.0L + 1.0W^1	See 2.1.5b(5)

Live loads were allowed to be omitted, if the omission produced a more severe condition. Any other loads were included in the load combinations.

While the Turbine Building was designed as a category II structure, to withstand the effects of the UBC earthquake, critical portions of the

turbine building were also evaluated for OBE and DBE seismic loads to ensure no collapse on category I structures or components. The load combinations considered were:

Load Combinations	Allowable Stress
D + L + OBE	WSD – normal stress
1.0D + 1.0L + 1.0DBE	USD

Φ Factors for Reinforced Concrete USD

Φ = 0.90 for concrete in flexure
Φ = 0.85 for diagonal tension, bond and anchorage
Φ = 0.75 for spirally reinforced compression members
Φ = 0.70 for tied compression members

2.0 MAIN TURBINE CONDENSER

The Hatch Unit 1 condenser consists of a two-shell, single pass unit, with heat transfer surface area of 280,000 ft^2 per shell. In Table 4-3 of Appendix D of Reference 1, the design attributes of this condenser are compared to the two condensers in the earthquake experience database most representative of the BWR type condensers: Moss Landing Units 6 & 7, and Ormond Beach Units 1 & 2. Note that the Hatch condenser is composed of two structurally independent shells, which may be independently compared to the earthquake experience condensers.

The condenser shells of the Hatch and the database condensers are 0.75" thick ASTM A-285C. The overall size and weight of the Hatch condenser are generally enveloped by the database condensers, as shown in Figure 3. The overall dimensions of the Hatch condenser are well represented by the earthquake experience data as well (Figure 4).

In summary, the Hatch Unit 1 condenser design and anchorage are similar to those at facilities in the earthquake experience database that have experienced earthquakes in excess of the Hatch Unit 1 design basis earthquake (see Figure 2). As discussed in Appendix D, Section 4, of Reference 1, amplification of ground input would be small.

> "Condensers at both BWR and data base facilities are located low in the structure on stiff foundations. Therefore, seismic input to the condensers should be roughly the same as ground input. Any amplification of ground input would be small and comparable in both BWR and data base facilities."

Appendix D of Reference 1 contains details of the earthquake experience for condensers. Hatch specific data used in the evaluation are as follows.

2.1 Design Basis

2.1.1 Design Code:

Heat Exchange Institute (HEI) Standards

2.1.2 Hydrostatic Test Requirement:

Shell – Completely filled with water and inspected for leakage.
Waterboxes – Design pressure was 55 psig, test pressure was 60 psig per HEI. Latest edition of HEI, however, requires hydrostatic test pressure to be 1.5 times design pressure.

2.1.3 Anchorage

Material changes of the tubes and tubesheets in the Unit 1 main condensers produced a net weight reduction of 425K and caused the condensers to have additional uplift loads during operation. New hold-down bolts were installed to handle these new uplift forces. These hold-down bolts offer no shear resistance.

Each condenser footing has 4 – 2 ¼" ASTM A36 anchors that project through a 2" thick sole plate. The sole plate has 1 ½" thick x 50" long shear plates that extend 4 inches down into a 4 foot high reinforced concrete pier. The concrete pier is anchored into the turbine building base slab. Shear forces are transferred from the anchor bolts into the sole plate and are carried through the reinforced concrete pier down into the base slab. Figure 6 shows the location of the anchors and the orientation of the slots for the anchors at the piers.

There is thermal growth of the condenser from a fixed point at the base; however, the condenser footings are designed with slotted holes so that no forces are transmitted into the piers due to thermal growth. Figure 6 shows the anchor layout.

The shear area divided by the demand (the condenser weight times peak ground acceleration) was used to compare anchorage in the earthquake experience data base. The values for Hatch Unit 1 condenser are: lower bound, 0.000130 in^2 per lb; upper bound, 0.000196 in^2 per lb. These values are higher than for many of the BWR condensers, and significantly higher than the comparable data base sites (see Figure 5; see also Reference 1, Figure 4-10 and 4-11).

2.1.4 Manufacturer: Foster Wheeler Energy Corporation.

2.1.5 Size, Weight, Dimensions:

Size – 560,000 ft^2 total, 280,000 ft^2 per shell.

Weight – (Based on new titanium tubes and tubesheets)
Dry Weight Per Shell 775,000 lbs.
Operating Weight Per Shell 1,627,000 lbs.

Dimensions – Per Shell
Length: tubesheet to tubesheet 50'-0"; overall incl. waterboxes 66'-7"
Width: 29'-0"
Height: 23'-9"
Height: incl. neck and exp. joint, 41'-2"; base slab to turb. conn. 45'-6"

Total plan dimensions for both shells – Length 66'-7"
Width 65'-8 ½"

2.1.6 Type: Base supported, rectangular, twin shell, single pass.

Figure 3: Size Comparison of the Hatch Unit 1 Condenser
with Representative Condensers from Earthquake Experience Database

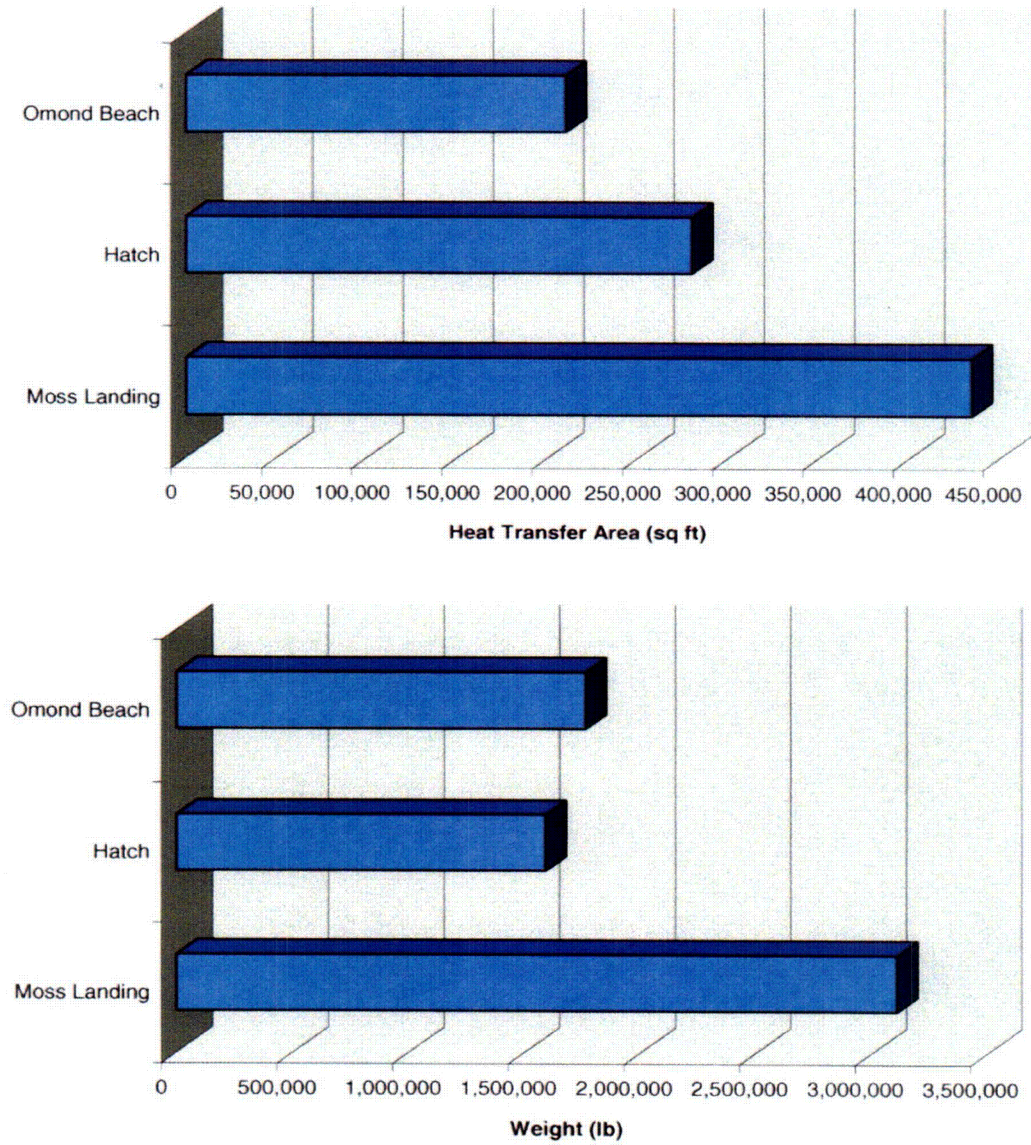
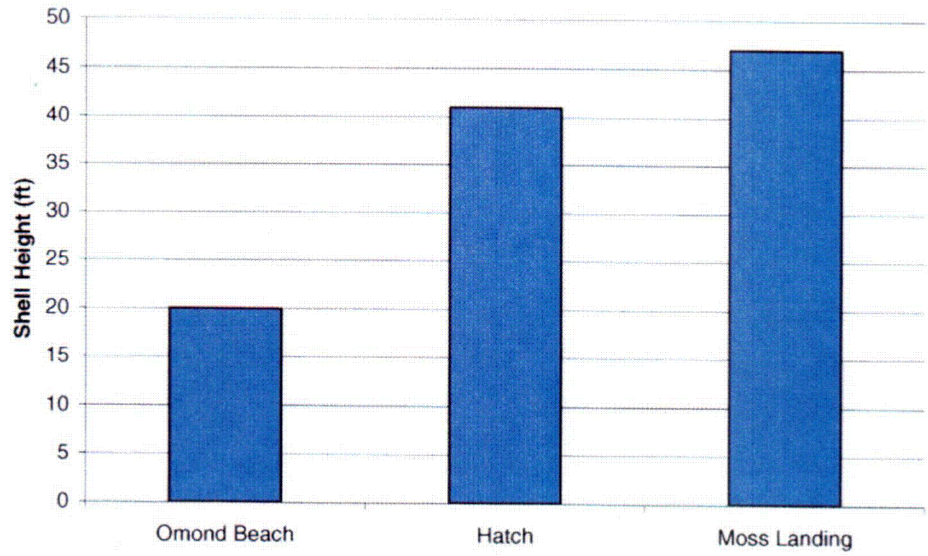
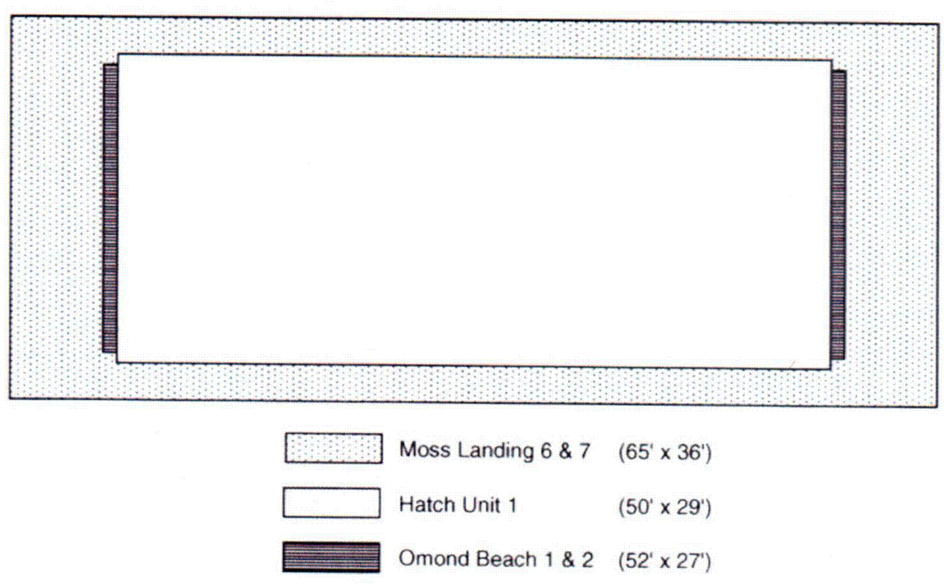


Figure 4: Dimensional Comparison of the Hatch Unit 1 Condenser
with Representative Condensers from Earthquake Experience Database



(a) Height Comparison



(b) Shell Footprint Comparison

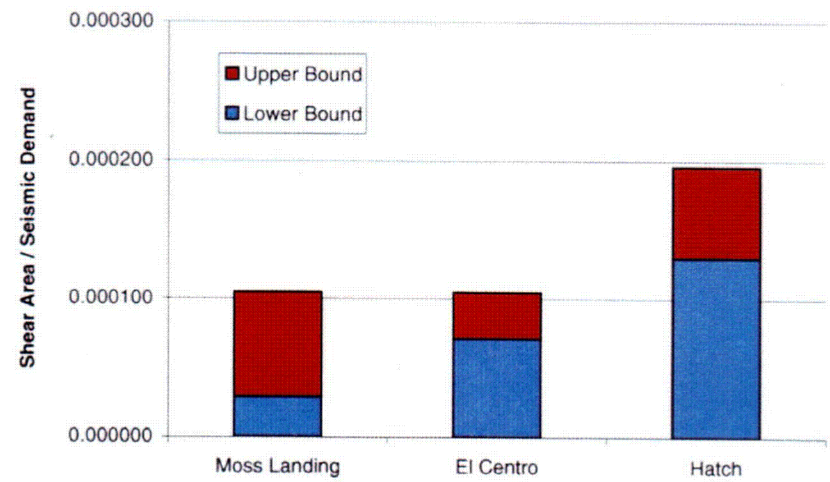


Figure 5a: Anchorage Capacity-to-Demand Ratio: Comparison of Hatch Unit 1 Condenser to Selected Data Base Sites: Parallel to Turbine Generator Axis (data from Reference 1, Appendix D, Figure 4-10 and 4-11)

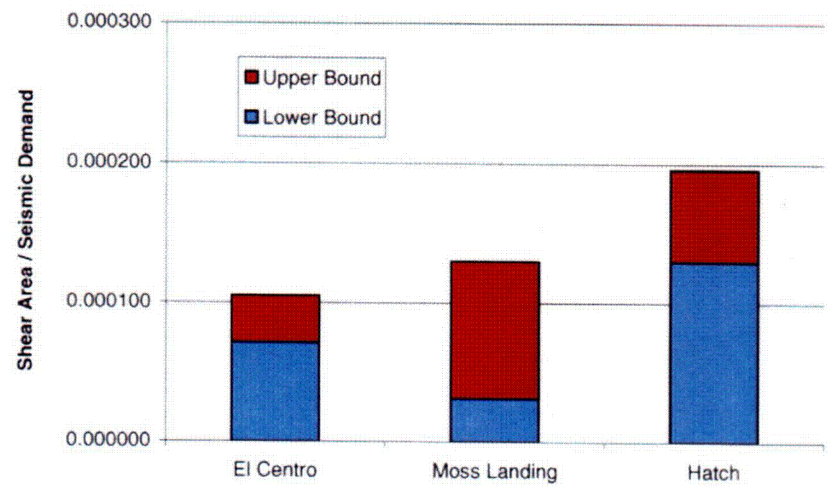


Figure 5b: Anchorage Capacity-to-Demand Ratio: Comparison of Hatch Unit 1 Condenser to Selected Data Base Sites: Perpendicular to Turbine Generator Axis (data from Reference 1, Appendix D, Figure 4-10 and 4-11)

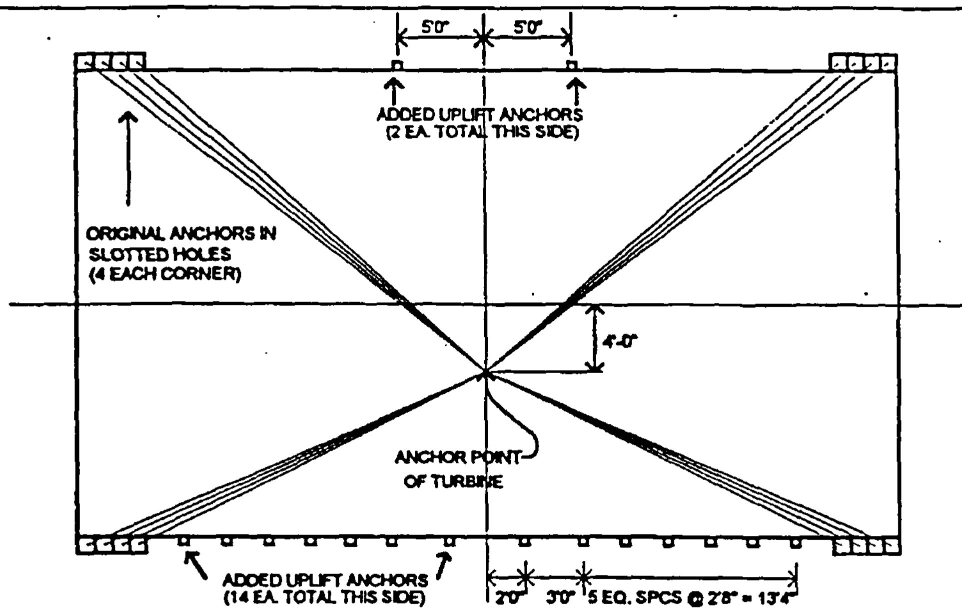


Figure 6a: Layout of Anchors

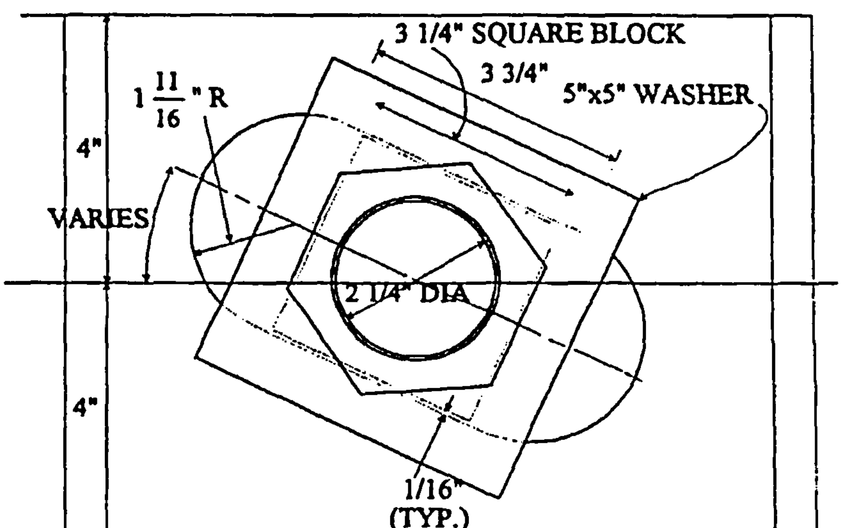


Figure 6b: Orientation of Slot for the 16 Original Anchors

2.1.7 Shell Material and Thickness:

Material – ASTM A-285 Gr. C. Flange Quality
Thickness – ¾"

2.1.8 Tube/Sheet Design
Material – Titanium
Thickness – 1.125"
Tubes – 1" OD titanium, 22 BWG, 21,480 tubes per shell, 42,960 tubes total.
Support Plate Spacing – 40" – Spacing design was based on original Admiralty tubes.
Stakes were added when the condenser was re-tubed with titanium.

2.1.9 Hotwell Capacity: 3 minutes, 63,600 gallons total.

2.1.10 Expansion Joint Design: 12 inch, stainless steel, convolute type.

2.2 Plant-Specific Analytical Evaluation of Condenser Anchorage

To provide additional seismic verification of the Plant Hatch condenser, a seismic response spectrum analysis was performed of the condenser to evaluate the condenser anchorage. As previously discussed the condenser is supported at its four corners by reinforced concrete piers. At each pier there are four 2-1/4" diameter cast-in-place anchor bolts to secure the condenser on the piers. Horizontal shear from the condenser is transferred through these bolts to the embedded sole plate to the piers. Each sole plate has welded to it shear plates that directly transfer the shear from the sole plate to the reinforced concrete piers.

In order to obtain a realistic seismic response at the concrete piers, a seismic response spectrum analysis of the Plant Hatch condenser was performed using finite element modeling technique. A general purpose computer program ANSYS was employed for modeling and analysis purposes. The same finite element model was also used to generate the reaction loads at the concrete piers due to vacuum pressure load condition. Manual calculations are used to establish the dead load and nozzle load reactions due to recirculating water inlet and outlets.

The results reported here are based on calculated in-structure response spectra from an analysis of the Turbine Building using the CLASSI set of programs consistent with the seismic input and methodology used for the Hatch Unit 1 Seismic Margin Assessment of its Seismic Category 1 structures (Ref. 2). This approach has previously been reviewed and accepted by the NRC (Ref. 4, 5, and 6). The resulting calculated Turbine Building SME IRS are a more accurate representation of the true seismic demand than the "estimated seismic demand" used in all other seismic evaluations for the Unit 1 MSIV alternate leakage treatment (ALT) pathways discussed in this report. It should be noted that the "estimated seismic demand" was found to be higher, i.e., more conservative, than the more accurate calculated Turbine SME IRS.

The SME IRS are based on an input ground motion equal to a 0.3g peak ground acceleration (PGA) NUREG/CR-0098 spectral shape. These SME IRS were therefore multiplied by ½ to obtain IRS at a PGA of 0.15g which is the Plant Hatch Unit 1 Design Basis Earthquake (DBE) PGA. It should also be noted that the ½ of the Hatch SME ground response spectrum is equal or

greater than the Hatch Unit 1 DBE ground response spectrum. Therefore, the ½ SME ground motion is conservative when compared to the Hatch Unit 1 DBE ground motion.

The anchorage capacity to demand results for load cases that include the Turbine Building ½ SME IRS plus operating loads demonstrated that all four sets of the cast-in-place anchor bolts at the piers and the hold down bolts on the sides, see Figure 6, have capacities greater than their demand for all load combinations. Anchorage capacities are based on the SQUG GIP (Ref. 8) and the GIP supporting document on seismic verification of equipment anchorage (Ref.11). The reinforced concrete piers were also evaluated for these load combinations. Capacities were determined using ACI 318 Ultimate Strength Design. The reinforced concrete pier capacities were also found to have capacities greater than demand.

The ½ SME IRS for all practical purposes satisfy current seismic analysis criteria as specified in NUREG-0800, but for resolution of USI A-46 an additional conservatism was added by treating the ½ SME IRS as realistic median-centered IRS. Using this conservative definition of the IRS would invoke an additional factor of conservatism of 1.25 (Table 4-2 of Ref. 8) for anchorage evaluations. Increasing the Turbine Building seismic demand by an additional 25% caused two of the four sets of the cast-in-place anchor bolts for one load case to exceed their allowable capacity by about 11%. This slight exceedance is judged acceptable when considering that the bolt material has probably higher yield strength than the specified minimum and the fact that the total load from all four piers for that load case is less than the total capacity of the anchor bolts at those four piers.

It is concluded that this additional condenser anchorage evaluation further supports the fact that the condenser will remain in place and provide the necessary structural integrity required for the purposes of the MSIV leakage.

3.0 MAIN STEAM AND DRAIN LINE/BYPASS PIPING

Portions of main steam and drain line/bypass piping designs that have not been seismically analyzed were reviewed to demonstrate that piping and supports fall within the bounds of design characteristics found in selected conventional power plant steam piping. These conventional power plant steam piping designs demonstrated good seismic performance and were shown to be comparable to the steam piping design for Hatch Unit 1. This included (1) a review of design codes and standards used to ensure adequate dead load support margin and ductile support behavior where subject to lateral loads, and (2) a walkdown to verify that small diameter piping and instrumentation is free of impact interactions from falling and proximity or differential motion hazards.

Seismically analyzed lines included the Main Steam Line (from the MSIV to the turbine stop valve) and the turbine bypass (to the bypass valves), the drain line portion in the reactor building, and portions of various main steam branch connections to the seismic anchor downstream of the isolation valves for the branch. Design methods for these analyzed lines are consistent with Seismic Category I qualification methods for Plant Hatch Unit 1 and design margins are the same as for other Seismic Category I piping. The seismically analyzed portions of the system were also included in the seismic verification walkdown to ensure that there were no seismic vulnerabilities not considered in the analysis.

For lines designed by rule or by approximate methods such as the drain path (in the turbine building) and interfacing piping, it was demonstrated that these systems are composed of welded steel pipe and standard support components, well represented in conventional plants in the earthquake database. Further, it was demonstrated that adequate design margins exist for typical or bounding support designs.

In summary, the piping for the main steam and bypass was seismically designed in accordance with ANSI B31.7, Class 2. Thus, although it has thinner walls than most piping of its size in the earthquake experience data base, its seismic capability is evident based on analysis and the seismic verification walkdown. The main drain and associated piping are similar to the piping found in commercial piping systems in the earthquake experience data base that have experienced earthquakes in excess of the Hatch Unit 1 Design Basis Earthquake (See Figure 2 and References 1, 7). Minor interaction issues identified in the walkdown that could be potential sources of damage were evaluated, and, where necessary, action has been initiated to eliminate the potential (see Table 2). Specific data used in the evaluation is summarized below. For the main drain and interconnected piping, it was demonstrated that adequate design margins exist to provide reasonable assurance that piping position retention will be maintained by the system dead weight supports under normal and earthquake loading.

3.1 Main Steam and Turbine Bypass

These systems were analyzed in accordance with the ANSI B31.7, Class 2, using response spectrum analysis techniques. The analysis model included the main steam (to the turbine), the bypass line, and significant branch piping up to the seismic anchor. For the steam seal, the moisture separator reheater, steam jet air ejector, and the reactor feed pump branches, the anchor is downstream of the isolation valve. Piping downstream of isolation valve is classified as B31.1

piping. Thus, detailed seismic design analysis was performed for these portions of the systems. Margin for the main steam and turbine bypass is basically the design margin inherent in the seismic design codes.

3.1.1 Design Basis

3.1.1.1 Piping Design Code: ANSI B31.7, Class 2, 1969 and B31.1, 1967

3.1.1.2 Piping Design:

a. Design Temperature: 545°F
   Design Pressure: 1250 psi
b. Pipe Material: ASTM A106-B
   Size, schedule, and D/t

Pipe Size (NPS)	Thickness (inch)	D/t
24	1.531	16
24	1.218	20
16	1.031	16
10.75	0.718	15
10.75	0.593	18
4.5	0.437	10
4.5	0.337	13
6.625	0.562	12
6.625	0.432	15
14	0.937	15

c. Typical Support Spacing: B31.1 suggested span

d. Support Types: Springs, struts, snubbers, box types, etc.

e. Design Loading: Weight, thermal expansion, seismic, steam hammer

f. Analysis Method: Linear elastic analysis, seismic response spectrum analysis, steam hammer time history

g. Seismic and Dynamic Design Basis – Response spectrum analysis using floor response spectra based on the Design Basis Earthquake (DBE) from the FSAR (0.15g maximum ground motion – see Figure 2 for comparison to experience data base ground motion)

3.1.1.3 Pipe Support Design Code: AISC, ANSI B31.1

3.1.2 Margin Assessment:

Design methods for these analyzed lines are consistent with seismic Category I qualification methods for Plant Hatch and design margins are expected to be adequate to ensure good seismic performance.

3.1.3 Main Steam and Turbine Bypass Supplemental Verification Walkdown Results

See Table 2.

3.2 Main Steam Drain to Condenser

The main steam drain to the condenser is welded pipe, and was analyzed by rule and approximate methods. The main drain and associated piping are similar to the piping found in commercial piping systems in the earthquake experience data base that have experienced earthquakes in excess of the Hatch Unit 1 Design Basis Earthquake (see Figure 2). In addition, as stated in Appendix D, Section 4, of Reference 1, the amplification in BWR turbine buildings would be typically less than that experienced by the bulk of the buildings from which the piping data base is formed. Therefore, the bulk of the piping systems in the data base have experienced significantly higher seismic motion than that which would be experienced by the piping in the Hatch Unit 1 turbine building due to a DBE event. Minor interaction issues identified in the walkdown that could be potential sources of damage were evaluated, and, where necessary, action has been initiated to eliminate the potential (see Table 2). Specific data used in the evaluation is summarized below. For these lines, it was demonstrated that adequate design margins exist to provide reasonable assurance that piping position retention will be maintained by the system dead weight supports under normal and earthquake loading.

3.2.1 Design Basis

3.2.1.1 Piping Design Code: ANSI B31.1

3.2.1.2 Piping Design

a. Design Temperature and Pressure: 575°F and 1250 psi; 562°F and 1146 psi

b. Pipe Material: ASTM A106-B
Size, Schedule and D/t: NPS 3, schedule 160, D/t = 8, and NPS 1, schedule 160, D/t = 5

c. Typical Support Spacing: B31.1 suggested spans

d. Support Types: Rigid struts, rods, springs

e. Design Loading: Weight, thermal expansion, hydro, seismic (inside reactor building only).

f. Analysis Methods: Linear elastic analysis

g. Seismic and Dynamic Design Basis: Response spectrum analysis using the Deisgn Basis Earthquake from the FSAR (inside Reactor Building); linear

elastic analysis (Turbine Building – dead weight and thermal only; no seismic)

3.2.1.3 Pipe Support Design Code: AISC and MSS SP-58

3.2.2 Margin Assessment

This assessment is to demonstrate the Main Drain Line supports provide adequate margins when subject to weight and seismic load, thus providing reasonable assurance that the position retention of the line will be maintained during a seismic event. In conjunction with the field verification, this assessment has provided assurance that the supports will behave in a ductile manner and that the lines are free of known seismic hazards. Further, it demonstrates that the Hatch designs will perform in a manner similar to piping and supports that have observed good seismic performance in past strong ground motion earthquakes. The methodology utilized to demonstrate the margins inherent in the piping support designs is based on capacity to demand check using the following steps:

- Conservative estimate of the Turbine Building earthquake response spectrum
- The estimated structural and piping response
- The component support capacity is conservatively estimated

This combination of conservatively defined seismic demand, piping and piping support response to the seismic demand, and conservative estimate of capacity is considered to result in a high confidence of reasonable assurance of performance.

3.2.2.1 Seismic Demand

Seismic demand is estimated based on the Hatch Unit 1 median centered seismic margins earthquake response spectra developed for the control building (Ref. 2, 5, & 6), and on the similarity of the turbine building and control building structures. Scaling and frequency shifting was performed using the original response spectra for the two buildings and the median centered margins response spectra for the Unit 1 control building. Details of the development of the estimate of the realistic median-centered in-structure response spectra are found in References 9 and 10.

3.2.2.2 Piping System Response Estimation

The system response estimation is based on the following:

- Loading Combination: Operating Mechanical Loads + Dead Weight + Seismic
- Component Standard Supports Evaluated by Load rating: $1.67(\text{LDC})\ \frac{Su}{Su^*}$

where,

LCD	=	load capacity data (catalog rated load)
S_u	=	Material ultimate strength at temperature

S_u* = Material ultimate strength at test temperature

Operating mechanical loads for this system are thermal expansion loads. Piping systems designed utilizing rod supports typically do not impose constraints on thermal expansion, and thermal loads are not typically considered in support design. However, thermal loading was considered in the support evaluation performed on the ALT path piping.

3.2.2.3 Pipe Support Component Capacities

The supplemental field verification determined that the support types used are considered to have good seismic performance. The system is predominantly supported utilizing dead load rods. These designs are constructed from standard support catalog items and typically consist of clamps, threaded rod, weldless eye nuts, turnbuckles, clevis and welded lug attachments to either concrete or to steel structures. These types of supports are designed to resist vertical load in tension. Design capacities are provided by manufacturers' ratings.

Load capacity ratings for piping standard supports are typically based on test and utilize a factor of safety of 5 in accordance with MSS SP-58. Therefore, the test load on which the load capacity data (LCD), i.e., catalog rated design load, is based on a factor of five higher than the LCD. The margins capacities of the standard piping supports were conservatively taken as the LCD x 1.67, corresponding to the faulted limits listed in the LCD of the identical standard supports. This margin capacity is conservative, but is used to be consistent with the previously submitted Hatch Unit 2 evaluation. By meeting this limit, the supports have the same margin as other Seismic Category I components.

Evaluation of bolted anchorage to concrete follows the procedures established in the Generic Implementation Procedure (GIP) for Seismic Verification of Nuclear Plant Equipment (Reference 8).

3.2.2.4 Margins Evaluation Results and Conclusions for Pipe Supports

All supports for the main drain to condenser inside the turbine building were evaluated based on the results of the supplemental field verification. Note that the portion of the main drain to the condenser inside the reactor building was seismically designed. For the portion of the main drain inside the turbine building, the pipe supports (MSS SP-58 components) have a margin that is over four (4.0) times the seismic demand based on the Plant Hatch DBE when combined with normal piping loads. Therefore, it is concluded that the system design has adequate margin to ensure position retention. Furthermore, based on the supplemental field walkdown inspection, the piping systems and their supports are similar to piping system and support designs that have experienced strong ground motion and demonstrated good seismic performance.

3.2.2.5 Bounding Seismic Analysis of the Main Drain Piping

As a check of the reasonableness of the application of the experience data to this system, a seismic response spectrum analysis of the main drain in the Turbine Building was performed using the estimated Turbine Building 5% IRS (see Section 3.2.1.4.1). This was considered to be the bounding seismic analysis of the main steam drain inside the Turbine Building. The seismic response spectrum evaluation of the main drain support was computed using a piping analysis computer code. The results of the piping analysis yields safety factors of 1.72, 1.96, and 1.78 relative to the code limits for sustained loads, faulted occasional loads, and thermal expansion loads respectively. Note that these factors were obtained without removing the conservatism inherent in ANSI B31.7, Class 2 (equivalent to ASME Section III, Class 2) equations and stress allowables.

3.2.3 Main Steam Drain to Condenser Supplemental Verification Walkdown Results

See Table 2.

4.0 INTERCONNECTED SYSTEMS

The interconnected systems are composed of welded steel piping and standard support components, well represented in the earthquake experience database. These systems, analyzed by rule and approximate methods, are similar to the piping found in commercial piping systems in the earthquake experience data base that have experienced earthquakes in excess of the Hatch Unit 1 design basis earthquake (see Figure 2). Minor interaction issues identified in the walkdown that could be potential sources of damage were evaluated, and, where necessary, action has been initiated to eliminate the potential (see Table 2). Specific data used in the evaluation is summarized below. For these lines, it was demonstrated that adequate design margins exist to provide reasonable assurance that piping position retention will be maintained by the system dead weight supports under normal and earthquake loading.

4.1 Design Basis

Table 1 shows the design parameters for the interconnected piping associated with the main steam, main steam bypass, main drain, and condenser.

4.1.1 Margin Assessment for Interconnected Systems

The methodology employed for the interconnected systems was the same as for Main Steam Drain to Condenser, Sections 3.2.2.1 thru 3.2.2.4.

Several support for interconnected systems were selected for evaluation based on the results of the supplemental field verification. Except for a few U-bolt supports, the support and anchorage design margins are significantly higher than the 0.15g plant design basis. The minimum design margin for the pipe supports and pipe support anchorage is over three (3.0) times the 0.15g plant design basis. Some U-bolt supports did not have these high design margins, primarily due to conservative assumptions which were made due to lack of detailed information about the orientation and mounting. These supports were identified as outliers, and have been modified as necessary. Therefore, it is concluded that the system design has adequate margin to ensure position retention. Furthermore, based on the supplemental field walkdown inspection, the piping systems and their supports are similar to piping system and support designs that have experienced strong ground motion and demonstrated good seismic performance.

4.1.2 Supplemental Verification Walkdown Results for Interconnected Systems.

See Table 2.

Table 1: Interconnected System Design Parameters

System Designation	Piping Design Code	Temp. (°F)	Pres. (psig)	Size (NPS)	Sch	D/t	Support Spacing	Support Types	Des. Code	Loading	Analysis Methods	Seismic Des. Basis to Anchor (Note 1)
Main Steam to Steam Jet Air Ejectors	ANSI B31.1	562	1146	6"	80	15	ANSI B31.1	Rod hangers, concrete anchors, bolted connections	AISC, MSS SP58	DW, Thermal, Hydro	Linear Elastic	RS anal. Using DBE
Main Steam to Reactor Feed Pump Turbine	ANSI B31.1	562	1146	4"	80	13	ANSI B31.1	Rigid struts, snubbers	AISC, MSS SP58	DW, Thermal, Hydro	Linear Elastic	RS anal. Using DBE
Main Steam to Moisture Separator Reheaters	ANSI B31.1	575 & 562	1250 & 1146	8" & 10"	80	17, 18	ANSI B31.1	Springs, struts, snubber, box type	AISC, MSS SP58	DW, Thermal, Hydro, Seismic (Note 2)	Linear Elastic, RS Analysis, steam hammer time history	NA (see note 2)
Instrument Header to Pressure Transducers	ANSI B31.1	575	1250	1" & 4"	160 & 120	5 & 10	ANSI B31.1	Mostly rod hangers	AISC, MSS SP58	DW, Thermal, Hydro	Linear Elastic	None
Main Steam to Sample System	ANSI B31.1	583	1387	½" tubing	.065 wall	8	ANSI B31.1	Standard tubing clips	AISC, MSS SP58	DW, Thermal, Hydro	Linear Elastic	None
Miscellaneous Drains	ANSI B31.1	562	1162	1", 2", 3"	160	5, 7, 8	ANSI B31.1	Rods, U-bolts, boxed supports, etc.	AISC, MSS SP58	DW, Thermal, Hydro	Linear Elastic	None

Note 1: This column applies only to the portion of systems which were included in the seismic analysis of the main steam. This analysis ended at the first anchor.

Note 2: Alternate Leakage Treatment Path boundary valve is before seismic anchor, so that all of this portion of the ALT was included in the seismic analysis of the main steam.

Table 2: Outlier Identification and Resolution

System Description	Outlier Description	Outlier Type (Potential Failure Mode)					Resolution Status	Action Taken
		A	F	P	D	V		
Main Drain to Condenser (in Steam Chase)	3/8" tubing from MS to F-3000 is inadequately supported	X					Acceptable by modification	Support per station specs. (four clam supports added). Tubing deleted per DCP H1040114001, FCR 001.
Main Drain to Condenser (Turbine Building)	Stanchion support on trapeze is in contact with large diameter steam line				X		Acceptable by modification	Modified support per DCP H1040114001
Main Steam (TB to Stop Valves)	Support 1N11-MSH-5 failed	X					Acceptable by repair	Support repaired during Fall 1994 outage
Main Steam to SJAE	Seismic interaction of pipe with respect to adjacent wall due to pipe axial seismic displacement.			X			Acceptable by modification	Modified wall to allow motion of pipe without interaction per DCP H1040114001
	Unusual pipe support	X					Acceptable as-is by analysis	
	Differential seismic motion of pipe which is hard supported				X		Acceptable as-is by analysis	
	Differential displacements between 6" pipe and 1" branch				X		Acceptable as-is by analysis	
	Rod hanger attached to building steel via cantilevered plate	X					Acceptable by modification	Modified support per DCP H1040114001
	Potential interaction of operator on boundary valve F095A with ceiling			X			Acceptable as-is by analysis	
Main Steam to RFPT	Four (4) stanchion supports on line could lock on baseplate bolts	X					Acceptable as-is by analysis	
	Drain near valve F044 is rigidly supported to column. Line is flexible.				X		Acceptable by modification	Removed lateral support (untagged). Installed new supports. DCP H1040114001
	Drain near valve F043 is rigidly supported to wall. Line is flexible.				X		Acceptable by modification	Removed lateral support (untagged). Installed new supports. DCP H1040114001
Main Steam to Sample System	Tube tray is supported on masonry wall along TC and T10		X				Acceptable as-is by analysis: masonry wall evaluated	
	Tray is located between control building wall and stairway column on Turbine Building slab				X		Acceptable as-is by analysis	

Table 2: Outlier Identification and Resolution (Continued)

System Description	Outlier Description	Outlier Type (Potential Failure Mode)					Resolution Status	Action Taken
		A	F	P	D	V		
Main Steam to Sample System (Continued)	Tube tray is supported by wire from ceiling		X				Acceptable by modification	Provided standard support per DCP H1040114001
	Tube tray supports appear to have loose anchor bolts to ceiling	X					Acceptable by modification	Tightened bolts and modified per DCP H1040114001
HP Drain Header Valve 1N22F799 to MSR Drain MOV 1N38F110A/F105A	Support spacing does not appear to meet intent of ANSI B 31.1	X					Acceptable as-is by analysis	
	MOV exceeds SQUG extended operator guidelines					X	Acceptable as-is by analysis	
	Missing nut on rod support	X					Acceptable by repair	Repaired per DCP H1040114001
HP Drain Header Valve 1N22F798 to MSR Drain MOV 1N38F110B/F105B	Support spacing does not appear to meet intent of ANSI B-31.1	X					Acceptable as is by analysis	
	MOV exceeds SQUG extended operator guidelines					X	Acceptable as-is by analysis	
	Rod hanger slightly bent around large pipe	X					Acceptable by modification	Modified support per DCP H1040114001
	Insulation of large diam. Pipe touching 1" line			X			Acceptable by modification	Coped out insulation per DCP H1040114001
Main Steam and Stop Valve Before Seat Drain to HP Drain Header	Support spacing does not appear to meet intent of ANSI B-31.1	X					Acceptable by modification	Added supports per DCP H1040114001
	U-bolt pipe supports do not screen out using conservative assumptions	X					Acceptable by modification	Re-evaluated and modified per DCP H1040114001
Control Valve Before-Seat Drain to HP Header Valve 1N22F797	Support spacing does not appear to meet intent of ANSI B-31.1	X					Acceptable as-is by analysis	
	U-bolt pipe supports do not screen out using conservative assumptions	X					Acceptable by modification	Re-evaluated and modified per DCP H1040114001
	Interaction with MSR riser			X			Acceptable by modification	Rerouted piping and added support. DCP H1040114001

Table 2: Outlier Identification and Resolution (Continued)

System Description	Outlier Description	Outlier Type (Potential Failure Mode)					Resolution Status	Action Taken
		A	F	P	D	V		
Drain from MS SJAE Supply to HP Drain Heater	Support spacing does not appear to meet intent of ANSI B-31.1 for piping along column line TE	X					Acceptable as-is by analysis	
	U-bolt pipe supports do not screen out using conservative methods	X					Acceptable by modification	Re-evaluated and modified per DCP H1040114001
	Support spacing does not appear to meet intent of ANSI B-31.1 for valve station	X					Acceptable by modification	Added supports per DCP H1040114001
	Stiff branch lines are connected to flexible large line				X		Acceptable as-is by analysis	
RFP Turbine Drains to HP Drain Manifold Valve 1N11-F078	Support spacing does not appear to meet intent of ANSI B-31.1	X					Acceptable by modification	Added supports per DCP H1040114001
HP Drain Heater to Aux. Steam Drain Valve 1P61F3026	Support spacing does not appear to meet intent of ANSI B-31.1	X					Acceptable by modification	Added supports per DCP H1040114001
Main Steam to EHC MS Pressure Transmitters	2 ½" PT line is wedged between 24" MS line and 6" Aux. Steam line			X			Acceptable as-is by analysis	
1N33-F023 to 1N33-F012 and –F013	MOV declutch lever is in contact with adjacent pipe insulation			X			Acceptable as is by analysis.	
	Pipe stanchion is not centered on spring can	X					Acceptable as is by analysis.	

Key to Outlier Types in Table 2:

A Anchorage or Support Capacity
F Failure and Falling
D Differential Displacement
P Proximity and Impact
V Valve Operator Screening

5.0 SUMMARY AND CONCLUSIONS

This document summarizes the results of the plant specific reviews, evaluations, the seismic verification walkdown, and explicit seismic analyses performed for Plant Hatch Unit 1 in order to provide reasonable assurance of the seismic integrity of the main turbine condenser and the steam piping systems in the ALT pathway. The following is a brief summary of the results:

1. The turbine building, which contains the main turbine condenser and most of the ALT pathway piping was shown to be of similar construction to turbine buildings and other similar industrial structures in the earthquake experience data base (Ref. 1) that have survived earthquake levels significantly larger than the Hatch DBE. Additional assurance was provided by the seismic margin assessment that was previously performed as part of the Hatch Unit 1 SMA (Ref. 2) which was reviewed and accepted by the NRC (Ref. 4, 5, & 6). The Hatch SMA reported the turbine building HCLPF of at least 0.3g peak ground acceleration (pga) which is twice that of the Hatch DBE.

2. The Hatch main turbine condenser design attributes and its anchorage were shown to be similar to those at facilities in the earthquake experience data base (Ref. 1) that have experienced earthquakes significantly larger than the Plant Hatch Unit 1 DBE. The condenser was also included in the seismic verification walkdown. For additional verification, a plant specific condenser anchorage evaluation was performed based on a seismic response spectrum analysis of the Plant Hatch condenser which demonstrated the condenser anchorage is adequate.

3. All piping included in the ALT pathway was walked down. All potential seismic vulnerabilities or "outliers" based on earthquake experience were identified and were resolved by either additional evaluations or modifications, as summarized in Table 2. To provide additional assurance, a safety margin assessment of the main drain line supports was performed which showed the margin greater than four times the DBE pga of 0.15g. Also a bounding seismic analysis was performed of the main drain piping which demonstrated significant safety margin. A conservative safety margin assessment of the most heavily loaded supports of the interconnected systems was also performed and shown to have a margin of at least three times the Hatch DBE pga of 0.15g.

Based on these comprehensive reviews, evaluations, the seismic verification walkdown, and explicit seismic analyses, it is concluded that the main steam piping in the ALT pathway and the main turbine condenser and turbine building have substantial inherent seismic ruggedness and that there is reasonable assurance that their pressure boundaries will be retained when exposed to the Plant Hatch Unit 1 DBE.

Additionally the following summary is provided that describes how the plant specific reviews and evaluations for Plant Hatch Unit 1 addresses the nine limitations listed in the NRC Safety Evaluation Report of the BWROG Topical Report (References 12 and 1, respectively):

1. Individual licensees should provide a detailed description of the ALT drain path and the basis for its functional reliability, commensurate with its intended safety-related function.

The licensee should also describe their maintenance and testing program for the active components (such as valves) in the ALT path.

Discussion: The ALT drain path at Plant Hatch has been confirmed to be capable of performing its post-LOCA function during and following an DBE, assuming offsite power is not available. This report summarizes the review and evaluation. A detailed description of the ALT drain path and the maintenance and testing program is provided in the introduction of this report.

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: The main steam drain piping included in the ALT path to condenser and associated boundary piping generally conforms to ANSI B31.1 design and construction rules. Piping is typically constructed of ASTM A-106 Grade B carbon steel material with butt-welded or socket-welded joints. Piping supports generally consist of rigid steel members and standard pipe support components such as rods and spring hangers. Typical support spacing is consistent with B31.1 suggested spans. Section 3 of this report provides design parameters for the main steam drain piping. Table 1 lists the design parameters for interconnected systems. The piping is similar to the piping found in the earthquake experience database. Minor interaction issues identified in the walkdown are listed in Table 2. Detail evaluations were performed to resolve these issues and, if necessary, actions have been taken to remove the potential sources of damage.

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: The main condensers at Plant Hatch have been confirmed to fall within the bounds of the design characteristics found in the selected conventional power plant condensers included in the earthquake experience database of Appendix D of Reference 1. This assessment is based on a design document review of the main condensers plus a seismic walkdown of these condensers to assess the as-installed condition and to verify that there are no seismic vulnerabilities. The assessment of the main condensers is summarized in Section 2 of this report. The anchorage of the condenser was evaluated and is discussed in section 2.2. These calculations confirm the condenser anchorage is adequate for the DBE plus normal operating loads. Based on these evaluations, it is concluded the condenser will remain in place and totally functional for MSIV leakage purposes.

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

   Discussion: Plant-specific evaluations were performed of supports and anchorage

associated with the affected piping and condenser. The condenser anchorage is discussed in item 3 above. Piping and pipe supports were walked down by qualified Seismic Review Teams (SRT) to assess the piping and its supports as being of good design and being within the bounds of the earthquake experience database. Analysis of certain piping runs and their supports were performed. For example see section 3.2 for discussion of plant-specific evaluations of supports and anchorage. Pipe supports and anchorage that were identified during the walkdowns as having potential seismic vulnerabilities were identified as outliers and resolved by further analysis or modification as described in Table 2.

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: The Plant Hatch main condensers are located within the lower elevations of the turbine building. The building above the main condensers and below the operating floor is a heavily reinforced concrete structure. The superstructure above the turbine operating floor is a concentrically braced steel superstructure with pre-cast concrete siding and a reinforced concrete slab roof deck.

   Section 1 of this report provides the basis that the Hatch Turbine Building is a seismically robust structure, and there is no significant risk of damage to the structure that would degrade the capability of neither the ALT pathway nor the main condensers. The conclusion is based on design document reviews, comparisons to earthquake experience data, the assessment of the Turbine Building original lateral load design for tornado winds to the lateral inertia loads of an earthquake, and finally a walkdown by the SRT to assure there are no seismic II/I interactions.

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: Plant Hatch Unit 1 was licensed prior to issuance of 10 CFR Part 100 Appendix A, and NRC included Plant Hatch Unit 1 in the USI A-46 program. Even though it is not required for Hatch Unit 1 to perform a bounding seismic analysis for the ALT path piping, a bounding seismic analysis was performed of the main drain piping as discussed in section 3.2.2.5. This bounding analysis was performed to provide additional assurance of the seismic robustness of the piping system used for the ALT path. As discussed in section 3.2.2.5, the piping seismic analysis demonstrated significant safety margin. In addition the interconnected systems were walked down to identify potential piping concerns as shown in Table 2. For the concerns that do not meet walkdown screening criteria, bounding evaluations were performed to determine their adequacy or to identify a need for physical modification.

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

Discussion: The methodologies and acceptance criteria used in the analytical evaluations are discussed throughout this report. For example section 2.2 describes the methodology and criteria for the analytical evaluation of the main condenser anchorage, sections 3.2.2.1 through 3.2.2.4 describe the methodology and criteria for the analytical evaluations of the Main Drain Line supports and their anchorage, section 3.2.2.5 describes the methodology and criteria for the bounding seismic analysis of the Main Steam Drain piping, and section 5 describes the verification methodology for the interconnected systems.

8. The facility ground motion estimates shown in figures 1 through 13 of this 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 MSIV leakage pathway for plants referencing the BWROG's Topical Report, NEDC-31858P, Revision 2.

   Discussion: A composite comparison of nine site ground response spectra of selected earthquake experience database facilities with the Hatch Unit 1 DBE ground spectrum is provided in section 1, Figure 2 of this report. These nine site ground response spectra are from the thirteen site ground response spectra that were reviewed and accepted by the NRC. For the condenser assessment an additional reviewed and accepted earthquake record site was included as part of the demonstration of the condenser earthquake experience. These comparisons to the Hatch Unit 1 DBE ground response spectra showed that the use of earthquake experience-based approach using the BWROG's report (Reference 1) is acceptable for Hatch Unit 1 to demonstrate seismic ruggedness of non-seismically analyzed piping, related components and supports, including the condenser.

9. At the present time, there is no standard, endorsed by the NRC, that provides guidance for determining what constitutes an 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 of the QME Standard that incorporates specific criteria for use of experience data in the qualification of mechanical equipment is endorsed by 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 12, for inclusion in the BWROG's earthquake experience database are representative and sufficient to apply in the seismic evaluation of the ALT pathways and boundaries.

6.0 REFERENCES

1. BWROG Report for Increasing MSIV Leakage Rate Limits and Elimination of Leakage Control System (NEDC-31858P-A) Volumes 1 and 2, August 1999.

2. Seismic Margin Assessment of the Edwin I. Hatch Nuclear Plant, Unit 1, six copies sent to Andy Murphy of the U. S. Nuclear Regulatory Commission under letter from William F. Garner of Southern Company Services to Robert P. Kassawara of the Electric Power Research Institute, January 31, 1991. This report was later issued by EPRI as EPRI NP-7217-SL, June 1991.

3. A Methodology for Assessment of Nuclear Power Plant Seismic Margin. Electric Power Research Institute, 1988. NP-6041.

4. U. S. Nuclear Regulatory Commission Memorandum, "Final Evaluation of the Hatch Seismic Margins Review," from Dan Guzy, RES Co-chairman and Goutam Bagchi, NRR Co-chairman, May 2, 1990.

5. "Hatch SMA Peer Review Group Final Report: Evaluation of the Application of the NRC and EPRI Seismic Margin Methodologies," from P. R. Davis, Chairman, Hatch Seismic Margin Assessment Peer Review Group to Dan Guzy, U. S. Nuclear Regulatory Commission Office of Nuclear Regulatory Research, May 3, 1990.

6. Supplemental Safety Evaluation by the Office of Nuclear Reactor Regulation Regarding Hatch Seismic Design Georgia Power Company, Et Al. Edwin I. Hatch Nuclear Plant, Units 1 and 2 Docket Nos. 50-321 and 50-366, from Kahtan N. Jabbour, Project Manager U. S. NRC Office of Nuclear Regulation to W. G. Hairston, III, Georgia Power Company, April 16, 1991.

7. Supplemental Piping Earthquake Performance Data, EQE International, December, 1993 (provided to the NRC in the Georgia Power Company submittal of January 6, 1994, Ref. 9).

8. Generic Implementation Procedure (GIP) for Seismic Verification of Nuclear Plant Equipment, Revision 2, Seismic Qualification Utility Group (SQUG), February 2, 1992.

9. "Edwin I. Hatch Nuclear Plant – Unit 2, Request to Revise Technical Specifications: Increase in Allowable MSIV Leakage Rate and Deletion of MSIV Leakage Control System," J. T. Beckham, GPC to NRC, October 1, 1993, January 6, 1994, and February 3, 1994.

10. Letter from NRC to Georgia Power Company, December 29, 1993, "Summary of December 10, 1993, meeting with Georgia Power Company and their consultants regarding the request to delete technical specifications for the main steam isolation valves leakage control system and to increase the allowable MSIV leakage rate – Hatch Nuclear Plant, Unit 2 (TAC No. M87850)," Docket No. 50-365, Attachment 8.

11. Seismic Verification of Nuclear Plant Equipment Anchorage (Revision 1) Vol. 1: Development of Anchorage Guidelines, Electric Power Research Institute, EPRI NP-5228-SL, June 1991.

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