Wm. H. Zimmer

SQRT Visit Report

(Initial)

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S. No.	Ref. No.	Title
1	NSSS-1	Safety Relief Valve
2	NSSS-2	MSIV Actuator
3	NSSS-3	Hydraulic Control Unit
4	NSSS-4	Level Switch
5	NSSS-5	Standby Liquid Control Pump
6	NSSS-6	Pressure Switch
7	NSSS-7	Pressure Indicator
8	NSSS-8	Spent Fuel Storage Racks
9	NSSS-9	New Fuel Storage Racks
10	NSSS-10	Reactor Core Cooling Bench Board
11	NSSS-11	Power Range Neutron Monitoring Cabinet (H13-P608)
12	NSSS-12	RCIC Instrument Panel A
13	NSSS-13	Flow Indicator Switch (288)
14	NSSS-14	Auxiliary Panel Relay
15	NSSS-15	Bailey Alarm
16	BOP-1	480V Motor Control Center
17	BOP-2	RBCCW Pumps
18	BOP-3	SGTS Equipment Trains
19	BOP-4	RBCCW Expansion Tanks
20	BOP-5	Remote Shutdown Panels
21	BOP-6	Gravity Shutter Isolation Damper
22	BOP-7	Opposed Blade Balancing Damper
23	BOP-8	Butterfly Isolation Damper
24	BOP-9	10 In. Globe Valve

25	BCP-10	3/4 x 1 In. Relief Valve
26	BCP-11	3/8 In. M, Globe Valve
27	BCP-12	10 In. AO, Globe Valve
28	BCP-13	Electrical Indicator Vertical Edgewise
29	BCP-14	Transmation Current Relays
30	BCP-15	Rosemont Temperature Detector Assembly
31	BCP-16	Atkomatic Deluge Solenoid Valve
32	BCP-17	SGTS Cooling Fan

1. SAFETY RELIEF VALVE

The SRV is furnished by the Crosby Valve and Gage Co. and has Model No. 6XRX10XHP-BP. It is qualified by analysis described in GE Documents 22A6539-22A6542, November 21, 1980 and by Wyle Labs. Report No. 43445-2, January 12, 1977. The valve is subject to seismic and hydrodynamic loads.

The valve was qualified by both test and analysis. During tests, it was attached to a rigid test fixture. It was a single axis sine sweep test to identify resonances. Natural frequency of 21 Hz in the lateral direction was identified. It was, then, subjected to biaxial random motion consisting of frequencies from 1 to 40 Hz. During the random motion tests, the inlet and outlet flanges were loaded to 800,000 and 600,000 in-lb, respectively. Functionality and structural integrity were verified and no leakage was detected. The TRS envelopes the Wyle Labs' generic RRS, which is not actually Zimmer loading situation, but conservative.

The valve and actuator were included in GE's analysis of the main steam and discharge piping. The analysis was performed using a finite element response spectrum method to determine stresses in the piping and components. The SAP and ANSI7 computer programs were used in the analysis. The flange moments were calculated and found to be less than ASME Section III Code allowables. As part of the analysis, the maximum valve response accelerations were determined to be 4.33 g lateral and 2.22 g vertical, which lie within the TRS of Wyle's tests for all frequencies above 4 Hz. The resonance search did not extend beyond 40 Hz, but the TRS does envelope the RRS in that region.

Based upon our observation of the field installation and review of the test and analysis reports, the SRV is adequately qualified for the prescribed loads.

2. MSIV ACTUATOR

The MSIV is supplied by Rockwell International Flow Control Division and has Model No. 24 x 20 x 24 Fig. 1612 JMMNTY. It is qualified in the GE documents "Final Test Report Seismic Qualification Test for Rockwell Manufacturing 24-in. MSIV Actuator," Volume II, May 1978, and "Main Steam Piping and Equipment Loads," GE Documents 22A6539-22A6542, November 1980. The valve is subject to seismic and hydrodynamic loads.

The valve actuator was qualified by test. It was mounted rigidly on a 45° test fixture. A sine sweep resonance search was performed from 2 to 50 Hz at 0.5 g. Natural frequencies in the 7.5 to 12 Hz range were identified for the actuator in the open and closed positions. The actuator was subjected to sine dwell tests at the resonant frequencies with 1.06 g lateral, 1.45 g longitudinal, and 2.0 g vertical and to a 4 g fragility test in the horizontal direction. The actuator was also tested with dual axis random input in 2 planes. The resulting TRS extends to 64 Hz and envelopes GE's RRS, which envelopes the response spectra at the wall location next to the MSIV.

During the fragility test, the actuator columns yielded slightly. At some time during tests, the alignment plate apparently bent but did not interfere with the closing operation of the valve. The safety function of the valve is to close during or after seismic and hydrodynamic events.

The valve itself was qualified by analysis performed by GE. A finite element analysis on the main steam piping using the response spectrum method was done. Cutoff frequencies of 33 Hz for seismic and 60 Hz for hydrodynamic loads were used and directional and modal combinations were made by SRSS. The SAP and ANSI7 computer programs were employed in the analysis.

The MSIV and actuator were contained in GE's finite element model. The valve end stresses and bonnet flange moment were calculated and determined to be less than ASME Section III Code allowables.

Since no difficulties have been identified, this valve is considered to be adequately qualified.

3. HYDRAULIC CONTROL UNIT

Hydraulic Control Unit (Equipment No. C11-D001; Model No. 761E500G1) was supplied by General Electric. It is a module of hydraulic, electric and pneumatic parts to operate a CRD and measusres about 22W x 19D x 102H in. It is located in the reactor building at an elevation of 546 ft. The field mounting consisted of 4-1/2 in. bolts. The qualification documents referred are: Wyle No. 53540 of August 28, 1973 and GE383HA6?3 of February 13, 1973. Seismic as well as hydrodynamic loads are considered in the qualification.

This item was qualified through test and analysis both. Analyses were performed to determine correlation between analytical and test natural frequencies and calculate stresses for three different support configurations. The dyanmic analysis consisted of 3D beam finite elements model with response spectrum input. One percent damping was used in the analysis. SRSS method was used to combine the modal responses for the result. The allowable stress in the bracket and frame is exceeded in all three support configurations. However, the beam arrangement, which is the Zimmer configuration, yields the lowest (still higher than allowable) stresses.

Wyle Laboratroy performed the dynamic testing on the unit. The laboratory mounting was the same as field. First of these was a resonance search test with an input level of 0.5 to 1.2 g in the range of 1 to 50 Hz. The following resonances were indicated:

S/S:2, 4.2, 7.75; 12.5; F/B:2.75, 5, 8.5, 14; V:10, 38, 41, 49.5.

Two OBE and one SSE level single axis, multifrequency random input tests were performed. These tests were done in each of the three axes. Test spectra were generated. Additional sine beat tests (8 to 25 oscillations per beat) with input g-levels of S/S = 5 g; F/B = 5.0 g and 7.0 g; V = 6.5 g were done. The following questions were raised with respect to the test and/or the analysis.

1. The TRS did not envelope the RRS below 2 cps. The unit has natural frequencies in that region.

2. Only single axis tests were performed.

3. Only two OBE and one SSE level tests were performed.

4. Even in the light of over stressed condition from the analysis, no strain gauges were mounted anywhere on the unit.

The applicant response to these concerns were:

1. That the plotted TRS's did not envelope the plotted RRS's. However, these RRS's were envelop of generic RRS's (for plants and levels). The applicant did produce Zimmer-unique RRS's which indeed showed their envelopment by TRS's.

2. Assuming that coupling between horizontal and vertical does exist, it is only necessary to increase the single axis RRS by some factor. A comparision of spectra show that the TRS has a ratio of 1.5 (lower frequency range) and typically more than 5, over the Zimmer plant-unique RRS at the significatnt frequencies of the HCU. The calculated modal participation factors from the GE analysis (even though of slightly different configuration but comparable) show quite low cross coupling values in the low frequency range. For an input g-level of about 1.8 g, as is required for the 2 Hz resonance point, the added g-loading due to cross coupling would be about 0.3 g, thus at 2 Hz the TRS would have to envelope 2.1 g. The actual TRS value at 2 Hz is 2.7 g or 1.3 times the RRS value plus cross coupling. The applicant further stated that a review of the modal participation factors calculated for other resonance regions showed that all other resonances were adequately enveloped by the TRS even when the cross coupling values are factored in.

3. In the light that this requirement is for mechanical aging the applicant responded that the following tests were performed:

   a. One at 60% of full level,

   b. two at 100% of full level, and

   c. three at 100% of full level with superimposed sine beats.

Each test duration was 45 seconds. Consequently the aging was enough before the SSE test.

4. In response to the overstress condition, the applicant pointed out the following:

   a. The response spectrum utilized in the analysis was significantly higher than the plant unique RRS at the established resonance frequencies,

   b. The analysis uses a damping value of 1%. This is a conservative assumption and the actual value of the damping is generally higher, and

   c. Especially, during the test by Wyle Laboratory, the HCU was subjected to a TRS which was significatnly higher than the RRS, the scram sequence was verified and no physical damage occured.

Based on our observation of the field installation, the review of the qualification reports and the applicant's response the hydraulic control unit is adequately qualified for the prescribed loadings for Zimmer-plant.

4. LEVEL SWITCH

Level switch (Equipment No. C11-N013; Model No. 5.0-751) was supplied by Magnetrol. It had an approximate physical dimension of 26.5 in. high and 5.5 in. in diameter. It is located in the reactor building at an elevation of 554 ft 2 in. The equipment has pipe connection and is attached to an angle iron with a U-bolt. The angle iron is attached to a channel and the channel in turn being attached to walls at its ends. The referenced qualification report is: Ogden Tech. Lab. No. F-73436 of August 1973. Seismic and hydrodynamic loads are considered for the qualification.

This item was qualified through test. The test mounting was on a pipe. It was then subjected to a resonsance search sine sweep test from 4 to 1000 Hz with an input level of 0.3 g. No natural frequency was detected below 75 Hz. Subsequently, single axis, single frequency, sine dwell tests at 30 Hz with input level of 5.0 g in the side to side, 4.1 g in the forward to backward, 9.5 g in the vertical direction and a dwell of 15 seconds were performed. The required g level in this range are S/S:1.8 g; F/B:1.8 g, V:2.0 g (ZPA). Contact chatter was monitored during the resonance search and endurance tests. No contact chatter in excess of 1.0×10^{-6} sec. was detected (small chatter of no consequence). Functionality was also verified. In response to the question about 5 OBE and one SSE level tests, the applicant stated that there were sufficient number of high g-level tests to account for a total time in excess of the required.

Based on our observation of the field installation, review of the qualification report and the clarifications provided by the applicant, the level switch is adequtely qualified for the prescirbed loads.

3. STANDBY LIQUID CONTROL PUMP

A. The Pump

The SLC pump (Equipment No. C41-C001A/B; Model No. X3TD-60) is supplied by Union Pump Company. This positive displacement pump with approximate dimensions of 22 1/2"W x 17 3/4"H x 40 3/8"L and weighing about 1350 lbs is located in the reactor building at an elevation of 570 ft 6 in. The pump is mounted on skids with 4-5/8 in. diameter bolts and the skid is attached to a pedestal with 7-3/4 in. diameter bolts. The referenced qualification report for this equipment is "Union Pump Co. (430-16 Rev. 2) of 2-2-77." Hydrodynamic and seismic loads are considered in the qualification.

Seismic qualification of the pump fluid end aligning pins, pump mounting bolts and foundation bolts is done through analysis. Since the natural frequency of the system is found to be in the ZPA range (50 Hz), an equivalent static analysis is performed. The ZPA values form new spectra combinations for the T-quencher model are used. The spectra are combined using absolute sum method. The calculated stresses in the pump mounting bolts, fluid aligning pins (dowel pins, cylinder tie studs) are below the respective allowables. The deflecton of the pump with respect to the motor is justifiably considered negligible and will not impair coupling between the motor and pump. The foundation bolts are judged to be non-critical (due to the pattern, bolt size and number of bolts). Nozzle loads are within the vendor allowables.

However, the field inspection indicated that the relief valve line between the suction and discharge lines of the pump was supported by a very loosely hung strip. This line appeared very flexible and could be a potential problem during dynamic events. A satisfactory response from the applicant is needed as to the qualification of this part.

B. <u>The Motor</u>

This unit (Equipment No. C41-C001A/1B, Model No. 5K324AN2960) is supplied by General Electric Company. This is also mounted on 1/4 in. thick skid with 4-1/2 in. diameter bolts and the skid is attached to pedestal with 7-3/4 in. diameter bolts. The referenced qualification report is: "Approved Engineering Test Labs (5430-6958) dated 1-28-77". The loads considered are seismic and hydrodynamic.

The motor has been qualified through test. The test mounting is similar to the field mounting. The test is a bi-axial, single frequency sine dwell at 33 Hz. The input g-level for the test is 2.0 g in each of the horizontal direction in conjunction with a 2.0 g in the vertical direction. These tests are performed during operating and non-operating mode with no functional impairment during and after the test. One OBE and four SSE level tests are performed. Since the resonance search between 10 to 80 Hz did not indicate any resonant frequency in this range this type of test is considered adequate. The required input g-level (ZPA, since rigid) is equal to/or below 0.38 g in each of the horizontal direction and 0.95 g in the vertical direction. The damping values used are one and two percent for OBE and SSE respectively.

Field inspection in this case indicated a difference between the field motor (5K324AK2120) and qualification report (5K324AN2960) model nos. A response as to their similarity or otherwise is needed.

Based on observed field installations and our review of the analysis and/or test documentation this unit consisting of the pump and motor is adequately qualified pending the resolution of the relief valve line for the pump and model number discrepancy for the motor.

6. PRESSURE SWITCH

Pressure switch (Equipment No. C71-N002, Model No. 12N-AA4-TT range: 0.2-6 psi) was supplied by Static-O-Ring. This particular one (out of a total of four mounted on different panel) was mounted on panel H22-P005 which was located in the reactor building at an elevation of 546 ft. It was attached to the panel with two 10-24 size bolts. Hydrodynamic and seismic loads were considered. The referenced qualification documents are: Ogden Technology Lab. No. 70526 of 4-30-71; Ganes Testing Lab No. 11192 of 8-11-70; Static-O-Ring Report No. 7401-110 of May 6, 1974 (certification by Viking Lab.).

This equipment was qualified through test. The test was performed in two steps. The first one done by Static-O-Ring was a resonance-search test with a 0.5 g input in the range of 5-1000 Hz. None was detected in this range. The second step was a single axis, single frequency with an input of 3.0 g and a dwell of 30 seconds at 5 and 30 Hz. The input was raised to 10.0 g at 30 Hz and maintained for 30 seconds. These tests were done in each of the three directions. The required input for this piece for this particular location was 2.0 g (ZPA) in each of the three directions. The operability after the test was verified.

However, the Static-O-Ring test report for the pressure switch did not specifically state or show the mounting condition. Further, it did not address the operability of the instrument during the test. In response to these inquiries, the applicant stated that the device can only be mounted rigidly, as required, utilizing the two mounting holes located about midway down the switch body and about 2.5 in. apart. In the requirement, it stated that the switch be oriented with the pressure connection down. This is how it is mounted in the field. In response to the operability question the applicant produced a report on an earlier test on a 12 N Static-O-Ring Pressure Switch conducted by General Electric at Philco Ford test facility (Report No. 225A6253 of 12-15-69). During this test the pressure switch was energized using a 30 psi air source. This test demonstrated a 15 g capability.

Based on our observation of the field installation, review of the qualification reports and the clarifications provided the applicant, this equipment is adequately qualified for the prescribed loading.

7. PRESSURE INDICATOR

Pressure Indicator (Equipment No. E51-R002; Model No. 713B range of 30 in. of Hg to 100 psi) was supplied by Robertshaw. This round gauge, about 6 in. in diameter 3 in. deep and weighing approximately 3 lbs, was mounted on panel H22-P017 with 3-1/4 in. bolts. The pressure indicator was about 3 ft 6 in. from the bottom of the panel. This panel was located in the reactor building at an elevation of 475 ft 6 in. The referenced qualification document was: TII Testing Lab No. 4938 of February 7, 1973. Loads considered in the qualification were seismic plus hydrodynamic.

This equipment was qualified through generic test. A resonance search (sine sweep) in the range of 2 to 200 Hz with an input level of 2.4 g indicated the following natural frequencies:

S/S:20,117 Hz; F/B:48,98, 130 Hz; V:none.

In response to the question of frequencies noted in the SQRT form as:

S/S: 16, 20, 23, 25 Hz; F/B: 21, 25, 30 Hz; V: 16, 20, 21, 23, 25, 30 Hz

the applicant stated that most of these were frequencies of the stem on which the instrument was mounted for the test and not of the instrument itself. The field mounting eliminated those frequencies. It was then subjected to pseudo bi-axial, single frequency sine dwell tests. The input of 4.8 g was applied at an angle of 33° 42' to the horizontal axis having a dwell of 5 minutes. Thus, each of the component exceeded the required acceleration of 2.0 g (ZPA) in each of the direction. Single frequency test in this case is satisfactory (given significant frequency of S/S:20 Hz and F/B:48 Hz). Instrument operability was monitored. In the generic testing on 26 gauges, 4 cracked and leaked at the end of the Bourdon tube. The applicant stated in response to a question in this regard that the pressure indicators used in Zimmer plant were of substantially improved version than those tested generically. The number of tests, level and the dwell time were sufficient to account for five OBE and one SSE Level tests.

Based on our observation of the field installation, review of the qualification report and the clarifications provided by the applicant the pressure indicator is adequately qualified for the prescribed loads.

8. SPENT FUEL STORAGE RACKS

This equipment consists of 37 spent fuel storage racks located in the spent fuel storage pool of the reactor building. Each rack has 20 spent fuel assembly storage locations arranged in a rectangular 2 by 10 array. Each rack is approximately 18 in. wide x 67 in. long x 183 in. tall. The racks are supported at the base with 4-1.0 in. diameter clevis type swing bolts and have horizontal seismic supports (2-1.0 in. diameter bolts) at approximately 111 inches from the base. These racks were manufactured by General Electric Co. with model No. 762E210. Seismic qualification of this equipment by static analysis was performed by General Electric Co. documented in report No. F16-10.

The natural frequencies of the spent fuel storage rack were determined to be 258.1 Hz side to side and front to back and 277.9 Hz vertical. These were determined by hand calculations, assuming the fuel rack boxes to be a clamped (bottom), pinned (horizontal seismic support) beam with a length of 111 inches. A static equivalent analysis was, then, performed using the ZPA values from the required response spectra (0.41 g E-W, 0.39 g, N-S, and 0.52 g vertical). The maximum stress was determined to be 14,250 psi compared to an allowable of 21,000 psi. This maximum stress occurred at the rack base.

As a result of our review of the analysis report, several concerns were noted. They are:

1) The natural frequencies were calculated neglecting the portion of the fuel storage racks above the horizontal seismic supports. The flexibility of the horizontal seismic supports was also neglected. Both of these are nonconservative: therefore, the natural frequencies should be determined accounting for these items.

2) The static equivalent analysis was performed using simplified methods which are not necessarily conservative for all locations. The analysis requires a more realistic approach

(uniformly loaded, cantilever beam with intermediate support). Further, the static equivalent analysis is to be justified on the basis of new natural frequency calculations.

3) The analysis performed did not adequately account for multi-direction earthquake loadings, particularly with regard to the support bolts. The analysis did not adequately address combined shear and axial loadings of the support bolts.

In order to complete our review a satisfactory response, addressing the above concerns, is needed from the applicant.

9. NEW FUEL STORAGE RACKS

This equipment consists of approximately 20 new fuel storage racks located in the new fuel storage vault of the reactor building. Each rack has a row of 10 new fuel storage locations. The dimensions of the racks are 6.38 in. wide by 71 in. long by 168 in. high. Vertical and horizontal supports of the racks are provided at the base. There are also horizontal supports near the top. The horizontal support at the base is provided by embedments in the vault floor. The upper horizontal support consists of four 1/2 in. diameter bolts. These racks were manufactured by General Electric Co. with Model No. 729E 943 G003. Seismic qualification of this equipment by dynamic analysis was performed by Nutech documented in report No. CGE-03-146 dated December 1980.

The analysis of the new fuel storage rack was performed using the computer code "STARDYNE". This consisted of a three dimensional finite element model with the response spectrum input. From this analysis, the natural frequencies of the racks were determined to be 8.8 Hz side to side, 15.1 Hz front to back, and 66 Hz vertical. The maximum combined bending stress was calculated to be 12,592 psi which is less than the allowable value of 13,200 psi. A modeling error was discovered with the analysis. The flexural stiffness of diagonal side braces was overestimated. On inquiry the applicant stated that this error would have little effect on the outcome of the analysis. After reviewing the mode shapes which would be affected by this error, it was agreed that this error did not warrant additional analysis.

Based on the inspection of the field installation and a review of their analysis report, the new fuel storage racks are adequately qualfied for seismic loading.

10. REACTOR CORE COOLING BENCH BOARD

The RCC bench board (Model No. 328X501TU (828E352TU); Equipment No. H13-P601) was supplied by General Electric Company. It measures 204L X 60W X 90H in. and weighs about 3900 lbs. It is located in the control room of auxiliary building at an elevation of 546 ft. The field mounting consists of welding to the floor. The referenced qualification documents are: Seismic Qualification Test Report No. 22A4315 of July 23, 1976 (for bench board H13-P603) and Sargent and Lundy Analysis EMD-021333. Seismic Load is considered for the qualification.

The qualification of this bench board involves two separate efforts. This GE bench board (H13-P601) is quite similar to another GE bench board (H13-P603) installed in Fukushima 6. H13-P603 is slightly smaller in size than H13-P601. H13-P601 was analyzed for stresses by Sargent and Lundy. The dynamic analysis model consisted of a 3D beam finite elements and response spectrum input. There were 25 modes in the range of 1 to 35 Hz. SAP IV computer program was used. Modal dynamic responses were absolutely summed for closely spaced modes and SRSS for overall response. A two percent damping was used in the analysis. The analysis discovered some overstressed points and recommended some field modifications.

A single axis, single frequency, sine dwell test had previously been performed on H13-P603. This was mounted with 18-5/8 in. x 3 in. size bolts and clamps. A sinusoidal test had indicated frequencies of:

S/S: 15 Hz; F/B: 13 and 19 Hz; V: 31 and 33 Hz.

The input g-level for the test was:

S/S = 0.75 g; F/B = 0.75 g; V = 0.75 g.

Report number 22A4315 for this test stated that the nine recorders experienced severe vibration in each axis tested. At 13 Hz in the lateral (F/B) direction, the display module was flexing and several indicator lights came out. Support for each recorder was recommended.

Under the circumstance the following two concerns should be addressed.

1. How the overstressed conditioned as indicated from the analysis was relieved, and

2. In the light of the severe integrity/operational problems with the recorders on H13-P603, how the integrity/operation of this bench board and the devices mounted on it can be assured.

In order to complete our review, satisfactory resolution of the above concerns are required from the applicant.

11. POWER RANGE NEUTRON MONITOR CABINET (H13-P608)

The neutron monitor cabinet is supplied by General Electric and has Model No. 328X105TU. It is mounted to a floor-embedded plate with welds of 2 in. length at 12 in. intervals. It is qualified by the GE documents "Qualification Test Report for Power Range Monitoring Instrumentation," 235A1893, September 26, 1972, and "Power Range Monitoring Cabinet, Seismic Qualification Test Report," August 26, 1975. The cabinet is subject to seismic loading.

This item was qualified on the basis of tests performed on a 5-bay Hanford 2 panel. It is identical to the Zimmer 608 panel. During tests, the cabinet was secured to the floor of the table with 22 bolts and clamps, which makes the Zimmer welded installation conservative. Accelerometers were attached and transmissibilities recorded. The major resonances in each direction are: 8 Hz side to side, 19 Hz front to back, and 26 Hz vertical. The panel was single frequency sine dwell tested at 0.7 g horizontal and 0.4 g vertical at each integer frequency in the 1 to 33 Hz range. The Zimmer required ZPA's are 0.4 g horizontal and 0.45 g vertical. Equipment was monitored for false trips and improper operation and no problems were detected. When the test g levels were increased to 1.3 g horizontal and 1.2 g vertical, several failures occurred. With modifications made to the module restraint system, power supply plugs, card support cage, and door latches the cabinet was able to meet these g levels.

Since the cabinet has only one resonanant frequency in each direction, and the cabinet sustained without failure lengthy sine dwell testing at g levels greater than or nearly equal to the required g levels, single frequency testing is justified and the cabinet is sufficiently qualified for Zimmer requirements.

12. RCIC INSTRUMENT PANAL A

RCIC Instrument Panel A (Equipment No. H22-P017; Model No. 368X272TU (1270182TU) was supplied by General Electric Company. It consists of two basic panels of sizes (30L x 48W x 94H) and (30L x 72W x 94H) put together resulting in a (30L x 120W x 94H) panel. They stand side by side but there is no structural connection between them. It is located in the reactor building at an elevation of 475 ft 6 in. It is welded to the floor with one-inch weld at twelve inches interval. Laboratory mounting was the same as the field mounting. The referenced qualification document is: Southwest Research Institute, Project No. 02-6056-001 of November 7, 1980. Seismic and hydrodynamic loads are considered in the qualification. The loads are combined as absolute sum.

This panel was qualified through test. Mock ups of 48 in. and 72 in. panel were tested for General Electric at SWRI. Resonance searches (0 to 100 Hz) indicated the following natural frequencies.

Frequencies in Hz

48 inches			72 inches		
S/S	F/B	V	S/S	F/B	V
13	18	none	9	7	none
71	22		38	13	
73	42		45	15	
77	51		52	28	
94	59		58	30	
	67		66	75	
	82		71	85	
	89			90	

In addition, the first torsion mode of the 48 in. panel was at 34 Hz whereas for the 72 in. panel it was at 21 Hz. Subsequetnly, a total of twelve multiaxis, multifrequency tests with random inputs, were performed.

Out of these ten were of OBE (5 in. each orientation) and two of SSE (one in each orientation) levels. The input ZPA levels were S/S = 2.48 g; F/B = 3.95 g and V = 5.6 g.

The multiaxis, multifrequency with random input tests are the appropriate tests. The input ZPA's are well above the required ZPA's of S/S = 0.6 g; F/B = 0.6 g and 1.02 g. There were sufficient number of OBE and SSE level tests. TRS for one, two and three percent damping were generated in each case. In general, the TRS does not envelope the RRS in the range below 4 Hz. This is not significant since the equipment frequency is reasonably removed from it. The acclerometer locations were satisfactory.

Based on our observation of the field installation, review of the qualification reports, the RCIC Instrument Panel A is adequately qualified for the prescribed loads.

13. FLOW INDICATOR SWITCH (288A)

There are 49 flow indicator switches. These are round gauges (7.5 inches in diameter, 2 inches thick) with a 3-4 in. thick box attached to the back of the gauge. This equipment is located at elevations 593 ft 6 in. and 475 ft 6 in. of the reactor building. These devices are panel mounted to a vertical plate which is attached to a unistrut frame by means of four 1/4 in. diameter bolts. It is manufactured by ITT Barton Co. with model No. 288A. This equipment was qualified for seismic plus hydrodynamic loads by testing performed by Wyle lab documented by report No. 53178.

The qualification tests performed were sine sweep for resonance and single frequency, single axis sine dwell. From the resonance search test, no natural frequencies were discovered below 100 Hz. The sine dwell tests were performed in all three directions at 38 Hz with an input acceleration level of 6 g. The required ZPA for this equipment is 2 g for all three directions. Test mounting of the flow indicator switches was at the back of the unit rather than just behind the gauge dial as is the case with field mounting. It is agreed that the test mounting is the more severe of the two, and therefore, of no concern.

The flow indicator switches inspected were model 288 rather than model 288A. The applicant said the model 288 units are to be replaced with model 288A units. Confirmation of this replacement is required.

Based on our observation of the field installation, review of the qualification report and the applicant's response to our questions, the flow indicator switches are adequately qualified for the prescribed loading pending the confirmation of the replacement of model 288 with 288A.

14. AUXILIARY PANEL RELAY

The Auxiliary Panel Relay is supplied by General Electric and has Model No. 12HFA51A. It is mounted into a cutout in the face of a panel using four screws. It is qualified by a document entitled "Qualification Test Data," DV13683137, February 28, 1977, which is a compilation of GE test data, and the report "Environmental Qualification of the Safety Related Instruments for LaSalle Nuclear Power Station," MCC Powers, Report No. 734-79.002 Rev. 1, September 3, 1979. The relay is subject to seismic loading.

The relay was qualified by testing. In the GE tests, the relay was monitored for chatter while being vibrated at 5 g, 7.5 g and 11 g over the 1 to 30 Hz range in the three directions. No chatter greater than 10 msec was detected up to these g levels.

In tests described in the MCC Powers report, the test module was back mounted in an instrument panel in the upright position. Biaxial tests were performed in two perpendicular planes. A resonance search from 1 to 40 Hz at 0.2 g was performed and no natural frequencies were identified. The panel was subjected to complex random input with a corresponding TRS that envelopes the RRS except for very low frequencies. The RRS is a generic spectrum that envelopes the spectra for all applicable panels in the LaSalle and Zimmer plants.

Continuity of contacts was checked and output response monitored. No malfunctions occurred and the test module remained functional after the tests. Since no problem has been identified, the relay is considered to be adequately qualified.

15. BAILEY ALARM

The Bailey Alarms are supplied by the Bailey Meter Co. and have Model Nos. 745110 AAAE1 and 745120 AAAE1. They slide into a rack which is mounted in a cutout in the face of a panel. They are qualified by GE Test Report Nos. 468 and 526, dated November 16, 1972, and June 14, 1973. The alarm is subject to seismic loading.

The alarms were qualified by test in both reports mentioned above. In the first test, a 12-unit rack was mounted to a holding fixture, which was mounted on the shaker. The rack was not cantilevered as it is in the Zimmer installation. The rack was subjected to sine beat endurance tests (two minutes) at 1.5 g and 100 Hz. It was also limit tested at 9 g F/B, 9.5 g S/S, and 13 g V at 33 Hz. During tests output relay action of the alarms was monitored and no malfunctions were detected.

In the second test, the rack was mounted in the cantilevered fashion that is used in the actual installation. Resonances of 18 Hz, 14 Hz, and 14 Hz were thus identified in the S/S, F/B, and V directions, respectively. Limit tests were then performed at these natural frequencies at 6 g, 4 g and 6 g in the S/S, F/B and V directions. During the limit tests, however, the back end of the rack was restrained in the side-to-side direction to prevent excessive displacement. This of course, is not representative of the field installation.

The required seismic input as presented in the qualification data is somewhat crude. The ZPA's from the floor level RRS were amplified by transmissibilities at accelerometer locations on the panel. The resulting required accelerations were 3.02 g, 8.55 g and 4.77 g in the S/S, F/B and V directions, respectively. This required input exceeds the input applied during the tests of Test Report No. 526. The applicant later furnished information that indicates that the transmissibilities used were too high and that the actual required accelerations are significantly less than applied accelerations.

There were no malfunctions identified during tests.

In order to complete our review, we have requested that the applicant perform an analysis to verify that the alarm would still function if back-end restraint were removed during tests.

16. 480 V MOTOR CONTROL CENTER

The 480 V Motor Control Center is provided by the ITE Imperial Corporation and has Model No. 5600 Series. It is currently qualified by the report "Seismic Withstandability of 5600 Series-Motor Control Center," ITE Imperial Corp., November 24, 1975, but a requalification is planned. The cabinet is subject to seismic and hydrodynamic loads.

The motor control center was originally qualified by testing. It was attached to a shaker table that provided motion at a 36° angle to the horizontal. Two vertical sections bolted together and containing devices were tested. The sections were tested in two perpendicular planes and devices were monitored. A resonance search from 1 to 33 Hz was performed and natural frequencies of 7 Hz in one plane and 8 Hz in the other were identified. Sinusoidal duration tests at frequencies from 1 to 25 Hz were also performed as were random vibration tests with center frequency set at resonance. Contact chatter occurred in one device during sinusoidal tests. The tests conducted thus far ignore the possibility of multimodal response over the 1 to 60 Hz range and were performed along only a single axis at a time.

To remedy deficiencies of the original tests, a retest of the Control Center is planned. The retesting will again be performed on two vertical sections bolted together. The unit will be tested for resonances and will be subjected to biaxial multifrequency tests containing input over the 1 to 65 Hz range. Instruments are to be contained in the cabinet and functional capability is to be monitored during and after tests. An RRS that envelopes all floor RRS at these cabinet locations at the Zimmer plant is to be exceeded by the TRS. This test plan will allow for proper qualification of the cabinet.

In order to complete our review we require the applicant to furnish the completed qualification test report on this item when available.

17. RBCCW PUMPS

The RBCCW Pumps are provided by Bingham Willamette and have Model No. 8X10X14 CAP. It is currently qualified by the report "Seismic Analysis of Bingham Willamette Co. 8X10X14 CAP Pump Serial No. 14210325/8 Wm. Zimmer Station I," Van Gulik and Associates, Inc., October 24, 1975, but is to be requalified. The RBCCW Pump is subject to seismic and hydrodynamic loads.

Qualification of this item was performed by analysis. In their analysis, Van Gulik and Associates considered only seismic forces for dynamic loads and the pump was determined to be adequate. With the introduction of the T-quencher loads, the nozzle loads exceed the manufacturer's current allowable values. To assess whether the new nozzle loads can safely be withstood, Bingham Willamette will re-analyze the valve to these loads and to the appropriate response spectra. Sargent and Lundy cannot perform this analysis because the manufacturer will not release necessary information.

The new analysis is to use finite elements and the response spectrum method. Stresses in all pump components are to be calculated with the current seismic and hydrodynamic loads and the corresponding nozzle loads applied.

In order to complete our review of this item, we require that the applicant furnish the completed seismic qualification report when available.

18. SGTS EQUIPMENT TRAIN

This equipment consists of two steel frames and plate boxes 42 ft long x 7 ft high x 7 ft wide bolted to reactor building floor, one at elevation 546 ft 0 in. and the other at elevation 593 ft 6 in. This was manufactured by American Air Filter. It was qualified for seismic plus hydrodynamic loads by analysis performed by American Air Filter Co. documented by report No. PEP-631 dated May 23, 1974.

The analysis was performed using the computer codes, ICES STRUDL II, DYNAL, FLAX, DYSTRESS, and STRESS. The natural frequencies, and mode shapes were determined using the computer codes DYNAL and FLAX. The natural frequencies in the side to side direction were determined to be 14.6 Hz, 31.9 Hz, and 40.4 Hz. Response spectrum analysis was performed in the side to side direction using the required response spectrum. A static analysis was performed in the other directions using the appropriate ZPA values. Static analyses were also performed for pressure and gravity loading. These were performed using the computer code ICES STRUDL II. A post processor program DYSTRESS was used to combine member end-forces for the different required load combinations. STRESST was used to compute member stresses and compare them to the stress allowables. The following critical stress results were obtained.

Element	Stress Ratio	Allow. Ratio
Member 1, Load Condition 2 (OBE)	0.90	1.0
Member 5, Load Condition 2 (OBE)	0.93	1.0
Member 9, Load Condition 1 (OBE)	0.91	1.0
Member 1, Load Condition 6 (SSE)	1.20	1.31
Member 5, Load Condition 6 (SSE)	1.22	1.31
Member 9, Load Condition 5 (SSE)	1.25	1.31

$$\text{Stress Ratio} = \frac{\text{Calc. Stress}}{\text{OBE Working Allow. Stress}}$$

Based on the field observation and a review of its seismic qualification report, the SGTS equipment train is adequately qualified for seismic loading.

19. RBCCW EXPANSION TANKS

This equipment consists of two horizontal cylindrical tanks 60 inches in diameter by 144 in. long located in the reactor building at elevation 593 ft 6 in. These are supported on two gusset saddle supports bolted to the floor with 8-1.0 in. diameter bolts. Tanks were manufactured by Bishopric Co., Drawing No. 9306-74-1 Rev. 2. These were qualified for seismic plus hydrodynamic loads by analysis performed by Sargent and Lundy Engineers documented in EMD File No. 026374.

The analysis was performed using the static coefficient method. Natural frequencies were calculated in three directions using closed form hand solution techniques. These are 82.7 Hz side to side, 13.9 Hz axial, 65 Hz vertical. Since the tank was found to be rigid in all but the axial direction, ZPA acceleration values were used in the side to side and vertical directions. Seismic acceleration from the required response spectra at 14.7 Hz was used to calculate the force in the axial direction. Static analysis using pressure, gravity, and nozzle loads were also performed. Stresses from these (seismic, hydrodynamic, operating, gravity) load combinations were evaluated at nozzles, tank supports, and the shell. Results at critical locations are:

Element	Calc. Stress	Allow. Stress
1. Supports (Max. Stress)	11.0 ksi	20.4 ksi
2. Nozzles (3 in. Sched. 40) - Max Stress	13.8 ksi	20.6 ksi
3. Saddle Welds	2.1 ksi	20.6 ksi
4. Shell (At Support)	30.5 ksi	30.8 ksi

Based on the field inspection and a review of their seismic qualification report, the RBCCW expansion tanks are adequately qualified for seismic loading.

20. REMOTE SHUTDOWN PANELS

Remote Shutdown Panels 1A, 1B (Equipment No. 1PL67JA/B, Model No. N/A) was supplied by Unit Electric Control, Inc. It is a rectangular metal cabinet of dimensions 90H x 50W x 200 in. and weighs about 1800 lbs. It is located in the auxiliary building at elevations of 546 ft (JA) and 525 ft. 7 in. (JB). The field mounting consists of fillet weld on 12 inches centers in the front and back. The qualification document referred is: Wyle Lab. Report No. 43481-1 of 5-19-1977. Seismic load is considered in the qualification.

This panel was qualified through test. The weld was analysed for strength and found to be adequate. In laboartory mounting it had 12-1/2 in 13 grade 5 bolts. The tests on the panel were multiaxes, multifrequency with simultaneous phase incoherent horizontal and vertical inputs. The tests were of 30 seconds duration at frequency bandwidths spaced one-third octave apart over the range of 1 to 40 Hz. The amplitude of each one-third octave frequency was idependently adjusted in each axis till the TRS enveloped the RRS. A one percent and a two percent damping were used for OBE and SSE respectively. The panels were attached to the test table in the side-to-side/vertical orientation for the intial sequence of tests and then were rotated 90 degrees in the horizontal plane for the front-to-back/vertical test orientation. There were five OBE and one SSE level tests in each test orientation for each panel (1A and 1B). Six accelerometers were mounted on each panel to record response. On each of the two panels, one switch each of five types were monitored. They were:

Representative Electrical Device	On Panel 1PL67JA	On Panel 1PL67JB
Electro Switch Series 40	1E51AS034	1B21HS009
General Electric SBM Handswitch	1E12AS003A	1E12AS003B
General Electric SB-1 Handswitch	1E51AS071S	1E51AS070B
General Electric CR2940 Switch	1B21CS011A	1B21CS011B
Cutler Hammer 10250T Switch	1B21CS012A	1B21CS012B

These did not reveal any contact chatter during the test. General Electric No. 180 Vertical Indicator and Transmation 610TS Signal Converter were mounted during the test but not monitored for electrical function. Qualification of the No. 180 Indicator is documented in Wyle Lab. Test Report 43493-1 of April 12, 1977. The first was a resonance search (sine sweep) with a 0.2 g input. Next test was a pseudo-biaxial, sine beats of over 3 g (4.97 pseudo biaxial) in horizontal and vertical direction component input at 1/2 octaves from 1-33 Hz. They were monitored and no malfunction detected. Transmation 610TS Signal Converter is similar to 610T which was tested and documented in Acton Environmental Testing Report 11483. The test was single axis, single frequency sine dwell of 30 seconds duration at 1, 2, 4, 8, 10, 20, 35 Hz in F/B and vertical and 8, 11, 14, 16, 18, 19, 26 Hz side-to-side. The signal converter was monitored and no malfunction occured.

The analysis for strength is adequate. The TRS from the test on the panels evelopes the RRS completely but does not evelope SSI-RRS below 4 Hz range. This is acceptable as there is not any system frequency in that vicinity. The fuctionality of items mounted on these panels were verified.

However, the test performed by Wyle Laboratory and documented in report No. 43493-1 included a time relay (Item 4) and a L and N recorder (Item 6). These two pieces were reported to have experienced structural and/or electrical problems during the test. The criticality of the problems in regards to the seismic qualification of these pieces were left for CG&E. A question was asked of the applicant, during the SQRT-site-visit, whether any of these equipment (Item 4, Item 6) were installed at Zimmer? If there were any, how were they qualified? The applicant stated that the answers to these questions would be provided at a later date.

Based on our observation of the field installation and review of the qualification reports this item is adequately qualified for the prescribed loading, pending satisfactory resolution of the issues mentioned in the preceding paragraph.

21. GRAVITY SHUTTER ISOLATION DAMPER

This equipment consists of 28 gravity actuated duct work isolation dampers. They vary in size from 25 inches by 16 inches to 60 inches by 30 inches with either internal or external counter balances. These are flange bolted to the duct work with 3/8 in. diameter bolts on six inch centers. These rectangular backdraft dampers were manufactured by Air Balance Inc. This equipment is located in the auxiliary building at various elevations from 525 ft 7 in. to 591 ft 7 in. These were qualified for seismic loading by both testing and analysis. The testing was performed by Air Balance Inc. documented by report No. ABI-015 dated 10-20-76 and ABI-016 dated 10-20-76. The analysis was performed by Sargent and Lundy Engineers documented by EMD file No. 027724.

A resonant search test was conducted on an external counter-balance prototype, 60 in. x 30 in. size, for frequency range of 1 to 33 Hz. The natural frequencies were noted for each axis. Then the prototype was vibrated at the natural frequencies for 120 sec. at an input acceleration of 4 g's in the X and Y plane and 2 g's in the Z plane. No malfunction was noted. For internal counterbalance dampers ("VC" Damper Equipment) a similar test procedure was conducted on a 48 in. x 50 in. Prototype with input accelerations of 2.5 g in the X-plane, 4.5 g in the Y-plane, and 2.0 g in the Z-plane applied at the natural frequencies.

The required acceleration levels for the dampers was determined using the "Kapur's" method. In this method acceleration values are determined by applying an amplification factor to the appropriate building floor spectra as a function of the ratio of damper hanger frequency to the damper frequency. The required accelerations are less than the test values used.

Based on the field inspection of the gravity shutter isolation dampers and a review of their qualification reports, the gravity shutter isolation dampers are adequately qualified for seismic loading.

22. OPPOSED BLADE BALANCING DAMPER

The Opposed Blade Balancing Damper is supplied by Tuttle and Bailey and has Model No. A718. It is qualified by the document "Requalification of HVAC Opposed-Blade Volume Control Balancing Dampers," Sargent and Lundy, February 17, 1981. The damper is subject to seismic and hydrodynamic loads.

Qualification of this damper was performed by analysis. In the analysis, the damper blade was assumed to be a uniformly loaded beam simply supported at the ends. The maximum blade length for all such dampers was used and the damper frame was assumed rigid. The lowest natural frequency calculated for the pin-pin beam was 23.9 cps.

The Kapur-Shao method was used to determine the response g level for the blade with the natural frequencies of the damper and supporting hanger known. The analysis was done using the worst response spectra at the hanger locations for all such dampers. The maximum blade response was calculated for each hanger-damper combination in the plant. The worst case damper response was 1.35 g EW, 1.45 g NS, and 3.07 g V. A value of 6 g in each direction was used in the analysis.

The directional accelerations were combined using SRSS and the pressure force was added in. The resulting blade bending stress was calculated to be 21030 psi, which is less than the allowable stress of 32000 psi.

The blade deflection was determined to be 0.5 in., which is acceptable. Stress on the bearings was only 786 psi and shear stress in the blade shaft was 900 psi.

Since no concerns with the analysis have been identified, the qualification of this item is considered adequate.

23. BUTTERFLY ISOLATION DAMPER

This equipment consists of 4-17 3/4 in. diameter and 23 3/4 in. diameter dampers with ITT motor operators. These are located in the auxiliary building at elevation 591 ft 7 in. Dampers are flange bolted to the connecting duct work with 3/8 in. diameter bolts on six inch centers. These were manufactured by American Warming and Ventilating Inc. Seismic qualifications was accomplished by both testing and analysis. Reports documenting the qualification work are Sargent and Lundy Engineers EMD File No. 009694 and EMD File No. 028332.

Seismic qualification of the motor operator was performed by testing. Qualification of the remainder of the damper was accomplished using static equivalent analysis. For the static analysis, the damper natural frequencies were determined by hand solution techniques in 3 directions. The natural frequencies for the two size dampers were determined to be:

	(1VC01YA/B)	(1VC02YA/B)
N-S	Rigid	Rigid
E-W	83.7 Hz	110.8 Hz
Vertical	83.7 Hz	110.8 Hz

The required g-levels are 0.66 g and 0.85 g in the two horizontal and 0.75 g in the vertical direction.

Operability of the dampers during seismic loading is assured by evaluating the deflection of the damper's shaft-blade assembly in addition to evaluating damper critical component stresses. They are:

Element	Calc. Stress	Allow. Stress
Damper Blade	1589 psi	23400 psi
Damper Bearing Load	426 lb	4900 lb
Shear Load/Anchor Bolt	30 lb	830 lb
Shear in Shaft	2607 psi	19200 psi
Bolt Connecting Blade and Shaft	18467 psi	19200 psi

Seismic testing of the motor operator was performed by Wyle Lab, documented in report No. 58072. The test results demonstrated operability up to 3 g's. For the test, the motor operator was base mounted only, a more conservative mounting than in the field. For the field mounting, the motor operator is supported at the base and at the motor end. Therefore, the seismic testing of the motor operator was adequate.

Based on the field inspection of the butterfly isolation damper and a review of their qualification reports, the butterfly isolation damper is adequately qualified for seismic loading.

24. 10-IN. GLOVE VALVE

This 10-in. glove valve is provided by the Powell Co. and has Figure No. 3051-T-WE. It is qualified by the Wm. Powell Co. Seismic Qualification Report No. S-67132, March 23, 1981, and Sargent and Lundy calculations dated April 18, 1981. The valve is subject to seismic and hydrodynamic loads.

The valve was originally qualified by analysis by the Powell Co. using the computer program SAFE. It was used to calculate resonances of 26.6 and 44.6 Hz. The program was also used to apply g-loads at the valve C.G. and to perform a static analysis to determine resulting stresses in the valve components. The stresses were compared to AISC allowables for the operator and bolting stresses and to the ASME Section III Code for other elements. The applied g loads were adjusted until an allowable stress was reached and the valve was thereby qualified to 3.5 g, 3.5 g and 3 g in the three orthogonal directions. Allowable valve nozzle loads were also determined.

Sargent and Lundy then requalified the valve by considering the bonnet flange moment. They also divided g levels at the valve C.G. by an amplification factor of 2 to account for the value flexibility. A similar amplification factor of 1.5 had been used by S&L in their valve qualifications for the LaSalle plant. The Sargent and Lundy analysis resulted in qualification g levels of 1.32, 3.12, and 2.82 in the three orthogonal directions. The allowable nozzle loads were not altered. The allowable g levels and nozzle loads are to be compared to actual results obtained from the piping analysis performed by the NUS Corp.

In order to complete our review, we have required that the applicant

1) Justify that use of an amplification factor of 2 to account for valve flexibility is conservative.

2) Show that the piping analysis results, when obtained, do not exceed allowable g levels and nozzle loads for the valve.

25. 3/4-IN. x 1-IN. RELIEF VALVE

This relief valve is supplied by the J. E. Lonergan Co. and has Model No. LCT 20/51. It is qualified by the document "Seismic Calculations Safety and Relief Valves," J. E. Lonergan Co., October 21, 1976, and by subsequent calculations performed by Sargent and Lundy. The relief valve is subject to seismic and hydrodynamic loads.

This item is qualified by analysis. In the analysis performed by the J. E. Lonergan Co., the natural frequencies for lateral bending and of the valve's spring system are approximated. Seismic accelerations of 3.5 g in each direction are applied at the C. G. of the valve. The loads at the nozzles are then calculated as reactions to these accelerations. This method does not appropriately account for motion of the piping in the determination of the nozzle loads. The Lonergan analysis finally determined that the valve section moduli and metal area at the inlet and outlet are significantly higher than that of the attached piping.

Sargent and Lundy later performed an analysis on the valve. The natural frequency for bending motion was recalculated, using less conservative assumptions, to be 88 Hz. This suggests that the valve body and housing around the spring can be treated as rigid. Since the spring and surrounding housing are of light weight relative to the valve body and are stout structure, they were not analyzed. The weaker inlet and outlet flanges were analyzed for nozzle loads from the Sargent and Lundy piping analysis. The applied nozzle loads are as follows:

	F_A(lb)	F_B	F_C	M_A(ft-lb)	M_B	M_C
Maximum load (inlet or outlet)						
	255	219	254	70	84	140

The allowable flange bending moment was determined to be 261 ft-lb. The flange bolts (1/2-inch) have a basic allowable stress of 25 ksi, which is sufficient. The g levels of the valve as determined by the piping analysis are 5.6 g, 2.1 g and 4.4 g in the three coordinate directions.

Since the valve flanges appear to be much more critical than the remainder of the valve and are of sufficient structural integrity for applied loads, this valve is considered to be adequately qualified.

26. 3/8 IN. M, GLOBE VALVE

The valve (size and type: 3/8 in. Globe; Oper. Type M; Model 6432) was manufactured by Henry. Vendor was Bahnson. In the field it was welded to a 1.5 in. diameter copper pipe located in the auxiliary building. The referenced qualification document is Corporate Consulting and Development Company Report No. A-129-77 dated 8-5-77. Seismic load is considered in the qualification.

This valve has been qualified through test. The laboratory mounting was on a fixture to simulate in service condition. There was no accelerometer mounted on the valve because of its small size. It was subjected to psuedo bi-axial, sine dwell at 27.5 Hz for 245 seconds with component input level of 4.0 g in "a", 4.0 g in "b" and 3.8 g in "c" direction. "a", "b" and "c" is along the outlet pipe run, perpendicular to "a" in the plane of this axis and valve stem, and perpendicular to both "a" and "b" respectively. There was only one test to simulate five OBE and one SSE in time duration.

In the field mounting, the system of piping on which the valve was mounted was rather flexible and appeared to be needing supports. On inquiry, the applicant stated that there were supports to the piping system. They had temporarily been removed for the purpose of wrapping insulation around the pipes. The supports would be put back in.

The test is satisfactory because the valve itself was relatively stiff. However, the g-levels (requirement level) from the piping analysis is yet to be verified.

Based on our observation of the field installation, the review of the qualification reports and the clarification provided the applicant, this valve is adequately qualified for the prescribed loading pending verification of the g-levels from the piping analysis.

27. 10-IN. AO, GLOBE VALVE

This 10-in. glove valve is provided by the Fisher Controls Co. It is qualified in the report "Requalification of the 10-in. (1WSC20) Fisher Valves for the Maximum Dynamic Loads Encountered - Subsystem WS-12," May 28, 1981. The valve is subject to seismic and hydrodynamic loads.

Fisher Controls originally performed a structural analysis on the valve to calculate stresses due to applied "g" loads using the SEISMIC 3 computer program. Fisher qualified the valve to ZPA's of the floor level response spectra. A natural frequency of 27.1 Hz corresponding to lateral vibration of the valve operator was also identified.

The valve was later requalified by Sargent and Lundy through analysis. Their analytical approach was to apply g loads at the C.G. of the valve such that the highest stress in the valve falls just under Code allowable. These g loads are then divided by 2 to account for flexibility of the valve and thereby establish the qualifying g levels for the valve. The resulting qualification values were 1.18 g, 1.03 g, and 1.64 g in the three orthogonal directions while the g loads from final piping analysis (by the NUS Corp) were 1.07 g, 0.90 g, and 1.59 g, respectively. Higher qualifying g loads could have been established, but the procedure of maximizing these g levels was stopped since the piping analysis results were already exceeded.

S&L's analysis included a calculation for the bonnet flange moment, which exceeded the ASME Section III Code allowable. Stresses in the valve due to the actual piping nozzle loads were also calculated and determined to be acceptable.

In order to complete our review, we have required that the applicant justify that use of an amplification factor of 2 to account for valve flexibility is conservative.

28. ELECTRICAL INDICATOR VERTICAL EDGEWISE

The indicator (Model No. Type 180 DC) was supplied by General Electric. It measures 6.83H x 6.04W x 2.294L in. and weighs 18 oz. It is mounted on main control board 1PM07J which is located in the auxiliary building at an elevation of 546 ft. The referenced qualification document is: Wyle Test Report No. 43493-1 of April 12, 1977. Only seismic loads are considered in the qualification.

This equipment was qualified through test. First the required g-levels for its location was obtained from an analysis performed on the panel (1PM07J). This was 1.4 g in each of the three directions. A two percent damping was used in the analysis. Both the laboratory and field mountings were standard mounting hardware for instrument on panel. Resonance search performed in the range of 1 to 33 Hz did not indicate any in this range. The qualification was performed with pseudo bi-axial single frequency sine beat test at 1/2 octave interval and with maximum beat excitation of 3 g in each direction. The criteria of 5 OBE and one SSE level test requirement was satisfied.

The test was adequate. The functionability was verified.

Based on our review of the qualification documents and observation of the field installation, this instrument is adequatley qualified for the prescribed loading.

29. TRANSMATION CURRENT RELAYS

The realys (Equipment No. 1FS-VC021, 23; Model No. 210A) are supplied by Transmation Inc. It was (1FS-VC021) mounted on panel 1PL14JA located in the auxiliary building at an elevation of 567 ft. This item weighing about 3.5 lbs had a box type apperance with approximate dimension of 3 x 6 x 6 in. It was mounted with 4-1/2 in. 8 - 32 pan head iron machine screws. The referenced document for qualification is Acton No. 11483 of April 3, 1975. Seismic loads are considered in the qualification.

This equipment had been qualified based on its similarity to relay Model (220A). Model 220A was tested. The laboratory mounting was the same as the field. A resonance search in each of its axis with a sine sweep of 0.5 g magnitude indicated the following resonant frequecies in the range of 0.5 to 35 Hz:

n_1:none below 35 Hz; n_2:8, 19 Hz; V:none

where n_1 is normal to the 3 x 6 face n_2 is normal to the 6 x 6 face and v is normal to the other 3 x 6 face and perpendicular to n_1 and n_2. The subsequent qualification tests were single axis, single frequency sine dwell with an input of 3 g. This test was repeated at frequencies of 8, 11, 14, 16, 18 19 and 26 Hz in each orientation. Each was of 30 seconds duration.

The worst of the two panel accelerations at instrument locations were n_1 = 2.5 g; n_2 = 2.5 g and V = 1.0 g. Single axis, single frequency test is adequate for this item. The number of tests performed are adequate to meet mechanical aging criteria.

Based on our observation of the field installation and review of the qualification documents the transmation current relays are adequataly qualified for the prescribed loading.

30. ROSEMOUNT TEMPERATURE DETECTOR ASSEMBLY

This equipment (10 of them) which have the physical appearance of a short (approximately 10 in.) length of 3/4 in. diameter pipe with a electrical connection head at one end. These assemblies are used with two types of mounting. One type threads directly into a threaded pipe nipple, the other type is wall mounted using an angle bracket which attaches to the wall with two 1/4 in. diameter bolts. The temperature detectors were manufactured by Rosemount Inc. (Drawing Numbers H34149-3203 and H34149-3205). This equipment was qualified for seismic plus hydrodynamic loading by testing performed by Rosemount, documented by report No. 107616.

Tests for the temperature detectors were performed for the more flexible wall mounted design. The tests consisted of resonance search from 1 to 35 Hz and pseudo biaxial sine dwell at resonance frequencies. The natural frequencies in each direction were determined to be:

FB/V	7.4, 24 Hz.
FB/V (rotated 180°)	7.6, 11, 25 Hz.
SS/V	7.7, 24 Hz.

The pseudo biaxial sine dwell tests were performed with a 4.3 g input level of 30 seconds duration. The required acceleration levels in each direction are H1: 2.8 g, H2: 1.7 g, V: 2.9 g. Operability was demonstrated before, during, and after the sine dwell tests. However, a small fracture with slight permanent deformation of the wall support bracket was sustained during the tests. The bracket was still capable of supporting the sensor assembly. Rosemount redesigned the wall bracket with additional bracing. The redesigned brackets were supplied for Zimmer. The temperature detector assembly with the redesigned bracket is being requalified by testing. The applicant has agreed to submit the requalification report for review.

Based on the field inspection of the Rosemount temperature detector assembly and a review of its qualification report, this item is adequately qualified for seismic loading pending satisfactory review of its new requalification report.

31. ATKOMATIC DELUGE SOLENOID VALVE

These 1 1/2 in. solenoid valves (8 of them) were manufactured by Atkomatic Valve Co. with model Number 5700-GX. These are a portion of the standby gas treatment systems located at elevations 593 ft 6 in. and 546 ft 0 in. of the reactor building. Valves are attached rigidly to an angle iron frame work with 2-2 inch U-bolts. These were qualified for seismic plus hydrodynamic loading by test performed by Gaynes Engineering and Testing Laboratories, Inc. documented by report No. 75411.

The tests consisted of a resonance search and pseudo biaxial single frequency sine dwell. No natural frequencies were found below 33 Hz. The pseudo biaxial sine dwell tests were performed at the following frequencies

FB/V = 5, 10, 15, 21, 27, 31, 33 Hz.

SS/V = 5, 10, 15, 23, 29, 33 Hz.

The duration of each dwell test was 60 seconds. The input excitation was 4.5 g in the horizontal direction and 3.0 g in the vertical direction. Operability of the valve was demonstrated before, during, and after the sine dwell tests. The required ZPA levels are N-S 0.36 g, E-W 0.42 g, vertical 0.75 g. The test values greatly exceed the required values.

Based on the field inspection and a review of its qualification report, the Atkomatic Solenoid valve is adequately qualified for seismic loading.

32. SGTS COOLING FAN

There are two 200 CFM, 1150 RPM fan-motor assemblies. These assemblies are mounted on the SGTS equipment trains at elevations 546 ft 0 in. and 593 ft 6 in. of the reactor building. The fans were manufactured by Buffalo Forge Co. with model No. 32 volume fan. The fan has a one horsepower Westinghouse motor with frame No. 1457. The fan-motor assemblies were qualified for seismic plus hydrodynamic loading by analysis performed by Buffalo Forge Co. documented by report No. SA-A.4007.

The seismic analysis was performed using the static equivalent method. The lowest natural frequency was determined to be 75 Hz for the fan rotor. The fan was analyzed for 1 g acceleration loading in all three directions. The fan motor was analyzed for the following acceleration levels, N-S 2.2 g, E-W 3.4 g, vert 9.3 g. Stresses for the critical locations were determined to be as follows:

Element			(psi) Calc. Stress	(psi) Allow. Stress
Fan:	Set Screw	Shear	736	3,700
	Shaft	Shear	242	17,000
		Tensile	483	28,800
	Bearing Bolts:	Comp.	117	27,000
Motor:	5/16 in. Mounting Bolts:	Shear	1040	13,566
		Tensile	2140	26,334
	Shaft	Comp.	2655	8,254

The calculated motor rotor deflection was 0.00063 inches compared to an allowable of 0.013 inches.

Currently the fan-motor assembly is mounted using 4 preloaded springs to act as a vibration isolation mounting. This is to be replaced with a rigid mounting. In order to justify the existing 1 g analysis of the fan, the new mounting must be rigid enough such that the lowest natural frequency be above 50 Hz. Otherwise, the current static analysis must be scaled up to account for dynamic amplification.

On the inlet side of the fan is a motor operated isolation damper. Support of this equipment for seismic appears to be questionable. Seismic qualification of this piece of equipment is requested.

Based on the field inspection and a review of qualification reports, the cooling fan is qualified for seismic loading pending satisfactory resolution of the above concerns.

LIST OF ATTENDEES

T. Y. Chang	NRC/EQB
Mary Haugney	NRC/EQB
T. P. Gwynn	NRC/I&E/Res. Insp.
D. J. Frederick	CG&E GED
Jonathan Reed	CG&E
Jim Sundergill	Bechtel
Gary Chew	NUTECH
Ray Hutchings	NUTECH
Vince Brocato	NUTECH
Bill McConagny	NUTECH
Ahmed Javid	NUTECH
Mechat Hassaballa	Sargent & Lundy
B. Goginini	Sargent & Lundy
A. E. Meligi	Sargent & Lundy
Thomas Miller	Sargent & Lundy
Joe Sinnappan	Sargent & Lundy
Bob Tjernlund	Sargent & Lundy
J. N. Singh	EG&G Idaho, Inc.
T. L. Bridges	EG&G Idaho, Inc.
G. K. Miller	EG&G Idaho, Inc.