Docket No.: 50-458

JAN 30 1985

Mr. William J. Cahill, Jr.
Senior Vice President
River Bend Nuclear Group
Gulf States Utilities Company
Post Office Box 2951
Beaumont, Texas 77704
ATTN: Mr. J. E. Booker

Dear Mr. Cahill:

Subject: Trip Report for Site Review of Seismic and Dynamic Qualification of Safety Related Equipment at River Bend Station

Enclosed for your information and action is the Seismic Qualification Review Team (SQRT) audit report. This audit was conducted on-site during the week of October 29, 1984. The information contained in this report is a detailed evaluation of the review team findings. The audit report documenting the findings of the Pump and Valve Operability Review Team (PVORT) conducted during the same week as the SQRT audit will be forwarded to you in the near future. Licensing Project Manager, Edward Weinkam, will coordinate your interaction with the staff to resolve the open items identified in the SQRT Audit Report.

Sincerely,

A. Schwencer, Chief
Licensing Branch No. 2
Division of Licensing

Enclosure:
As stated

cc: See next page

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NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

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River Bend Station

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River Bend Station, Unit 1
SQRT Audit Report

INTRODUCTION

This report is prepared by Brookhaven National Laboratory (BNL) and documents the evaluation of seismic qualification of some preselected Seismic Category I equipment for the River Bend Station. The audit by the Seismic Qualification Review Team (SQRT) was performed at the plant site, Francisville, Louisiana, the week of October 29, 1984. The BNL seismic review team consisted of J. Curreri, M. Kassir and K. Bandyopadhyay. The Nuclear Regulatory Commission was represented by G. Baghchi, N. Romney and E. Weinkam (partial attendance).

A total of eighteen pieces of equipment, eight from Nuclear Steam Supply System (NSSS) and ten from the Balance of Plant (BOP), was selected for the audit. The audit consisted of site inspection of one or more samples of each equipment family followed by review of the pertinent seismic qualification documents as presented by Gulf State Utilities Company (GSU) and its agents General Electric Company (GE) and Stone & Webster Engineering Company (S&W). The site installation was compared with the qualification mounting, and the qualification documents were reviewed to meet the adequacy of structural integrity and functional operability of the equipment. Due to energization of the equipment and/or unaccessability of the mounting, some installations could not be properly inspected. During the audit period, GSU, GE and S&W described their qualification program through presentation and interpretation and clarification of qualification reports.

The seismic evaluation of the equipment resulting from the audit is individually described in the following sections including the equipment-specific open issues requiring resolution for acceptance of its seismic qualification program. A listing of the audited equipment and a brief

description of the findings including respective status are provided in the attached table. The generic open issues also requiring resolution for acceptance of the seismic qualification program are listed in the following subsection.

GENERIC OPEN ISSUES

1. Each equipment qualification document package contained summary statements overall conclusions. The conclusions for each package was that the equipmen is fully qualified. However, in many instances it was observed that evidence necessary to reach the state of conclusion of complete qualification was unavailable. More recent documentation packages were incomplete and appeared to be put together without adequate checking. Therefore, the applicant is to develop a more systematic program to perform the acceptance review of all safety-related equipment.

2. Where the qualification document package identifies a need for equipment modification, the applicant is to provide either a statement indicating implementation of the modification or justification for not implementing the modification.

3. In many cases, it was observed that the equipment qualification report identified parts with a limited-life. Such equipment could be located in either a mild or a harsh environment. The applicant is to develop a systematic procedure for identifying limited-life parts and to ensure their replacement at appropriate intervals during the acceptance review of equipment.

4. There were equipment pieces found to be incorrectly or improperly installed. The applicant is to develop a procedure to check proper mounting of all safety-related equipment consistent with the qualification mounting configuration.

5. It was observed that for many equipment the enclosure panel was partially removed or screws were loose reportedly in order to facilitate preoperational testing. The applicant is to develop a procedure to insure that such equipment is returned to the qualified status.

6. Upon completion of as-built piping analysis for all pipe-mounted safety-related equipment, the applicant must confirm that the g-values used for qualification of these equipment were not lower than the g-values obtained from the as-built piping analysis.

7. The qualification of those pieces of equipment which were originally qualified to meet IEEE Std 344-1971, should be identified and upgraded to meet the requirements of IEEE Std 344-1975 as applicable.

8. Upon completion of the on-going qualification process, the applicant must confirm that all safety-related equipment have been qualified.

Table of Audited Equipment

SQRT ID No.	Applicant ID No.	Equipment Name and Description	Safety Function	Findings	Resolution	Status	Remarks
NSSS-1	1C11*ACTD001	Hydraulic Control Unit. Assembly consists of N_2 cylinder, water accumulator and various valves.	Translates scram signal into hydraulic energy to insert the control rod drive and allow its return flow to discharge through the exhaust valve.	The additional brace used during qualification test of the equipment was missing from the installed unit.	Pending	Open	
NSSS-2	H13-P680	Plant Control Console. A U-shaped monitoring benchboard.	The console supports instruments which are used to monitor and control the safe operation and shutdown of the plant.	1. The dynamic similarity between the tested specimen and the River Bend console was not established. 2. The test mounting was not documented in the test report. 3. For components qualification, the capability g-values were not defined and demonstrated to envelop the RRS over the entire frequency range.	Pending	Open	
NSSS-3	C61-P001	Remote Shutdown Vertical Board	It provides redundant means for safe shutdown of the plant.	The installation condition of being next to another cabinet and the wall was not addressed in the qualification.	Pending	Open	

Table of Audited Equipment(Cont'd)

SQRT ID No.	Applicant ID No.	Equipment Name and Description	Safety Function	Findings	Resolution	Status	Remarks
						Qualified	
NSSS-4	E12-C002A,C	RHR Pump and Motor	The assembly is required to pump water in the suppression pool during pool cooling modes and LPCI vessel injection modes.				
NSSS-5	H13-P601	Reactor Core Cooling Bench Board. A monitoring panel.	It contains instruments that are used for manual control for accident mitigation of the emergency core cooling system.	1. Dynamic similarity between the tested specimen and the River Bend Unit was not established. 2. Test mounting was not completely documented in the test report. 3. For component qualification, the capability g-values were not defined and demonstrated to envelop to RRS over the entire frequency range. 4. Qualification of some devices below 5 Hz was missing. 5. Controller and recorder units were sliding during tests. It could not be verified from documentation presented wheth-	Pending	Open	

Table of Audited Equipment (Cont'd)

SQRT ID No.	Applicant ID No.	Equipment Name and Description	Safety Function	Findings	Resolution	Status	Remarks
NSSS-5 (Cont'd)				er River Bend panel contains these devices. 6. Site inspection revealed the following: a) One unistrut was loose. b) GE ERIS terminals were very flexible.			
NSSS-6	H13-P670	Neutron/Process Radiation Monitoring System.	Provides information about power levels and power distribution in the reactor, and is tied to a trip system (Reactor Protection System).	The cabinet was installed with 1/2" diameter bolts although the specimen was tested with 5/8" diameter bolts.	Pending	Open	
NSSS-7	H22-P041,42	Main Steam Flow Local Panel	It supports Class 1E devices	1. Transmitters were not environmentally aged prior to seismic testing. 2. Transmitter output variation was detected during testing apparently due to incomplete instruction provided by GE to	Pending	Open	

Table of Audited Equipment (Cont'd)

SQRT ID No.	Applicant ID No.	Equipment Name and Description	Safety Function	Findings	Resolution	Status	Remarks
MSSS-7 (Cont'd)				testing engineers regarding calibration. GSU/GE is to confirm that River Bend installation engineers have received the complete instruction and the transmitters are properly calibrated.			
MSSS-8	B21-F028B	Main Steam Isolation Valve	It isolates the steam line upon demand.	1. Adequacy of the valve body was not demonstrated. 2. GSU is to confirm compliance with GE's recommendation regarding the following required for qualification: a) Bracket modification for Limit Switch. b) Elimination of junction box. 3. The source of River Bend specific RRS was not presented during the audit.	Pending	Open	

Table of Audited Equipment (Cont'd)

SQRT IO No.	Applicant ID No.	Equipment Name and Description	Safety Function	Findings	Resolution	Status	Remarks
BOP-1	1CCP*MOV138	10" Motor Operated Valve	The valve is required to isolate the containment and to intercept the water flow of the reactor plant component cooling water system (RPCCW) to the non-regenerative heat exchanger.			Qualified	
BOP-2	1RCP*TCA03	Termination Cabinets	The cabinets are required at penetrations to contain the wiring used in instrumentation monitoring and control of equipment used in various safety related functions.			Qualified	
BOP-3	1EHS*MCC	Motor Control Center. A two-bay rectangular cabinet containing starters, circuit breakers, switches, terminal blocks, etc.	MCC is required to provide Class 1E power distribution.	1. Qualification of devices apparently covered by Gould reports R-STS-10,31 and analysis was not available for review. 2. Test mounting was not documented. 3. It is not clear from test report whether the MCC was tested for 5 OBE and 1 SSE for <u>both</u> the	Pending	Open	

Table of Audited Equipment (Cont'd)

SQRT ID No.	Applicant ID No.	Equipment Name and Description	Safety Function	Findings	Resolution	Status	Remarks
BOP-3 (Cont'd)				energized and de-energized conditions. 4. Supplemental evaluation report for HE 4-3 circuit breakers was not part of the qualification documentation package.			
BOP-4	1E12*PC003	Centrifugal fill pump. A pump/ motor assembly.	It maintains the RHR system piping filled and ready for main RHR pump start-up.	The site inspection revealed the following deficiencies: 1. The shim stack was loose. 2. One nut in the seal housing was loose and anotner was missing. 3. The motor name plate was missing.	Pending	Open	
BOP-5	1HVC*ACU1B	Control building air conditioning unit.	It maintains the control building at design temperature and and humidity.			Qualified	
BOP-6	1HVR*AOD10A	Air operated damper. It is duct mounted and supported from the ceiling.	It operates only during LOCA when it bypasses the air to the Standby Gas Treatment Building.			Qualified	

Table of Audited Equipment (Cont'd)

SQRT ID No.	Applicant ID No.	Equipment Name and Description	Safety Function	Findings	Resolution	Status	Remarks
BOP-7	1LSV*CJA	Leakage Air system compressor. A single rotary compressor compressor with electric motor drive	It provides pressurized air to containment isolation valves to prevent release of fission products after LOCA.			Qualified	
BOP-8	1SCM*XRC14	Transformer	It furnishes power to various Class 1E instruments as part of the Uninterrupted Power Supply System.	1. Dynamic similarity between the tested specimen and the River Bend transformer was not established. 2. Test mounting was not completely documented in the test report. 3. Test anomalies were mentioned, but neither described nor justified in the test report. 4. Site inspection revealed the following: a) There was no contact between the base plate and concrete in most places b) Side panels were loose c) Base plate was not addressed in the	Pending	Open	

Table of Audited Equipment (Cont'd)

SQRT ID No.	Applicant ID No.	Equipment Name and Description	Safety Function	Findings	Resolution	Status	Remarks
BOP-8 (Cont'd)				qualification documents presented.			
BOP-9	1EJS*LDC1A	Load Centers	They are required to furnish power distribution to HVAC systems in the Control and Diesel Generator Building and also to Class 1E Motor Control Centers.	Only a summary of test report was available. The original Wyle Test Report is needed for review and documentation.	Pending	Open	
BOP-10	1SWP*P2B	Standby Service water pump. An electrically driven vertical turbine pump.	It provides cooling water for safety related equipment when normal service water is lost.	1. Torsional frequency of assembly needs to be computed and compared to motor's operational speed. 2. Operability of pump under seismic load needs to be assured.	Pending	Open	

10" Motor Operated Valve

The 10" motor operated gate valve is part of the containment flow isolation system. It is required to isolate the containment and to intercept the water flow of the Reactor Plant Component Cooling Water System to the non-regenerative Heat Exchanger. The valve is located in the Auxiliary Building at the 116' level.

An evaluation of all of the loads on the valve showed that the significant ones were the internal pressure, the hydrodynamic and the seismic. Thermal effects are shown to be insignificant. The flow velocity is small and is not expected to appreciably affect the ability of the valve to close.

The documents show that the valve was qualified by a combination of test and analysis. The structural adequacy of the valve and assembly was shown through a static analysis. The overall assembly operability was demonstrated through a static deflection test. The test showed that there was no binding of the shaft or any other component to interfere with functional operability. A fatigue evaluation of the critical components was carried out to demonstrate the ability of the valve to maintain structural integrity in accordance with the specifications. The static stress analysis demonstrated the adequacy of the valve assembly up to 11.6 g loading for seismic, hydrodynamic and operating loads. The required maximum acceleration is 5.5 g at the valve. The valve assembly regions of high stress concentration were checked for fatigue damage. The analysis was performed at all critical locations. It was shown that the cumulative damage factor is always less than unity. Therefore, no fatigue damage is expected to occur.

A test program was conducted to qualify the valve in a number of BWR power plants. Because the program was generic, the magnitudes and duration of

the test procedures were more severe than the test requirements at River Bend Unit 1.

Two valve assemblies were pressurized and operated before, during and after the tests to demonstrate functional operability during the series of dynamic tests. These included sine scan as well as sine beat tests. Seat leakage was monitored in the tests. The limit switches were monitored; contact chatter was recorded. It was shown that there was no contact chatter in excess of 2 multiseconds. The tests included aging to simulate the normal plant vibrations in addition to the seismic environment.

The motor operator and other parts which contained non-metallic age-sensitive components were also qualified for the normal and accident environmental parameters.

The operator dynamic testing performed by the Limitorque Corporation was supplemented by further tests. These tests caused some bolts to loosen. In addition, there was excessive chatter. As a result of the anomalies, a standard for the adjustment of the geared limit switch finger assembly and a standard for the bolt torque were developed. These were made part of the installation and inspection procedures for River Bend. After these procedures were implemented, the valve was qualified to levels in excess of those required at the installed location.

The results of the analysis, the valve operability tests and the motor-operator dynamic tests show that the functional capability of the valve will be maintained during and after the seismic and hydrodynamic event, and the equipment can be considered seismically qualified.

Electrical Penetration Termination Cabinet

The termination cabinets are required to anchor the ends of wires that pass through containment and shield wall penetrations. These cabinets are provided in pairs for this function, one cabinet inside the containment and one cabinet outside, to house the anchor points for the wires on opposite sides of the containment.

The termination cabinets are rectangular boxes which measure 120" H x 48" W x 42" DP. The cabinets contain many general electric EB-25 terminal strips. The cabinet # 1RCP*TCA03 is located at the 114' elevation level of the Auxiliary Building, for which the ZPA magnitudes for SSE is 0.32 g horizontal and 0.30 g vertical.

The termination cabinet itself is qualified by a finite element analysis using a STRUDL-SW computer code. The terminal blocks are qualified by a test in accordance with IEEE Std 344-1975.

The seismic response of the cabinet is determined by the response spectrum modal analysis in which the first twenty modes are used. The excitations in the side to side, front to back and vertical directions are all considered. Stresses in structural members, connections and support welds are shown to be less than the allowable values.

The terminal blocks were qualified by a random bi-axial excitation test program. A single axis slow sine-sweep was applied in the frequency range of 1 Hz to 33 Hz at a level of 0.2 g. The independent bi-axial random multifrequency motion test was than applied. The equipment was tested in two axes simultaneously, front to back and vertical and then side to side and vertical. The required five OBE's and one SSE were applied in each test. The random motion was controlled in 1/6 octave bandwidths and was applied for a duration 30 seconds for each of the twelve tests.

The lowest natural frequency of the cabinet was determined to be 20 Hz. The field mounted condition showed that the fillet weld actually used was a continuous 1/4" weld instead of the 3/16" fillet weld 2" long on 4" centerline. This heavier mounting can only raise the natural frequency and so is accepted as conservative. The terminal blocks were environmentally aged by Southwest Research Institute.

It is concluded that the termination cabinets are qualified for the dynamic environment in which they are located.

Motor Control Centers

The Motor Control Centers (MCC's) are part of a Class 1E electrical system and are required to provide Class 1E power distribution. There are multiple Class 1E MCC's located on various buildings in the plant. The units are supplied by ITE Gould, Inc. One typical MCC is a tow-bay rectangular cabinet containing starters, circuit breakers, switches, terminal blocks and such other electrical devices. It weighs approximately 1600 lbs. and measures about 90" high x 46" wide x 20" deep.

The MCC 1EHS*MCC15B located at elevation 98 feet of the Diesel Generator Building was inspected. The base framing channel of the cabinet was welded to the embedded steel.

The qualification requirements are provided in Stone & Webster (S&W) Design Specification No. 242.562 Rev. 1, Addendum 1 through 5 and E & DCR No. P22104A, dated 10-2-84. The following qualification documents were available during the audit:

1. Gould Seismic Report No. SC-289, Rev. 3 (S&W File No. 4242.562-082-002E, dated, 10-27-84).
2. Gould Weld Report No. R-344-1,-3 (S&W File No. 1242.562-082-001C, dated, 10-26-83).
3. Gould Supplement Report (S&W File No. 4242.562-082-002F, dated, 10-27-84).

The qualification of the MCC enclosure panel and some electrical devices are based upon shake-table testing of a similar 5600 series unit. A resonance search test was performed on the specimen in each direction followed by bi-axial multi-frequency random vibration inputs for 5 OBE and 1 SSE

conditions. The MCC was electrically monitored during and after the vibration tests. The TRS enveloped the RRS except slightly at a small frequency range below the fundamental frequency.

The circuit breaker HE 4-3 was reportedly qualified by a separate Gould Report (No. R-STS-25) which was not available for audit. S&W provided the following description based on their review of the report: The breaker was included in a similar MCC and the MCC was tested by sine beats at resonant frequencies. There was no indication of electrical malfunction during the test.

The qualification of other electrical devices apparently qualified by Gould Report No. R-STS-10,31 and other analysis, was not available for audit, nor was there any indication that S&W had reviewed these missing reports while accepting the overall qualification of the MCC's.

Based upon our review of the available documents, the field inspection and the clarification provided by the S&W personnel, we have come to the conclusion that in order to qualify the MCC's GSU should resolve the following comments:

1. The reports R-STS-10 and 31, and an analysis used by Gould to qualify some electrical devices as described above should be reviewed by GSU/S&W, and be made available for review by the SQRT. The final qualification package must contain qualification reports for the MCC's including all internal electrical devices.

2. The test mounting should be completly documented in the test report and compared with the field installation for acceptability.

3. It is not clear in the available test report whether the test specimen was tested for 5 OBE and 1 SSE for both the energized and the de-energized conditions. GSU should provide documentation to confirm testing for both conditions. This comment is also applicable for all electrical devices tested separately.

4. The supplemental evaluation report prepared by S&W in order to qualify the circuit breaker HE 4-3 should be made part of the qualification package.

RHR Centrifugal Fill Pump
(Mark No. 1E12*PC003)

The RHR centrifugal fill pump is required to maintain the RHR piping system filled and ready for main RHR pump start up. The total weight of the unit is 276 lbs. and it measures approximately 39" x 12" x 15". It is located in the Auxiliary Building at 78.5' elevation and mounted to a floor plate by means of four 3/4" bolts.

The pump qualification document given in SQRT form and reviewed during plant visit is "Analysis of RHR ECCS Subsystem Fill Pump", No. 4237.160-180.002C, dated March 3, 1983, prepared by McDonald Engineering Analysis Co., and reviewed by Stone and Webster Engineering Corp. The pertinent reference design specifications for qualification requirements used were as follows:

Specification 237.160	- Horizontal centrifugal pumps
E&DCR C-6069A	- Engineering & design coordination report for assembly mounting.

The pump/motor assembly was modeled as a 3D beam and qualified by analysis. Seismic loads higher than those specified for the plant and maximum nozzle loads were imposed on the mathematical model. A standard STRUDL computer program was employed to compute the response of the assembly. The fundamental natural frequency was found to be 41.2 Hz, and the critical stresses and deflections were confirmed to be less than the allowable stresses and operating clearances, respectively.

In addition to above, the motor itself (Model TBFC) was analyzed by Westinghouse Electrical Corp., in Report No. 80D16115, "Seismic Analysis of Motor", which was reviewed by Stone and Webster Engineering Corporation. Under operating and SSE loading, the motor mounting bolts were found to be the most highly stressed part. The combined shear and tensile stresses were checked by an interaction formula and found to demonstrate an adequate safety factor. The shaft deflection of the motor exhibits a safety factor of 3.2 compared to available clearances at the rear bracket which eliminates the possibility of "rubbing".

During the site audit the following were noticed: (1) the shim stack in the middle west side of the pump is loose and can be moved by hand, (2) one nut in the mechanical seal housing is loose and one nut is missing from the coupling ground, and (3) the motor name plate is missing.

Based on the above information, it is concluded that the Residual Heat Pump will be qualified for the seismic loads at River Bend plant site, provided the above listed installation deficiencies are corrected.

Control Building Air Conditioning Unit
(Mark No. 1 HVC*ACU1B)

The air conditioning system maintains the Control Building at the required design temperature and humidity. There are two units located near each other at elevation 115' of the Control Building. The inspected unit is capable of circulating 37,000 CFM, weighs 16,900 lbs. and has overall dimensions of 208" x 132" x 115". It is comprised of three sections, namely, a filter-mixer cabinet, a blower section containing a fan and its housing support, and a cooling coil section. The unit is mounted on a 6" concrete pedestal by means of a steel floor mat consisting of a series of 6" x 2-3/4" x 1/8" channels, and is anchored to the floor by way of 24 anchor bolts. The three sections are dynamically uncoupled from each other through the use of flexible connections. Within the blower section, the fan motor and its supporting structure are rigidly mounted to the base frame.

The qualification document for the filter-mixer cabinet and the blower-fan sections is Report No. 76J-9743-44, prepared by McMahon Engineering Company and reviewed by Stone and Webster Engineering Corporation. These components have been qualified by analysis. For the modeled beam with the longest span, the lowest natural frequencies calculated are 11.4 Hz (vertical mode) and 11.9 Hz (longitudinal mode). A computer program "STRESS" is employed to calculate frequencies, member stresses and deflections in the fan and the fan support structure. Here, the lowest natural frequency calculated is 11.6 Hz. Since these frequencies are greater than the River Bend cut off frequency, it appears that rigid range acceleration may be used to establish seismic qualification for the components under OBE and SSE conditions. Maximum member stresses are also calculated and are found to be less than the code allowable values. In the fan wheel blade, the maximum critical deflection is determined to be 0.003" while the minimum clearance required for

functional operability is 0.082". Hence, there is an adequate margin of safety in the calculated deflection.

For the cooling coil section, the qualification document is Report 76J-9743-59, prepared by Aerofin Corporation and reviewed by Stone and Webster Engineering Corporation. The pertinent design reference is Specification No. 216.200 which is in accordance with ASME III, subsections ND and NF. The coil section is qualified by analysis using computer program "NASTRAN". It appears that the analysis is applicable to a generic unit which is 1-1/2 times heavier than the actual unit at River Bend site. The seismic loading used in the generic unit is higher than the applicable one at the actual unit for both normal and faulted conditions. The natural frequency of the generic unit is calculated to be 13.3 Hz. Furthermore, the critical stress in the footplate of the coil section is calculated to be less than the code allowable value. Based on the above factors, it is concluded that the cooling coil section is structurally sound and is qualified for the seismic loading at the River Bend site.

The report regarding the fan motor is identified by number 76J-9743-44. It is prepared by Westinghouse Electric Co. and reviewed by Stone and Webster Corporation. The report describes seismic qualification by static analysis. The fundamental natural frequency of the motor is 62 Hz. This is obviously in the rigid range. Peak seismic accelerations are used to compute maximum stresses and critical deflections of the motor elements. In reviewing this report during the audit visit, an error was detected which underestimated the critical stress in the motor shaft. It was requested that this error should be corrected and a new critical stress for the motor shaft be computed.

This was done and a two-page summary of principal stress calculation was prepared and made available during the audit. The pages are entitled "Shaft Stress Calculations", dated 10/31/84. The summary shows that the maximum

principal stress is less than the allowable and there is an adequate factor of safety. These results are acceptable. The calculations should be included in the qualification documentation for the air conditioning unit.

The maximum critical deflections in the shaft at rear cap and bracket and in the rotor are also evaluated in the report and these are found to have adequate margins of safety compared to the available clearance requirements.

Based upon our review of the reports, the field installation and the clarification provided by GSU personnel, we have concluded that the control building air conditioning unit is seismically qualified.

Air Operated Damper
(Mark No. 1HVR*AOD10A)

The air operated damper is a part of the reactor ventilation system. It is required to perform a safety-related function which consists of turning the blades during LOCA to divert the air to the standby gas treatment building instead of releasing it to the atmosphere. The inspected equipment is located in the Auxiliary Building, has a box-type appearance with overall dimensions of 53" x 30" x 8" deep, and weighs 340 lbs. The damper is supported from the ceiling (elevation 165.5 ft) by means of a structural support system with the centerline of the box at elevation 159'9". In addition, it is mounted to a duct system on the side.

The damper assembly consists of the damper, two actuators, three NAMCO limit switches and one ASCO Solenoid valve. The damper and its structural support system are qualified by analysis while the actuators, limit switches and solenoid valve are all qualified by testing. The design requirements are given in Specification No. 215.480 with Addendum 1 through 7.

A report entitled "Seismic Analysis of Safety Related Air Operated Dampers and Manual Balancing Dampers", prepared by Quality Air Design Co. and reviewed by Stone and Webster Engineering Corporation (Report No. 4215-480-278 -002D, dated 10-10-1981) documents the qualification for the damper. It contains manual calculations for a generic damper of larger size. It also uses generic values of acceleration higher than the applicable plant acceleration. Thus, a conservative design is obtained. The minimum natural frequency of the generic damper is found to be 39.4 Hz and the critical stresses and deflections for each component were lower than the allowable limits.

The actuator is qualified by test. This is documented in Report No. 11041-1, "Seismic Qualification Report on a Spring Return Actuator", prepared by Structural Dynamic Research Corporation and reviewed by Stone and Webster Engineering Corporation. The test response spectra used during testing exceeded the required response spectra by at least 10% in the applicable plant range. Triaxial random multifreqency testing was applied in 1/3 octave interval over a frequency range of 1 to 50 Hz. Five 30 second OBE tests and one 30 second SSE test were performed. The actuator was supplied with 80 psi air pressure to cycle it before, during and after the seismic event. The actuator functioned properly during the test and exhibited no degradation in performance. A photograph in the report indicates that the qualification mounting of the actuator is consistent with the field mounting.

Seismic qualification of the limit switch is described in the report, "Qualification of EA 180 Series Limit Switches", prepared by Edward J. Walter and Associates and reviewed by Stone and Webster Engineering Corporation. The switch was tested in each of three axes which coincide with the major axes. The resonance survey applied sine sweeps from 1-35 Hz at a sweep rate of one octave per minute having displacement of 1" for frequencies 1-10 Hz and 1/10" for frequencies 10-35 Hz. The minimum natural frequency detected is 46.6 Hz. The switch was also vibrated at 100 Hz at an acceleration level of 1.3 g for a total of 10 cycles, one-third of which were along each axis. The switch performed with no malfunction. In addition, the report states that the test circuit did indicate a reaction to a small voltage change which when monitored on the oscilloscope was within the acceptable level. And the trip position of the switch remained within the required limit.

The qualification of the solenoid valve is described in a report, "Qualification Test on Solenoid Valve", No. AQ521678/TR, prepared by Dayton T. Brown and reviewed by Stone and Webster Engineering Corporation. The solenoid valve was energized and subjected to OBE seismic testing (1 Hz - 33

Hz - 1 Hz) for 10 minutes. The g-input level was from 0.307 g to 3.0 g. The test was repeated with the test item de-energized. Combined SSE and fragility tests were also performed. The frequencies were from 1 -35 Hz and each was maintained for 15 seconds. The input level raised from 0.31 g to 4.2 g. The minimum natural frequency found is 90 Hz and during all tests (including vibratory aging test), the solenoid valve operated successfully without any leakage.

During the audit, GSU personnel were requested to present the seismic qualification document of the damper's structural support system. A report entitled "Duct Support Design - Auxiliary Building" prepared by Stone and Webster Engineering Corporation and dated 10-24-1984 was introduced. It contains essentially a static analysis of the structural support system, and uses the computer program STRUDL to evaluate natural frequencies and critical stresses and deflections. The lowest natural frequency computed is 17.8 Hz and all critical stresses and deflections were found to have adequate safety margins. It was requested that this document be included with the qualification package.

Since there was no report assessing the seismic qualification of the main supporting bolts of the damper and also of the plate which mount the limit switches and solenoid valve on the damper's box, it was requested that these questions should be addressed. This was done and manual calculations prepared by GSU personnel were introducted during the audit visit. The summary sheets of these calculations, prepared by Stone and Webster Engineering Corporation and dated 10-31-1984, indicate that the results are within the acceptable values for the River Bend site. This is acceptable and it was requested that these calculations too should be added to the qualification document.

In summary, each of the components of the air operated damper reviewed in the audit has been shown to be qualified for the seismic loads that are applicable at the River Bend plant.

Leakage Air System Compressor
(Mark No. 1LSV*C3-A)

The purpose of the compressor is to provide pressurized air to containment isolation valves in order to prevent release of fission products after LOCA. The unit (70 SCFM at 120 psig) is located at elevation 141.5' in the Auxiliary Building. It weighs 3000 lbs. and measures approximately 72" x 42" x 55". It is mounted on top of a 12" concrete floor pedestal by means of ten 3/4" diameter anchorage bolts. The equipment is a single rotary compressor with an electric motor drive, compression being effected by a rotating band of water, which is separated from the compressed air and re-cycled. There are two such units in the building.

The pertinent design specifications used for this equipment are listed in Specification No. 221.512, Rev. 1, "Leakage Control System Air Compressor", dated July 18, 1983. They include RRS curves that envelop River Bend curves in the applicable range and requirements of ASME Section III, Class 2, concerning the design, fabrication, inspection and tests of active components. The requirements of IEEE Std 323-1974 are also applicable to Class 1E components of the unit.

The equipment is qualified by test. The qualification document, No. 4221.512-327-003A, dated August 13, 1984, is prepared by Dayton T. Brown Corp. and reviewed by Stone and Webster Engineering Corporation. The resonant search test determined fundamental frequencies of 19 Hz in both the transverse and longitudinal axes. In addition, no vertical resonance frequency was detected. Since these frequencies are in the rigid range, it is confirmed that the TRS envelops the RRS with an adequate margin. Furthermore, the compressor operated in a satisfactory manner during portions of the testing procedure and a post-test visual inspection revealed no anomalies.

Additional qualification documents include an environmental qualification report for Class 1E components of the electrical drive motor and a fatigue evaluation to assure qualified life for forty years. However, these documents were not reviewed by SQRT. Stone and Webster personnel noted that all Class 1E items will be replaced with new qualified items (qualification by similarity) except the electric drive motor and confirmed that fatigue analysis was performed to assure qualified life for forty years.

Based on the seismic testing performed, it is concluded that the Leakage Air System Compressor is qualified for the seismic load at the plant site at River Bend.

Transformer
(UPS)

The Transformer is part the Uninterrupted Power Supply Station Control Monitoring System and is required to furnish power to various Class 1E instruments. The 50 KVA UPS transformer is located in the Control Building at elevation 116 feet. The equipment is supplied by Elgar Corp. The transformer weighs approximately 1090 lbs. and the rectangular enclosure measures about 34" x 20" x 38".

The Transformer (ID No. 1SCM*XRC14A1) was inspected during the audit. The side panels of the enclosure were found loose. The equipment base frame was welded at four corners to a base plate which in its turn was mounted to concrete by means of four bolts in the middle leaving wide cantilever on all sides. In most places there was no contact between the base plate and supporting concrete.

The qualification requirements are described in S&W Specification 244.512, Addendum 1 through 4. The qualification document presented for audit was Elgar Report No. 1006101 (S&W No. 6244-512-271-008A, dated 10-25-84). The qualification of the River Bend transformer (Elgar Model No. PLC-503-1-1) is based upon testing of another transformer (Elgar Model No. PLC-253-1-1, weight 620 lbs.). The test specimen was subjected to a biaxial random multifrequency input motion in each horizontal direction coupled with the vertical direction in Wyle Laboratories. Five OBE tests were performed followed by one SSE test. The Transformer was electrically monitored. Test anomalies are mentioned, but are neither described nor justified in the available document. The TRS envelope the RRS.

The reviewer's summary and evaluation report prepared by S&W and presented during the audit concluded that "the Transformer will perform its

safety function ...," although the reviewer's comment page presented with the qualification report indicated outstanding qualification comments to be resolved by Elgar.

Based upon our review of the available documents, the site inspection and the clarification provided by S&W Engineers during the audit, we have come to the conclusion that in order to qualify the UPS Transformer, GSU should resolve the following comments:

1. Dynamic similarity between the tested specimen and the River Bend Transformer must be established in order to use the referenced Elgar report for qualification. Otherwise, testing of the plant-specific equipment will be necessary.

2. The test mounting should be completely documented in the test report and compared with the field installation for acceptability.

3. The test anomalies mentioned in the referenced qualification document should be described and justified for acceptance.

4. a) The site installation should be corrected to provide continuous contact between the base plate and the supporting concrete, unless otherwise justified.
   b) Side panels should be tightly and securely fastened.
   c) The qualification of the base plate should be demonstrated.

Standby 480V Load Centers

The standby 480V load centers are required to furnish power distribution to HVAC systems in the Control and Diesel Generator Buildings and to Class 1E Motor Control Centers.

The load center 1EJS*LDC1A is located at the 98' elevation level of the Control Building. It is a large, six section rectangular cabinet which measures 94'H x 12'W x 60"DP and weighs 12,000 lbs. It is attached to one end of a Transformer Cabinet 1EJS*1A to form a complete equipment line-up.

The qualification of the load center is based upon the seismic testing of a prototype. The test unit was installed on a triaxial test machine at the Wyle Test Laboratory. The qualification documents that were available for inspection did not include the Wyle Test Report. Only a brief summary of the test was included in the audit package. The summary describes that the attached transformer cabinet was simulated by the addition of a mass and that sine sweeps in each direction were made over the frequency range from 1 Hz to 100 Hz.

The lowest natural frequency of the load center was reported to be 4.3 Hz in the side-to-side direction, 6.8 Hz front to back, and 16.0 Hz vertically, with the transformer coupling mass simulation removed. When the mass was added, these natural frequencies were raised to 4.9 Hz, 8.1 Hz and 20.5 Hz, respectively.

An increase in natural frequency is not the direction of change that would normally be expected by the addition of a mass. However, since the Wyle Test Report was not available, the rationale for the increase in frequency could not be pursued. The appropriateness of the substitution for the transformer cabinet could not also be reviewed. It is necessary to examine the

Wyle document for this type of evaluation as well as to examine the nature of any anomalies that might have developed during the test.

The SSE ZPA values at River Bend are 0.3 g horizontally and 0.31 g vertically. The load center appeared to be tested for 1.48 g horizontally and 1.62 g vertically with no structural damage.

Electrical power was applied to the load center during the test program. The essential operational characteristics were monitored during and after the tests. The tests demonstrated that the electrical operational function of the load center was not compromised during the tests.

The environmental qualification evaluation is carried out in accordance with IEEE Std 323-1974. The design lifetime for the equipment is required to be 40 years plus 100 days. However, not all of the parts for this equipment were found to be qualified for the entire period. Accordingly, proper maintenance and surveillance procedures must be followed, as recognized by the Powell Electrical Manufacturing Company (see generic comment no. 3).

Based upon the above discussion, we have come to the conclusion that the original Wyle Test Report is needed to determine the adequacy of the existing seismic qualification of the equipment.

Standby Service Water Pump
(Mark No. 1SWP*P2B)

The inspected pump-column assembly is located in the standby cooling tower pumphouse. It is connected to a floor plate at elevation 118 ft. by means of four 1" diameter bolts. Additional lateral supports for the column consist of a series of seven tubular A-frames attached to the wall at approximately nine feet apart along the column length. The overall dimensions of the assembly are 5' x 5' x 61' with a total dry weight of 2100 lbs. There are four such pumps in the plant for the purpose of providing cooling water for safety related equipment in case the normal service water system becomes inoperative.

The pertinent reference design specifications for qualification requirements of the pump-column assembly are:

Specification 232.920 - Specification for standby service water pumps, ASME Sec. III, Class 3

Specification 221.940 - Specification for standby service water pump supports.

The combination of pump, column and support system is qualified by analysis. The qualification document, "Pump Seismic Analysis" was prepared by McDonald Engineering Analysis Co., dated 12/11/80 and was reviewed by Stone and Webster Engineering Co. in their Report No. 4232-920-257.001B. It is essentially a static analysis for determining the lowest natural frequency and critical deflections and stresses. The motor/pump component is modeled as a three dimensional lumped mass and beam and analyzed by means of an ICES-STRUDL computer program. Imposed on the mathematical model is a system of loads which consist of plant seismic loading, generic nozzle loads of higher magnitudes from those calculated by piping stress analysis, internal pressure

of 142 psig and operating motor load. The fundamental natural frequency for the assembly is found to be 26 Hz and the critical deflection is calculated to be 0.08" at the impeller. Since the required allowable for clearance is 0.012", it is concluded that the operability will not be impaired. Similarly, for the motor shaft, the maximum deflection relative to the bearings is 0.008" which is an order of magnitude less than the allowable value of 0.08". In addition, the calculated stresses were found to be adequately less than the applicable allowable values.

In addition to the above, the electric motor was also examined separately. A static analysis using the ICES-STRUDL computer program was performed on a 3D lumped mass and beam model of the motor. Rigid range seismic accelerations of 1.0 g SSE horizontal/vertical and 0.5 g OBE, and motor operating loads were applied. All critical deflections and stresses were found to be less than their corresponding allowable values. The support system of A-frames and studs were also analyzed in accordance with the requirements of ASME code, Section III, subsection NF, 1977 and the support brackets and connecting bolts were found to be adequate for the seismic load at River Bend.

It appears that no calculations were made regarding the torsional frequency of the pump-column assembly and thus the question of resonance with the operational speed of the motor remains unanswered. In addition, the operability of the pump under seismic loads needs to be assured and the effect of critical speed on bearing hydrodynamic pressure should also be addressed. This is required so that the equipment can be shown to be suitable for its intended service.

Based on the above, this equipment is qualified pending the resolution of the following comments:

1. Include in the seismic qualification of the assembly the calculation for the natural critical torsional frequency of the turning pump/motor/column assembly. Verify whether a potential resonance exists between the critical speed and the operational speed.

2. Assure that the motor will be operable under seismic loading as per ASME code requirements (Section III), performance tests and bearing temperature.

3. Provide a periodic program for in-service inspection tests in accordance with ASME Section XI requirements to ensure maintenance of minimum design performance.

Hydraulic Control Unit
(Mark No. 1C11*ACTD001)

The Hydraulic Control Unit (HCU) is located in the Containment Building at elevation 114 ft. There is a total of 145 such units in the building. The inspected equipment is mounted on the floor by means of four 1/2" diameter bolts and the back side is attached, through the main frame, to two structural beams. The HCU assembly consists of a scram accumulator N_2 cylinder, a scram water accumulator, wiring through assembly and various valves. Its overall dimensions are 22" wide x 102" high x 22" deep and it weighs approximately 920 lbs. At the lower support beam (a distance of 36" above the base), there is a metal brace connecting the nitrogen and water cylinders to the unit's main frame which is itself attached to the structural beam by means of 2-1/2" x 2-1/2" x 1/4" angle. The top of the nitrogen cylinder is attached to a manifold compartment by means of a bolt hanger (4" long, 3/4" diameter and made of 304 stainless steel).

The principal operational requirement of the HCU is the successful completion of a scram cycle. During scram, the HCU permits the stored accumulator hydraulic energy to pass through the inlet scram valve and insert the control rod drive. It also allows the control rod drive return flow to discharge through the exhaust scram valve. During seismic loading, structural integrity of the HCU is to be maintained until successful completion of a required scram cycle. The pertinent design specification is given in General Electric Specification 524.1063-Rev. A, "Qualification Program Test for One Hydraulic Control Unit", dated August 2, 1983.

The HCU seismic capability is demonstrated by a combination of test and analysis. The test is documented in Report No. 58870, "Seismic Qaulification Testing of One Hydraulic Control unit for General Electric Company" conducted by Wyle Laboratories and dated September 15, 1983. The program consists of

vibration aging, two bi-axial (vertical axis and one of the principal horizontal axes) SRV cycling of 15 minutes each, five upset cycles and one faulted cycle each for 30 seconds.

The above mentioned report indicates that after 3 minutes and 40 seconds of the SRV cycling test in the side-side axis, the hanger holding the nitrogen cylinder sheared off at the bottom thread. The hanger was replaced, and an additional brace was attached to each accumulator and connected to the HCU support frame by means of an additional angle member. Then, the test was repeated with no additional structural damage noted. The report states further that, "The broken hanger had no adverse bearing on the operation of the HCU, although it is probable that if the test had continued for the required 15 minutes, the N_2 cylinder would have broken loose".

The Wyle report goes further to mention that during the SRV cycling about the F/B axis, the bracket holding the wiring through assembly broke on both sides. This occurred after 9 minutes and 40 seconds of test. The report indicates that at the direction of GE representative, the bracket was repaired and the testing continued. No additional anomalies were observed during the remainder of the test.

Since the inspected HCU assembly at the River Bend site has only one brace connecting the accumulators to the support frame, it must be concluded that the mounting conditions of the successful Wyle Test are different from the actual field installations at River Bend site.

The remaining qualifying document presented during the audit visit is a report prepared by General Electric Company which contains manual calculations and finite element analysis of the hanger and the HCU assembly. The intent of the analysis is to show that the bottle hanger has adequate fatigue life for at least 40 years and that the HCU assembly can be qualified for the River

Bend seismic loading. One of the results noted in the report during the audit visit was that the natural frequency of the N_2 cylinder remains the same whether it has one strap or two. The bottle hanger (made of 304 stainless steel) failed by elastic-plastic fracture due to initiation of cracks at the bottom thread (stress riser). The analysis for fatigue life does not preclude this type of fracture under dynamic loading.

Based on what mentioned above, the applicant should demonstrate applicability of the test results on the as-installed equipment. Otherwise, they should modify the field installation to represent the test mounting of the unit. The applicant should also justify the bracket failure during the SRV cycling.

Plant Control Console
ID No. H13-P680

The Plant Control Console located in the Control Building at elevation 136 feet contains numerous Class 1E electrical and I&C devices that will be used to remotely supervise, monitor and operate the power plant system. The console will also be used for hot standby and cold shutdown of the plant. The benchboard-type console weighs approximately 4000 lbs. and measures 240" wide x 63.5" high x 118" deep with the two side wings. The unit consists of a structural steel frame and sheet steel enclosure on which the monitoring devices are mounted. The console was supplied by General Electric (GE) Co.

A field inspection was conducted on the console. The equipment was energized, and, hence, the inspection was limited to external visual observation only. The mounting was inaccessible and could not be inspected.

The benchboard was qualified by comparison with test results of another benchboard. Some electrical and I&C devices were separately tested and reportedly qualified to their capability levels which were then compared with the product of ZPA and transmissibility values at appropriate locations inside the tested panel. The following qualification documents prepared by GE were available for audit:

1. DRF A00-1138, Tab T, dated 2-20-81.
2. DRF H00-00006, dated July 1981.
3. DRF A00-02200, Vol. 1, Rev. 0, dated 10-11-84.

Based upon our review of the available documents and the interpretation provided by GE Personnel during the audit, we have come to the conclusion that in order to seismically qualify the equipment the following comments should be resolved:

1. The dynamic similarity between the tested specimen and the River Bend equipment shall be demonstrated in order to utilize the existing test results.
2. The test mounting should be completely documented in the test reports and compared with the in-service mounting for acceptability.
3. For devices qualified separately, the complete test report should be available to define the capability g-values and to demonstrate that the RRS is enveloped over the entire frequency range.

Remote Shutdown Vertical Board

The Remote Shutdown Vertical Board provides a redundant system for shutting down the plant in the event it cannot be done from the control room. It is a large unit, measuring 120"W x 90"H x 36"DP and contains many switches, several power supplies, a square toot converter, a controller, an inverter, six meter panels and other associated hardware. It is field mounted with 20 5/8 inch bolts.

The equipment is qualified by test of another remote vertical board with the same model number (C61-P001). The qualification documents include:

a) Cofrentes C61-P001 DRF A001138 Tab A, February 20, 1981.
b) Acceleration Response Estimation at Various Regions of Instrument Panels - DRF H00-00006, July 1981.

The tests were conducted at the G.E. Service Test Facility in San Jose, California. The tests were performed to IEEE Std. 344-1975 requirements. The operational capability of all Class 1E equipment was mounted before, during and after the tests.

The tests were done at TRS levels that envelop the River Bend Control and Diesel Generator Building RRS.

Various dynamic tests were performed as follows:

1) A very slow sine sweep from 2 to 33 Hz at a g level of 0.5g.
2) A transfer function test of each accelerometer to single out the natural frequencies (Random low level signal).
3) A thirty second 0.5g sine dwell at the lowest natural frequencies detected in paragraphs (1) and (2).

4) Dual axis OBE (minimum of 5) and SSE Random Response Spectrum tests were conducted. These random tests were conducted with both, the input signals in-phase and 180 out-of-phase. Table response spectra were plotted for each dual axis SSE Test.

All equipment performed the intended function before, during and after the tests. The C61-P001 Remote Shutdown Vertical Board is capable of withstanding service forces greater than those required for River Bend, as shown in the results of the series of dynamic tests.

However, aging tests have shown that not all parts are qualified for 40 years, e.g., SBM switches, SB-9 switches, SQRT converters, controllers, etc. The maintenance and service procedures should identify such items and schedule replacements to be installed appropriately (see generic comment no. 3).

The Remote Shutdown Vertical Board is installed in the Control Building at River Bend at the 98 foot elevation. It is mounted adjacent to another Remote Shutdown Panel (RSS*PNL101) which is installed next to a wall of the building. The clearance between the C61-P01 and the RSS*PNL101 is approximately 1/8 inch. However, the panel was tested in the free-standing condition. Its lowest natural frequency is about 22 Hz.

Therefore, in order to qualify the equipment, GSU/GE should address this installation discrepancy and evaluate the interaction between the two connected panels.

RHR Pump and Motor

The Residual Heat Removal Pump is required to pump suppression pool water during pool cooling modes and during low pressure cooling vessel injection modes.

The system includes a long (420") three-stage vertical pump driven by a 700-hp induction motor. The motor is located at the 70-foot elevation level in the Auxiliary Building. The base of the motor is secured to the support structure by twenty-four, 2" diameter bolts.

The RHR pump and motor are qualified by the analysis and tests that were done to qualify the identical RHR pump and motor at Clinton. The response spectra at River Bend are enveloped by those used for the Clinton analysis.

A three-dimensional finite element model of the pump/motor and its support was developed and dynamically analyzed using the response spectrum analysis method. The same model was analyzed using loads due to static nozzle loads, pump thrust loads and dead weight. The absolute sum of the dynamic and static loads in each direction was obtained. The location of the critical stresses was identified and the stresses were compared with the allowable stress criteria. The critical deflections and their locations were obtained and compared with the limits that are necessary to assure operability.

The results of the analysis as documented in the qualification report shows that the stresses at all critical locations were less than the allowable values when the pump/motor was subjected to the applicable static and dynamic loads. Pump operability criteria were also satisfied when the calculated critical displacements were shown to be less than their corresponding allowable displacements.

The cyclic loading nature of the upset condition seismic loads was considered. The number of stress cycles over the plant life results in an ASME code alternating stress allowable value that is higher than the stresses calculated at stress concentrations. Vibration displacements from pump operation are less than the values listed in the Hydraulic Institute Standards. It is concluded that the high cycle vibration stresses are low and would not lead to pump failure.

The motor integrity and operability were demonstrated by a combination of test and analysis. It was shown that the calculated acceleration at the top of the motor was less than the allowable acceleration as specified by the motor manufacturer.

A test of the motor was done by the manufacturer to qualify the insulation system and to benchmark the analysis. The resonant frequencies were determined in a sine sweep test. A multiaxis, multifrequency test was performed on the motor to determine its operability up to the design values of acceleration.

During the on-site inspection, it was observed that a "Reject" tag was attached to the RHR pump/motor. It was also observed that a bolt was missing on a side support bracket. A request was made to obtain the Quality Assurance Inspection report associated with the reject tag. This was done and the report was found to note the missing bolt along with two other items.

It is concluded that the RHR pump/motor is qualified for the dynamic and seismic loads that apply to River Bend.

Reactor Core Cooling Benchboard
ID No. H13 - P601

The Reactor Core Cooling Benchboard is located at elevation 136 feet in the Control Building. The safety function of the equipment is to provide manual control for accident mitigation of the emergency core cooling system. The unit is required for both hot standby and cold shutdown of the plant. The benchboard measures about 204" wide x 91" high x 36" deep and contains isolators, controllers, indicators, converters, switches and such other electrical devices. The equipment was supplied by General Electric (GE) Co.

The equipment was inspected in the installed position. The base framing angle was bolted to structural beams. One unistrut supporting some safety devices was found to be loosely connected and some GE ERIS terminal block supports were observed to be very flexible.

The benchboard was qualified by comparison with test results of another benchboard. Some electrical and I&C devices were separately tested and reportedly qualified to their capability levels which were then compared with the product of ZPA and transmissibility values at appropriate locations inside the tested panel. The following qualification documents prepared by GE were available for audit:

1. DRF A00-1138, Tab I, Dated 2-20-81
2. DRF H00-00006, dated July 1981
3. DRF A00-02200, Vol. 1, Rev. 0, dated 10-11-84.

Based on our site inspection, review of the available documents and the interpretation provided by GE Personnel during the audit, we have come to the conclusion that in order to qualify the equipment, the following comments should be resolved:

1. The dynamic similarity between the tested specimen and River Bend equipment shall be established in order to utilize the existing test results.
2. The test mounting should be completely documented in the test report and compared with the as-built configuration for acceptability.
3. For devices qualified separately, the complete test report should be available to define the capability g-values and to demonstrate that the RRS is enveloped over the entire frequency range.
4. The existing qualification of some devices should be augmented to demonstrate their acceptability below 5 Hz.
5. Since the controller and the recorder units were sliding during the test, it should be verified whether these types of units or supporting systems similar to these units are being used for River Bend. If so, justification should be provided for acceptance of such devices.
6. The following and similar installation deficiencies should be corrected (see also Generic Comment No. 4):
   a) One unistrut was loose.
   b) GE ERIS terminal block supports were very flexible and might hit nearby safety devices.

Neutron/Process Radiation Monitoring System

The Neutron/Process Radiation Monitoring System (NMS) provides information about power levels and power distribution in the reactor. It is tied to a trip system (Reactor Protection System) which is activated in the event the power levels or distribution exceeds the prescribed limits. Four such units are used. Each receives information from appropriate probes in each of four quadrants of the reactor. This is done for redundancy and for statistical sampling of data.

The NMS is located in the Control Building at the 136 ft. elevation. Each unit consists of three bays of a single panel which measures 30"W x 90"H x 36"DP.

The Neutron/Process Radiation Monitoring System at River Bend is qualified by a test on a similar unit that was done for the Clinton Nuclear Power Plant. The seismic qualification report is "BWR/6 Cabinets, Clinton, Seismic Test", No. DRF A00-794-14, dated 12/19/80. The test levels were more severe than those that are required for River Bend. The Clinton NMS panel, consisting of the three bays attached side to side, was mounted on the seismic table and secured with 5/8" bolts. The equipment was made operational before, during and after each seismic event. The cabinet functions were monitored during excitation. Twenty-two accelerometers were mounted on the cabinet to measure frequencies and responses.

A sine sweep was performed from 1 to 60 Hz, at a rate of 1 octave per minute, in each of three orthogonal directions. This was followed by a total of twenty-three OBE and four SSE multifrequency two directional seismic tests with phase coherent excitation. The test procedure satisfied IEEE Std 344-1975 requirements.

The tests showed that the Neutron Monitoring System will perform its safety related function during and after a seismic excitation at the levels specified for River Bend.

The qualification documents also contained an aging analysis for the Neutron Monitoring System. The GE Report Number PAR-710-82-021, Drawing 851E921AAG001 is dated 5/7/84. The report lists the qualified life for each of the essential devices for the NMS Cabinet. Many of the devices have a qualified life which is less than 40 years (refer to Generic Comment #3). The power supply, for example, has a qualified life of 8.5 years.

The field inspection revealed, however, that the in-situ installation at River Bend uses 1/2" bolts instead of the 5/8" bolts that are listed in the SQRT report. The test results for the NMS cabinet were for an installation in which 5/8" bolts were used. Therefore, GSU should augment the existing qualification to show that the equipment is still qualified, even though the base is held with the smaller diameter bolts.

Main Steam Flow Local Panel
ID No. H22-P041,42

The Main Steam Flow Local Panel is part of a leak detection system and supports Class 1E devices. The panel is located at elevation 114 feet in the Reactor Building. The weight of the equipment is approximately 900 lbs. and the overall dimensions are about 48" x 84" high x 30" deep. The panel is an open rack and is made of welded structural members. The monitoring devices are mounted on unistruts and such structural framing members. The equipment was supplied by General Electric (GE) Co.

Panel H22-P042 was inspected at the site. The unit was welded to a base plate which in its turn was attached to the concrete floor with 5/8" diameter bolts. Structural members were found welded all around at the connection.

The similarity approach was employed to qualify the equipment. An identical local panel with similar devices was tested for another application at Wyle Labortories. The summary of the test results was documented by GE in their report A00-794-10, Rev. 0, dated 4-25-80. The generic H22 panel was subjected to resonance search tests in three orthogonal directions followed by 10 OBE and 2 SSE successful tests each of 30 seconds duration using random multifrequency biaxial phase-incoherent bandwidths spaced one-sixth octave apart. The TRS envelop the applicable RRS.

The panel piping was hydrostatically pressurized using the panel calibration station and maintenance of pressure was monitored during seismic testing to assure pressure integrity of the instruments and plumbing. The report indicates that the pressure integrity was maintained throughout the testing. Representative instruments were functionally monitored before, during and after the vibration tests. There was no indication that any of

the devices was environmentally aged prior to seismic tests, nor whether were identical River Bend devices included in the test panel.

The following anomalies were reported in the available summary document:

1. Welding at a member connection broke during vibration exposure.
2. The output of some transmitter varied during seismic excitation. The majority of the variations exceeded the acceptance criterion.

Poor welding of the test specimen was cited as an explanation of the first anomaly. Subsequently the specimen was welded per specification and withstood the remaining tests without any crack. River Bend frame was reportedly welded per the same specification.

In response to the second anomaly, GE claims that the transmitter output variation was due to incomplete instructions provided to the testing engineers regarding calibration.

In addition, GE identified a mounting discrepancy between the tested specimen and the River Bend panel in that the specimen was tested with 3/4" diameter bolts instead of 5/8" diameter field bolts. GE reconciled this difference in their report DRF-A00-2200, Vol. 2, Rev. 0.

Based upon our site inspection, review of available documents and the clarification provided by GE personnel during the audit we have come to the conclusion that the following comments should be resolved in order to qualify the local panel:

1. Since the monitoring devices can be subjected to a harsh environment, it should be justified why these devices were not environmentally aged

prior to seismic testing as required by IEEE Std 323-1974. Otherwise, GSU should provide qualification of aged devices.

2. It should be confirmed that River Bend installation engineers have received the complete instruction and the transmitters are properly calibrated, and be justified that installation per GE's instruction will preclude output variation as ocurred during the seismic test. Also, if all River Bend devices are not identical to the tested devices, the difference should be identified and justified.

Main Steam Isolation Valve
ID No. B21-F022,28

Two Main Steam Isolation Valves (MSIV's) are installed on each of the four 24-inch Main Steam Supply lines. One valve is installed on each line within drywell (B21-F022) and one valve on each line immediately outside the containment in the Auxiliary Building (B21-F028) on horizontal sections of the lines. The MSIV is Atwood-Morrill Co. Model 13564-01-H. The Class 1E portion of the MSIV includes an electro-pneumatic actuator, which is R.A. Hiller Co. Model SA-A070 assembly consisting of an air valve subassembly, a hydraulic manifold and a pneumatic cylinder. The actuator assembly also includes three solenoid valves and limit switches.

The air valve assembly is used to route pneumatic pressure to the pneumatic cylinder which lifts the MSIV disc from its seat. The hydraulic manifold is a damping device which slows the closing speed of the MSIV to within the specified limit.

The MSIV is an air-operated wye-pattern globe valve and is about 60" wide and 130" along the 45° inclined axis. The weight of the valve assembly is about 11700 lbs. when dry, and 12590 lbs when wet. Each MSIV is butt welded upright (45° with the vertical) into a horizontal run of the Main Steam line. The actuator is attached to the valve bonnet, and the bonnet is attached to the valve body with 24 - 1-7/8" diameter studs. There are four parallel external springs on the topworks in order to facilitate almost instantaneous closure to a fail safe mode. The valve remains open in a normal operating condition and is required to remain operable (i.e., remain capable of closing without sticking open) up to one-hour after initiation of a Loss-of-Coolant-Accident thereby isolating the containment side from the turbine side of the Main Steam lines. MSIV B2-F028B was inspected as installed.

The qualification methodology was similarity to a tested topwork assembly. The test specimen was Atwood-Morrill Model 13560-01-H 26" MSIV with Hiller Actuator Model SA-A068. A summary of the environmental and seismic test results is documented in the GE Report NEDC-30801, Class II, Book No. S05A, October 1984. The test specimen was environmentally and mechanically aged prior to dynamic and seismic testing.

The summary report indicates that the MSIV actuator, mounted on the MSIV bonnet was mounted to a seismic test shake table at a 45° angle from vertical in order to simulate its attachment to the MSIV body. The actuator was vibration aged, and biaxially tested (both axes pairs) for the following aging and seismic dynamic conditions:

1. A 0.2 g, 1 to 200 Hz continuous sine sweep was applied to determine the actuator assembly natural frequencies (amplification of 4 or greater).

2. At each natural frequency below 100 Hz, the actuator was twice aged at 0.5 g for 10 seconds.

3. A 0.75 g 25-200 Hz continuous sine sweep was applied to the actuator at 2 octaves per minute to provide additional dynamic aging. From 5 to 25 Hz a 0.25 inch magnitude sine sweep was performed.

4. The MSIV actuator was dynamically tested in both biaxial directions (X-Y and Z-Y) for 15 minutes to simulate the dynamic effects of SRV actuations (SRV Aging).

5. Following the vibration aging, the actuator was tested to simulate 5 OBE and 1 SSE events. The actuator was biaxially tested in each pair of axes (X-Y and Y-Z) using the random multi-frequency method. Test duration was 30 seconds minimum for each test.

6. Finally, the actuator was aged for 15 minutes duration (each axis pair) according to a TRS which enveloped a Chugging RRS to simulate discharge line chugging dynamic effects. Tests were performed in both biaxially tested directions.

Several anomalies occurred during dynamic testing. During SRV cycling, the junction box electrical connections broke resulting in closure of the actuator. During SSE testing in the Z-Y direction, the TRS dipped below the RRS at two points. Due to peak broadening of the RRS and considering the actual MSIV resonant frequencies, the nonconformance was determined not to be significant.

In summary of qualification, GE recommended that the limit switch bracket be modified per their Drawing No. 796E794, Rev. 0 and the junction box be eliminated for River Bend. GE also recommended periodic replacement and refurbishment of actuator nonmetallic parts; but there was no evidence that this recommendation was made part of the maintenance manual nor was there any other procedure cited to assure the needed periodic replacement.

Based upon our review of the available documents, site inspection and the interpretation provided by GE personnel during the audit, we have come to the conclusion that the following comments should be resolved in order to qualify the equipment:

1. Adequacy of the valve body to withstand the appropriate load combination should be demonstrated.

2. GSU should confirm compliance with GE's recommendation regarding the following required for qualification:

a) Bracket modification for limit switch
b) Elimination of junction box
c) Assurance of periodic replacement and refurbishment of nonmetallic parts (see generic comment no. 3)

3. The source of the River Bend specific RRS was not presented during the audit. This should be made available to SQRT for the review.