TENNESSEE VALLEY AUTHORITY
CHATTANOOGA, TENNESSEE 37401
400 Chestnut Street Tower II

February 1, 1982

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Director of Nuclear Reactor Regulation
Attention: Ms. E. Adensam, Chief
Licensing Branch No. 4
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Dear Ms. Adensam:

In the Matter of the Application of) Docket Nos. 50-390
Tennessee Valley Authority) 50-391

From previous communications with the NRC staff, including the NRC's letter from R. L. Tedesco to H. G. Parris dated October 23, 1981 which transmitted Watts Bar Nuclear Plant's Final Safety Analysis Report (WBN FSAR) questions 270.7 and 270.8, it is TVA's understanding that the only remaining concern regarding equipment qualification is qualification to site specific spectra including a possible site audit to verify that qualification.

TVA addressed the adequacy of seismic input used for qualification of equipment in a presentation to NRC staff representatives on October 20, 1981, and in report CEB-81-50, "Evaluation of Structures, Piping and Equipment for 84th Percentile Earthquake" (provided by letter from L. M. Mills to E. Adensam dated December 9, 1981). This report provided the demonstration that the safe shutdown earthquake criteria for WBN (including floor response spectra to which equipment has been seismically qualified) completely envelopes the corresponding 84th percentile spectra. Consequently, all piping, electrical, and mechanical equipment are qualified for the 84th percentile (site specific) earthquake. It would follow then that NRC staff approval of the report would effectively close the equipment qualification issue.

This information, in addition to information provided in the response to WBN FSAR questions 112.5, 112.8, 112.33, and other 112 series questions would seem to negate the necessity for a site audit. This view is based on the following scenario:

--Coordinating discussions with NRC seismic team representatives as early as mid-1976 recognized the Sequoyah and Watts Bar facilities as "sister" plants with Sequoyah being the predecessor. It was agreed that TVA would address the matter of equipment seismic qualification for these two plants on a generic basis.

--As an integral part of this generic evaluation effort, NRC's seismic team was invited to inspect TVA's equipment as installed at the plant sites. Being the earlier of the two plants, with more of its equipment in place, it was logical that the equipment inspection be conducted at Sequoyah.

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Director of Nuclear Reactor Regulation February 1, 1982

--With the earlier procured and qualified Sequoyah equipment having been shown to satisfy the updated criteria, it logically follows that the corresponding Watts Bar equipment, qualified at some later date to correspondingly updated criteria (including significantly higher seismic levels), would be at least equal in compliance.

It is recognized that in spite of the above discussion, NRC staff may still want to conduct a Watts Bar site audit. Anticipating this situation, and in an effort to support such an audit to the fullest practical extent, the following information is provided:

1. Enclosure No. 1 - BOP Electrical Equipment Qualification List (WBN FSAR Table 3.10-1 and -4)
2. Enclosure No. 2 - BOP Mechanical Equipment List
3. Enclosure No. 3 - NSSS Electrical Equipment Qualification List (WBN FSAR Table 3.10-2)
4. Enclosure No. 4 - NSSS Mechanical Equipment Qualification

It is important for the NRC staff to note that the attached lists, as presented, represent all of the information that is readily available. As has been previously discussed with NRC staff representatives, to provide additional seismic information to the lists would require retrieving the qualification reports from the contract files for each item of equipment. This effort would involve the expenditure of a considerable level of manpower and is beyond the level that should be required for preparatory work by the NRC staff in the event that a site audit is deemed necessary. TVA will, however, make available to the NRC staff following the site audit, detailed seismic information for specific equipment identified during the audit.

If the NRC staff concurs with this approach, TVA would propose that the audit be conducted at NRC staff convenience any time after March 1982.

If you have any questions concerning this matter, please get in touch with D. P. Ormsby at FTS 858-2682.

Very truly yours,

TENNESSEE VALLEY AUTHORITY

L. M. Mills

L. M. Mills, Manager
Nuclear Regulation and Safety

Sworn to and subscribe before me
this 1st day of Feb. 1982

Paulette H. White
Notary Public

My Commission Expires 9-5-84

Enclosures

TABLE 3.10-1
WBNP INSTRUMENTATION AND ELECTRICAL EQUIPMENT
SEISMIC QUALIFICATION SUMMARY

SHEET 1

EQUIPMENT	LOCATION BLDG/EL*	TVA CONTRACT NO.	VENDOR	SEISMIC QUALIFICATION CRITERIA	QUALIFICATION METHOD	TEST METHOD	TEST LAB
ELECTRICAL PENETRATIONS	R-(ALL LEVELS)	76K61–87064	CONAX CORP	IEEE 344-1971	ANALYSIS		
125V DC VITAL BATTERIES	A-757	76K3-85763	GOULD IND.	IEEE 344-1975; IEEE P535, DRAFT 2 DATED NOV. 15, 1974	TEST	RANDOM, BIAXIAL, MULTIFREQUENCY	WYLE LAB
TRANSFER SWITCHES	A-772 A-757	75K5-87048	B-K ELECT PROD	IEEE 344-1971	TEST	SINGLE AXIS, SINE BEAT	AERO NAU LA
125V DC VITAL CHARGERS	A-772	74C8-85251	PWR. CONV. PROD.	IEEE 344-1971, DRAFT 5	TEST	MULTIFREQUENCY, RANDOM, BIAXIAL	WYLE LAB
125V DC BATTERY BOARDS	A-757	75C2-85281	WESTINGHOUSE	IEEE 344–1971, ENCLOSURE NO. 5	TEST	SINE BEAT, BIAXIAL, FOUR POSITIONS	WESTINGHOUSE
120V AC VITAL INVERTERS	A-772	74C8-85264	SOLID STATE CONST	IEEE 344-1971, DRAFT 5	TEST	MULTIFREQUENCY, RANDOM, BIAXIAL	WYLE LAB
120V AC VITAL INSTR. BOARDS	A-757	74C4-85216	WESTINGHOUSE	IEEE 344-1971, ENCLOSURE NO. 5	TEST	SINE BEAT, BIAXIAL, FOUR POSITIONS	WESTINGHOUSE
6.9KV SD BD LOGIC PANELS	A-757	75K2-85354	H. K. PORTER	IEEE 344, R3 (FEB. 15, 1974)	TEST	MULTIFREQUENCY, RANDOM, BIAXIAL	WYLE LAB
6.9KV SD BDS	A-757	74C2-84376	G. E.	IEEE 344, DRAFT REV. 5	TEST	MULTIFREQUENCY, RANDOM, BIAXIAL	WYLE LAB
480V SD BDS, TRANSFORMERS AND PRESS. HTR. TRANSFORMERS	A-772 A-782	74C2-84647	WESTINGHOUSE	IEEE 344 R3, AND ENCLOSURE NO. 5	TEST	MULTIFREQUENCY, RANDOM, BIAXIAL	WYLE LAB
480 DISTRIBUTION PANELBOARDS FOR PRESSURIZER HEATER BACKUP GROUP	A-782	75K3-86476	EL TEX	IEEE 344, DRAFT R5	TEST	MULTIFREQUENCY, RANDOM, BIAXIAL	WYLE LAB
480V MOTOR CONTROL CENTERS	A-772 A-757	74C5-84646	ITE	IEEE 344, DRAFT 3 (FEB. 15, 1974)	TEST	SINE BEAT	WYLE LAB

*R-REATOR BLDG.
A-AUXILIARY BLDG.
C-CONTROL BLDG
D-DIESEL GEN. BLDG.

Revised by Amendment 35

TABLE 3.10-1
WBNP INSTRUMENTATION AND ELECTRICAL EQUIPMENT
SEISMIC QUALIFICATION SUMMARY

SHEET

EQUIPMENT	LOCATION BLDG/EL*	TVA CONTRACT NO.	VENDOR	SEISMIC QUALIFICATION CRITERIA	QUALIFICATION METHOD	TEST METHOD	TEST LAB
CONTROL INSTRUMENT LOOPS	MULTIPLE LOCATIONS	73C3-92784	BAILEY METER CO	IEEE 344-1971	TEST	SINGLE AXIS	ACTION ENVIRONMENTAL TESTING CORP.
INSTRUMENTATION AND CONTROLS	MULTIPLE LOCATIONS	77K3-87352	ROBERTSHAW CONTROLS CORP	IEEE 344-1974	TEST	RANDOM FREQUENCY, MULTIAXIS	WYLE LAB
FABRICATION OF LOCAL PANELS AND INSTALLATION OF INSTRUMENTS	MULTIPLE LOCATIONS	73C38-92800	H. K. PORTER	IEEE 344-1974 (DRAFT REVISION TO IEEE 344-1971)	TEST	MULTIFREQUENCY, BIAXIAL	WYLE LAB
PRESSURE GAUGES, PRESSURE SWITCHES, & LEVEL SWITCHES	SEE NOTE 1						
STANDBY POWER SYSTEM	D-742	74C63-83090	MORRISON-KNUDSON POWER SYSTEMS DIV.				
DIESEL GENERATOR PROTECTIVE RELAY PANELS				IEEE 344-1971	TEST	BIAXIAL MULTIFREQUENCY	WYLE LAB
DIESEL GENERATOR CONTROL PANELS				IEEE 344-1971	TEST	BIAXIAL MULTIFREQUENCY	WYLE LAB
DC DISTRIBUTION PANELS				IEEE 344-1971	TEST	BIAXIAL MULTIFREQUENCY	WYLE LAB
125V DIESEL BATTERIES AND BATTERY RACKS				IEEE 344-1971	TEST	BIAXIAL MULTIFREQUENCY	WYLE LAB
BATTERY CHARGERS				IEEE 344-1971	TEST	BIAXIAL MULTIFREQUENCY	WYLE LAB
STANDBY DIESEL GENERATORS				IEEE 344-1971	ANALYSIS		
EMERGENCY DC LIGHTING	A-757 A-772	75C2-85737-1	GRAYBAR ELECTRIC, INC.	IEEE 344-1971	TEST	MULTIFREQUENCY, BIAXIAL	WYLE LAB

NOTE 1 - These instruments were purchased under various TVA contracts and were tested to IEEE 344-1971 and 344-1974 criteria.

Revised by Amendment 35

Table 3.10-3

WATTS BAR SEISMIC QUALIFICATION

Equipment: Metalclad Switchgear

Equipment Rating: 6.9 kv, 60 Hz, 3-phase

Mounting: The switchgear was bolted to test table to simulate in-service configuration.

Seismic Test: The control circuits of the switchgear were energized with 125 VDC and subjected to the following tests:

1. Exploratory tests (Resonant Search)--Consisting of a low level single axis sweep from 1 Hz to 35 Hz at a rate of two octaves per minute and at a level of 0.2 g per peak. Resonant search test was performed in the front-to-front and side-to-side orientation.
2. Proof Test - Consisting of biaxial multifrequency random tests in front-to-back and side-to-side orientations. More than 5 OBE's and one SSE were performed in each orientation.

Monitoring: A multichannel recorder was used to monitor electrical continuity contact chatter and change of state before, during, and after tests.

Results: The specimen's structural integrity was not compromised and circuit continuity was maintained.

Reference: Wyle Laboratories Report No. 42659-1, RA

Added by Amendment 35

Table 3.10-3 (continued)

WATTS BAR SEISMIC QUALIFICATION

Equipment: 6900V Shutdown Board Logic Panels.

Electrical Rating: Not applicable.

Mounting: The specimen was mounted with its base flush to the test table and welded to the table top, simulating the in-service configuration.

Seismic Test: The specimen control circuits were energized (125V DC) and the specimen was subjected to the following tests:

1. Exploratory Test (Resonant Search) - Consists of low-level (0.2g horizontal and 0.1g vertical) multiaxis sine sweep from 1 Hz to 35 Hz to 1 Hz in front-to-back and side-to-side orientations to determine major equipment resonance points.
2. Proof Test (Multifrequency)--Consisting of simultaneous horizontal and vertical incoherent inputs of random motion at frequencies spaced 1/3 octave apart from 1-4 OHz in front-to-back and side-to-side orientations. Aging was obtained with a minimum of five half-level SSE tests in each orientation prior to performing the full-level SSE test.

Monitoring: A multichannel recorder was used to monitor electrical continuity, contact chatter, and change of state before, during, and after the seismic test.

Added by Amendment 35

Table 3.10-3 (continued)

Results: The specimen's structural integrity was not compromised. A "b" contact of the normally de-energized DC auxiliary relay controlled by the AC undervoltage relay experienced contact chatter.

Based upon further analysis of the "b" contact, it was determined that the contact chatter was of such an extremely short-term duration that it will not in any way affect system operation.

Reference: Wyle Test Report No. 43137-1.

Added by Amendment 35

Table 3.10-3 (continued)

WATTS BAR SEISMIC QUALIFICATION

Equipment: Power Transformers

Electrical Ratings: 6900 to 480-V AC, 60-z, 3 phase in ratings of 500*, 1000* and 2000 KVA (* qualified by analysis).

Mounting: The 2000 KVA transformer was bolted to the test table to simulate actual in-service mounting.

Seismic Tests: The transformer was energized to 480-V AC on the secondary and subjected to the following tests:

1. Resonance Search--A low level (0.2g) biaxial, sinusiodal sweep from 0.5 Hz to 40 Hz to 0.5 Hz was performed to determine resonance.
2. Proof Testing--The transformer was subjected to a 30 second biaxial random motion input wave with sine beats added to ensure enveloping of the required response spectra by the test response spectra. Five OBE's followed by one SSE were performed in each of four orientations (45°, 135°, 225°, and 315° to the axis of the test table). After proof tests another resonance search was performed in the last orientation.
3. Analysis--The 500 and 1000 KVA transformer were compared to the 2000 KVA transformer actually tested. It was shown that the two smaller transformers have lower weights, smaller dimensions and less coolant than, but are of the same skin thickness as the 2000 KVA transformer and therefore, have lower stresses for the same seismic excitation.

Added by Amendment 35

Table 3.10-3 (continued)

Monitoring: Data was recorded on three ink-type oscillographs. Input acceleration was analyzed on a spectral dynamics shock spectrum analyzer.

Results: No structural damage occurred and the 2000 KVA transformer remained fully operational during and after testing. The 500 and 1000 KVA transformers were analytically found to be capable of successfully withstanding a seismic excitation equal to that of the 2000 KVA transformer.

Reference: Seismic Test Report No. XAL 71789, SD 3036, Westinghouse Seismic Design Analysis Report No. SBR-75-7.

Added by Amendment 35

Table 3.10-3 (continued)

WATTS BAR SEISMIC QUALIFICATION

Equipment: 480V metal enclosed switchgear, Westinghouse type DS.

Electrical Rating: 480V AC, 60 Hz, 3 phase.

Mounting: The test specimen, consisting of two typical units, was bolted to the test table to simulate actual mounting.

Seismic Tests: The test specimen was energizer to 480V AC and 125V AC (control circuits) and subjected to the following tests:

1. Resonance Search--A low level (0.2g) biaxial sinusoidal sweep from 1.0 Hz to 40 Hz to 1.0 Hz was performed on the specimen in the 225° (to the test table axis) orientation.
2. Proof Test--The specimen was subjected to an input wave made up of decaying sinusoids from 1.25 Hz to 35.0 Hz with two sine beats added to achieve enveloping of the required response spectra by the test response spectra. A minimum of five OBE's followed by a minimum of four SSE's were performed in the 225° and 315° orientations. In the 45° and 135° orientations only SSE's were performed. A second sine sweep for resonance was performed after proof testing.

Monitoring: Contact monitoring was performed by an event recorder and seismic monitoring by four ink-type oscillographs. Additionally, 20 accelerometers, 5 strain bolts and a strain gage were also used for monitoring.

Added by Amendment 35

Table 3.10-3 (continued)

Results: The specimen maintained its structural integrity and there were no failures that would jeopardize proper functioning of the equipment.

Reference: Westinghouse Seismic Qualification Report, type DS low voltage metal enclosed switchgear, with attached Westinghouse Astronuclear Laboratory Report (XAL 71706, SD 3027).

Added by Amendment 35

Table 3.10-3 (continued)

WATTS BAR SEISMIC QUALIFICATION

Equipment: 480V Motor Control Centers--I-T-E Imperial Corporation subsidiary of Gould, Inc., Type 5600.

Electrical Rating: 480V AC, 60 Hz, 3-phase, 22KA short circuit bracing.

Mounting: The specimen which consisted of 3 panels was welded to the test table simulating the in-service condition.

Seismic Test: Control circuits (120V AC) of the specimen were energized and the specimen was subjected to the following tests:

1. Exploratory Tests (Resonant Search)--Consisting of low level (approximately 0.2 g horizontal and 0.1 g vertical) biaxial sine sweep from 1 Hz to 35 Hz in front-to-back/vertical axes test and side-to-side/vertical axes test to determine major equipment resonances. Resonant frequencies at 8.75 Hz and 35 Hz were found for the front-to-back/vertical axes test and resonant frequencies of 10 Hz and 35 Hz were found for the side-to-side/vertical axes test.
2. Proof Test (Biaxial Sine Beat)--Consisting of biaxial sine beats at equipment resonances listed above. Aging was accomplished during the 8.75 and 10 Hz tests with 4 one-half level phase coherent half level tests and 4 half level incoherent tests. Full level (1.37 g input) tests were performed at each resonance for energized, deenergized, in phase*, and out-of-phase conditions.
3. Main circuits (480V AC) were deenergized during the tests.

Added by Amendment 35

Table 3.10-3 (continued)

Monitoring: A 14 channel recorder was used to monitor electrical continuity, current/voltage levels, spurious operation, and contact chatter before, during, and after the seismic tests.

Results: It was demonstrated that the specimen possessed sufficient integrity to withstand, without compromise of structure, the prescribed seismic environment. Some contact chatter was encountered during the testing; however, full-level tests were performed without chatter after corrective action was taken by the I-T-E Technical Representative.

Reference: I-T-E Imperial (Subsidiary of Gould, Inc., Seismic Certification SC-77 and Wylie test report TR-42926-1.

Added by Amendment 35

Table 3.10-3 (continued)

WATTS BAR SEISMIC QUALIFICATION

Equipment: 480V Power Distribution Cabinet

Electrical Rating: 480V AC, 60 Hz, 3-phase

Mounting: Specimen was wall-mounted with commercially available bolts, nuts, and washers to a wall-mounting fixture which was welded to the test table. Mounting simulated the in-service configuration.

Seismic Test: The specimen was subjected to the following tests:

1. Exploratory Test (Resonant Search--Consisting of a low level (0.2 g horizontal and vertical) biaxial sine sweep from 1-33 Hz in both front-to-back and side-to-side orientation to obtain major resonance points of the equipment.
2. Proof Test (Multifrequency)--Consists of simultaneous horizontal and vertical incoherent inputs of randon motion at frequencies spaced 1/3 octave apart from 1-31.6 Hz in front-to-back and side-to-side orientations. Aging was accomplished with a minimum of 5 half-level SSE tests followed by one full level SSE test performed in both orientations.

Monitoring: A multichannel recorder was used to monitor electrical continuity, contact chatter, and change of state before, during, and after the seismic test.

Results: The specimen's structural integrity and circuit continuity was not compromised.

Reference: Wyle Test Report No. 43039-1.

Added by Amendment 35

Table 3.10-3 (continued)

WATTS BAR SEISMIC QUALIFICATION

Equipment: The components of the Emergency Diesel Generator.

Seismic Test: An analysis was performed on the components listed on page 12 of this table for the seismic conditions and criteria as specified in TVA Specification WB-DC-40-31.2.

1. The natural frequencies of the engine and the generator system were determined by analysis.
2. Selected critical components 1-9 were analyzed for 3 g horizontal and 2 g vertical accelerations (above seismic criteria), whereas, components 10-21 were analyzed for 1.62 g horizontal accelerations and 1.08 vertical accelerations (as specified by seismic criteria).

Results: The system was found to be rigid with natural frequencies above the seismic range. All the components analyzed had conservative margins of safety in all cases under the maximum combined loadings.

References: Corporate Consulting and Development Co., Ltd. CCL Report No. A-27-74, CCL Project No. 74-1110, CCL Report No. A-5-73A, CCL Project No. 73-1024.

Added by Amendment 35

Table 3.10-3 (continued)

WATTS BAR SEISMIC QUALIFICATION

Diesel Generator Components

1. Air Intake Filter at Mounting Bracket.
2. Accessory Rack at Base.
3. Engine Tube Oil Filter at Accessory Rack.
4. Water Expansion Tank at Accessory Rack.
5. Governor (Hydraulic Actuating).
6. Primary Oil Pump at Engine.
7. Scavenging Oil Filter at Engine.
8. Scavenging Oil Pump at Engine.
9. Engine Lube Oil Cooler.
10. Engine at Base.
11. Generator at Base.
12. Engine at Foundation.
13. Generator at Foundation.
14. Heat Exchanger.
15. Air Turning Box.
16. Air Intake Filter at Foundation.
17. Air Tank Saddle at Bolts.
18. Air Tank at U-Bolts.
19. Cricital Weld in Air Tank Saddle Mount.
20. Maximum Pull Out of Concrete Insert.
21. Maximum Shear in Concrete Insert.

Added by Amendment 35

Table 3.10-3 (continued)

WATTS BAR SEISMIC QUALIFICATION

Equipment: Engine Generator Control Panel, D. C. Distribution Panel, and Battery Charger.

Mounting: As per test specifications, the equipment was mounted on the Wylie Multi-Axis Simulator.

Seismic Test:

1. A resonant search test was conducted consisting of two low level (approximately 0.2 g horizontally and 0.1 g vertically) multi-axis sine sweeps in each test one octave per minute.
2. Two sine beat tests in-phase and two sine beat tests out-of-phase were performed at each resonant frequency. The sine beat consisted of 15 oscillations per beat. A train of five beats with a two-second interval between beats was used at each test frequency.

Monitoring: Three to four electrical monitoring channels were recorded on an oscillograph recorder to ascertain electrical continuity, current/voltage levels, spurious operations, contact chatter, before, during, and after the seismic excitation.

Results: The equipment listed above withstood the prescribed simulated seismic environment without any loss of electrical functions and structural failures.

Reference: Wyle Report No. 42879-1.
Wyle Job No. 42879.

Added by Amendment 35

Table 3.10-3 (continued)

WATTS BAR SEISMIC QUALIFICATION

Equipment: The main components of the Emergency Diesel Generator analyzed are as follows:

1. Stator Frame
2. Rotor Shaft
3. Pole Doetail
4. Pole Heads
5. Bearings
6. End Bells
7. Mounting Feet
8. Hold Down Bolts

Seismic Test: An analysis was performed on the components listed above for seismic criteria as specified by TVA Specification WB-DC-40-31.2.

1. The components listed above were analyzed for a seismic loading of 2.7 g horizontal acceleration and 1.8 g vertical acceleration acting concurrently.
2. The mechanical response of the rotor and stator in terms of deflections and stresses was evaluated from static considerations and vertical seismic loads, acting concurrently.

Results: All the stresses calculated were within the respective material working levels as called out in the material specs.

References: Elective Products Division, Portec, Inc., Cleveland, Ohio.

Added by Amendment 35

Table 3.10-3 (continued)

WATTS BAR SEISMIC QUALIFICATION

Equipment: Emergency Diesel Generator Atlas Jacket Water Cooler.

Seismic Test: An analysis was performed on the Atlas Water Jacket Cooler for seismic conditions as specified in TVA Specification WB-DC-40-31.2.

1. The analysis evaluated the base natural frequency of the structure to determine the appropriate acceleration from the response spectra.
2. For emergency, upset, and normal conditions, the analysis considered the adequacy of the anchor bolts, supports, shell at the supports, and tubes, due to a combination of seismic loads, nozzle loads, deadweight, and pressure.
3. When emergency condition stresses were less than normal condition allowables, separate upset and normal load case calculations were omitted.

Results: All the calculated stresses at the various points on the cooler were well below the allowable stresses under all possible conditions.

Reference: Dynatech Project No. AIM-20.

Dynatech Report No. 1237.

Added by Amendment 35

Table 3.10-3 (continued)

WATTS BAR SEISMIC QUALIFICATION

Equipment: Diesel Generator Relay Boards.

Electrical Rating: 125V DC, and 120V AC, 60 Hz, 1 phase.

Mounting: The test specimen was welded to a steel plate which in turn was welded to the seismic test machine.

Seismic Testing:

1. Resonance Search--A resonance search was conducted using an input level of 0.2 g in the frequency range of 1 to 33 Hz with a frequency sweep rate of 1 octave per minute. The resonance search was conducted with the horizontal and vertical axis simultaneously, first in phase and then with the horizontal 180 degrees from the original phase. The resonance search was then repeated in the second horizontal and vertical axis. The two horizontal axis were identified as longitudinal and lateral. Two control and six response accelerometers were utilized during the resonance search. The output of each accelerometer was recorded on a direct readout recorder.
2. Sine Beat Test--A sine beat test composed of ten oscillations per beat was performed at each resonance frequency determined from the resonance search. Each sine beat was applied five times at each frequency, first with one horizontal and the vertical inputs in phase and then with the horizontal input 180° from the original phase. a two-second interval between each sine beat was

Added by Amendment 35

Table 3.10-3 (continued)

used. The maximum peak acceleration for the horizontal axes was 1.08 g and for the vertical axes was 0.72 g. In addition to the resonance frequencies, the sine beat test was performed at each one-half octave over the frequency range of 1 to 33 Hz.

Monitoring: A 125V DC voltage source was used to energize relay circuits during testing. A source of 120V AC was applied to monitor an AC voltmeter on the front panel of the specimen. Two chatter/transfer detectors were utilized to monitor a total of 14 channels of relay contacts during testing. The chatter/transfer detectors were set for a time duration of 1.0 millisecond or greater. During testing all monitored circuits were tested in the transfer, or open, mode. In the event of a momentary closure of a duration of 1.0 millisecond or greater, a red indicator light for that particular circuit would illuminate and remain illuminated until a reset button was pushed to reset the circuit.

Results: Visual examination of the test specimen after each test revealed no structural damage dur to the sesismic tests. Of the 14 channels monitored during testing, only one circuit (Westinghouse type CM relay) indicated chatter. TVA circuits show that this relay will only be used during testing pahses of the diesel generator system; and therefore, it cannot prevent operation of the diesel generators during or after a seismic event because of contact chatter.

Reference: Wyle Laboratories Report No. 54064.

Added by Amendment 35

Table 3.10-3 (continued)

WATTS BAR SEISMIC QUALIFICATION

Equipment: Emergency Generator Starting and Control System including

Test Series 1

1 Battery (six cells), C & D 3DCU-9 with Rack PSD-007012

1 Battery Charger, C & D ARR130HK-50

1 Fuel Oil Pump, Viking GG195D

1 Soakback Oil Pump, EMD 8274507

1 Contactor/Relay System consisting of:

1 Square D Temperature Switch, Class 9025, Type BGW397
1 Fenwall Temperature Switch, No. 20800
1 Barksdale Pressure Switch, E1HM90V
1 Overspeed Trip Limit Switch, EMD 8246095
1 Crankcase Pressure Switch, EMD 8370362
2 Square D Relays, Class 8501, Type KP

Test Series 2

1 Engine Control Panel, PSD-A990F02501

1 Anode Transformer, GE-278G121AA

Test Series 3

1 Switchgear Exciter Assembly, PSD-A990F11000

Mounting: As per test specifications, the equipment was mounted on the Wyle Multi-Axis Simulator.

Seismic Test: 1. A resonant search consisting of a low level single axis sine sweep from 1 Hz to 33 Hz was performed to establish natural frequencies. The input acceleration level for all pieces of equipment was 0.2 g in the vertical direction and 0.4 g in the horizontal direction (when specified as needed).

Added by Amendment 35

Table 3.10-3 (continued)

2. Sine beat tests were performed at the natural frequencies detected in the resonant search test. The sine beat tests were performed as a train of beats with the number of beats per train depending upon the resonant frequency of each piece of equipment. The vertical and horizontal accelerations in the sine beat test were varied according to the piece of equipment being tested.

Monitoring: All specimens shall be operating during full level testing, and specified functions will be monitored and recorded. Electrical powering of 480V AC, 3 phase will be furnished for operation of the switchgear, battery charger, soakback pump and the anode transformer. For operation of the Fuel Oil Pump, 125 VDC will be furnished.

The battery discharge rate (10 amps), the charger output rate, the anode transformer secondary voltage and the discharge pressure of both pumps will be recorded on an oscillograph recorder. Continuity circuits on the Switchgear Assembly, the Engine Control Panel and the Contactor/Relay System will be monitored for a change of state and a monitor trace recorded on an oscillograph recorder.

Results: The equipment demonstrated the ability to withstand the prescribed seismic environment without any loss of

Added by Amendment 35

Table 3.10-3 (continued)

electrical function or significant operational change. No structural degradation was noted during the tests.

Reference: Wyle Report No. 42749-1.

Wyle Job No. 42749.

Added by Amendment 35

Table 3.10-3 (continued)

WATTS BAR SEISMIC QUALIFICATION

Equipment: Transfer Switch Circuit Breaker Assemblies and Safety Switch.

Electrical Ratings:

1. 480V AC, 400A, manual circuit breaker assembly, nema 1 enclosure.
2. 480V AC, 600A, manual circuit breaker assembly, nema 1 enclosure.
3. 600V AC, 60A, 3 pole, non-fusible safety switch nema 1 enclosure.

Mounting: The swtiches were mounted to the test fixture to simulate actual mounting. The 400A circuit breaker assembly and the safety switch were tested on the same fixture. The 600A circuit breaker assembly was tested separately.

Seismic Tests: The switches were energized to 480V and subjected to the following tests:

1. Resonance Search--The switches were subjected to a continuous sinusoidal search from 1 to 35 Hz in each of three mutually perpendicular axes. The frequency was adjusted in discrete 1 Hz steps with vibration maintained for at least 20 seconds in each step. Peak acceleration varied from 0.1 g to 0.31 g above 5 Hz and 0.01 g to 0.26 g from 1 Hz to 5 Hz.

Added by Amendment 35

Table 3.10-3 (continued)

2. Proof Testing--The switches were subjected to a 30 second 0.5 SSE of 0.76 h followed by a 30 second SSE of 1.51 g's at each half octave over the range from 1 Hz to 35 Hz where no resonant frequencies were present. Where resonance was present, a 0.5 SSE (0.76 g) followed by a SSE (1.51 g's) were performed at those resonant frequencies. Testing was conducted in the front-to-back, side-to-side and vertical axes.

Monitoring: The switches were monitored for proper operation during the testing.

Results: No external physical damage or malfunction was noted as a result of these tests.

Reference: Aero Nov Laboratories, Inc., test report No. 5-6156 dated October 31, 1975.

Added by Amendment 35

Table 3.10-3 (continued)

WATTS BAR SEISMIC QUALIFICATION

Equipment: 125-DC Battery Charger.

Electrical Rating: AC Input--480V, 60 Hz, 3.

DC Output--125V, 100 Amperes.

Mounting: The battery charger channel sill was welded to the Wyle simulator table in a manner duplicating the expected in-service configuration at WBNP.

Seismic Test: The battery charger was energized with 480V AC, 3-phase, 60 Hz and subjected to the following tests:

1. Resonance Search--A low level (approximately 0.2 g horizontally and 0.1 g vertically) biaxial sine sweep was performed to determine major resonances in both the front-to-back/vertical and the side-to-side/vertical orientations. The sweep rate shall be one octave/minute over the frequency range of 1 Ha to 40 Hz.
2. Multifrequency Tests--The specimen was subjected to 30 second duration simultaneous horizontal and vertical inputs of random waveform motion consisting of frequencies spaced one-third octave apart over the frequency range of 1 Hz to 40 Hz as necessary to envelope the REquired SSE Response Spectra (RRS). The amplitude of each one-third octave frequency was independently adjusted in each axis until the Test Response Spectra (TRS) enveloped the RRS. The

Added by Amendment 35

Table 3.10-3 (continued)

control accelerometers were recorded on tape an oscillograph recorders. The resulting table motion was analyzed by a spectrum analyzer at a damping of two percent (2%) and plotted at one-third octave frequency intervals over the frequency range of interest.

Five, one-half-level RRS test followed by a full-level RRS test was performed in each orientation with the specimen energized and operating in its normal charging mode.

Full-level RRS tests were also preformed in the front-to-back/vertical orientation during which the specimen's AC and DC circuit breakers were tripped using a low voltage AC current source.

Monitoring: A multichannel recorder and three accelerometer devices were used to monitor the test results. Each accelerometer device consisted of two sensors, one oriented for the vertical axis and the other for the horizontal axis. The horizontal axis accelerometers were realigned for the direction of motion after the charger was rotated 90 degrees on the horizontal plane. Three channels of the multichannel recorder were used to monitor (1) input voltage, (2) state of a parallel circuit consisting of the NO alarm contacts, and (3) output voltage.

Added by Amendment 35

Table 3.10-3 (continued)

Results: The oscillograph traces revealed no alarm contact chatter or breaker misoperation. No apparent physical damage was noticed in the visual checks. The charger performed satisfactorily before, during, and after the tests. The two DC meters mounted on the front of the charger cabinet would "peg" during the full SSE but each time they would return pretest readings with no recalibration necessary.

Reference: Wyle Laborator's Seismic Test Report No. 42959-1.

Table 3.10-3 (continued)

WATTS BAR SEISMIC QUALIFICATION

Equipment: 125-Volt Battery (Call type NCX-2100).

Electrical Rating: Two-hour rate--696 amperes to minimum battery terminal voltage of 105 volts at 60 F initial electrolyte temperature.

Mounting: Test rack containing the batteries was welded to the test table.

Seismic Test: Battery (3 cells) was energized to an approximate 20-ampere restive load and subjected to the following tests:

1. Exploratory test (resonant search) consisting of a low level (approximately 0.2 g horizontally and vertically) sine sweep was performed to determine the specimen resonance frequencies in each of the three orthogonal axes. The sweep rate was 1 octave per minute over the frequency range of 1 Hz to 35 Hz.
2. Proof test (multifrequency) consisting of 30-second duration simultaneous horizontal and vertical inputs of random motion consisting of frequency bandwidths spaced one-third octave apart over the frequency range of 1 Hz to 35 Hz. The amplitude of each one-third octave bandwidth was independently adjusted in each axes until the TRS enveloped the RRS.

Added by Amendment 35

Table 3.10-3 (continued)

Monitoring: The output voltage of the battery was monitored on an oscillograph recorder during the seismic excitation.

The following parameter was monitored:

Output voltage ±4 Percent.

Results: The battery performed satisfactorily and all parameters monitored were within their prescribed tolerances before, during, and after the test.

References: Wyle Laboratories Test Report No. 43479-1.

Added by Amendment 35

Table 3.10-3 (continued)

WATTS BAR SEISMIC QUALIFICATION

Equipment: Battery Rack.

Seismic Test: The battery rack was qualified by analysis as described below:

1. Natural Frequency--The calculations for natural frequency were based upon a static analysis where all the component parts were analyzed for deflection. The sum of the deflections was then used to calculate the natural frequency of the rack.
2. After determination of the natural frequency of the rack, a stress analysis was again performed on each individual component part. The absolute combined stress was then calculated by peak value analysis.
3. Data was provided with the analysis to show that all the critical acceleration response spectra was enveloped in this test.

Results: The data showed that the rack will meet the requirements as laid out by TVA specifications and IEEE 344-1971 and will perform adequately during and after a seismic event.

Reference: Gould, Inc., Industrial Battery Division, 60 NCX-2550 and SO 7-074526-806.

Table 3.10-3 (continued)

WATTS BAR SEISMIC QUALIFICATION

Equipment: 125V DC Vital Battery Boards.

Electrical Rating: 125V DC, 20,000 amperes short-circuit.

Mounting: The equipment was bolted to the vibration generator in a manner that simulated the intended service mounting including bolt size and configuration.

Seismic Tests:

1. A resonant search test in test direction No. 1 using a sinusoidal input level of approximately 0.2 g from 1 to 33 Hz, and at a sweep rate of one octave per minute.
2. A sine beat test in test direction No. 1 with maximum peak acceleration corresponding to the SSE. The beat test was conducted at each natural frequency. Before each SSE beat test, five 1/2 SSE beat tests were applied.
3. Steps 1 and 2 repeated for 3 more directions.

Monitoring:

1. Six accelerometers were mounted on the test table and throughout the boards to monitor input and output accelerations. The output was recorded on graphs made from oscillographs.
2. Ten circuit breakers carrying 90 percent of rated current were monitored for contact opening.
3. Alarm reset light was energized during all tests and was visually monitored.
4. Undervoltage relay was energized and the normally closed contact was monitored during all tests.
5. Each fuse checked for continuity after testing.

Added by Amendment 35

Table 3.10-3 (continued)

Results: The testing proved the integrity of the board/ component system since no failures developed.

Reference: Westinghouse Seismic Test Procedure No. CO-33697.

Added by Amendment 35

Table 3.10-3 (continued)

WATTS BAR SEISMIC QUALIFICATION

Equipment: 120V AC Vital Instrument Power Boards.

Electrical Rating: 120V AC, 60 Hz and 5,000 amperes short-circuit.

Mounting: The equipment was bolted to the vibration generator in a manner that simulated the intended service mounting including bolt size and configuration.

Seismic Tests:

1. A resonant search test in test direction No. 1 using a sinusoidal input level of approximately 0.2 g from 1 to 33 Hz, and at a sweep of 1 octave per minute.
2. A sine beat test in test direction No. 1 with maximum peak acceleration corresponding to the SSE. The beat test was conducted at each natural frequency. Before each SSE beat test, five 1/2 SSE beat tests were applied.
3. Steps 1 and 2 repeated for 3 more directions.

Monitoring:

1. Six accelerometers were mounted on the test table and throughout the boards to monitor input and output accelerations. The output was recorded on graphs made from oscillographs.
2. Ten circuit breakers carrying 90 percent of rated current were moniotred for contact opening.
3. Lights were energized during all tests and were visually monitored.
4. Undervoltage relay was energized and the normally closed contact was monitored during all tests.
5. Fuses checked for continuity after testing.

Added by Amendment 35

Table 3.10-3 (continued)

Results: The testing proved the integrity of the board/component system since no failures developed.

Reference: Westinghouse Seismic Test Procedure No. CO-33419.

Added by Amendment 35

Table 3.10-3 (continued)

WATTS BAR SEISMIC QUALIFICATION

Equipment: 120V AC, 60 Hz Vital Instrument Static Inverter.

Electrical Rating: AC Input--480V, 60 Hz, 3 phase, dc input--125V.

AC Out--120V, 60 Hz, Single phase.

kVa Out--20kVa.

Mounting: The inverter channel sills were welded to the shake table in the exact manner they would be installed on steel floor plates at Watts Bar.

Seismic Test: The inverter was energized to 480V, 3 phase and subjected to the following tests:

1. Exploratory Search--A low level (approximately 0.2 g horizontally and vertically) performed on each test configuration from 1 Hz to 33 Hz to establish major resonances. The sweep rate was one octave per minute.
2. Multifrequency Tests--The specimen was subjected to simultaneous horizontal and vertical inputs of random motion consisting of frequencies spaced 1/3 octave apart over the range of 1 Hz to 40 Hz. The amplitude of each 1/3 octave frequency was independently adjusted in each axis until the test response spectra enveloped the required response spectra. The resulting test table motion was analyzed at one percent damping by a spectrum analyzer and plotted at one-third octave intervals over the frequency range of interest. The

Added by Amendment 35

Table 3.10-3 (continued)

duration of the tests was 30 seconds. The horizontal and vertical input accelerations levels were phase incoherent. Five 1/2-level SSE's were performed on the invertor.

Monitoring: The equipment used to monitor the test included a visual counter for output frequency; a 3-channel recorder to monitor (1) input voltage, (2) state of a parallel circuit of 12 NO alarm relay contacts, and (3) output voltage; and 5 accelerometers. Each accelerometer device consisted of two sensors, one oriented for vertical axes, and the other for horizontal axes.

Results: The inverter withstood the seismic test satisfactorily without any failures.

Reference: Wyle Laboratories Seismic Test Report No. 42854-1.

Table 3.10-3 (continued)

WATTS BAR SEISMIC QUALIFICATION

Equipment: Electrical penetrations (all types and voltages used at Watts Bar).

Seismic Test: Seismic qualification was done by analysis. The seismic analysis done on the penetrations consider the seismic loads imposed for both a safe shutdown earthquake and a 1/1 safe shutdown earthquake in accordance with TVA specification 2697.

1. The analysis calculated the natural frequencies during a seismic event using standard formulas for stress and strain by the R. Roark or Rayliegh's methods.
2. Maximum stresses for the normal and seismic load conditions were calculated. Seismic loads were considered to act in the vertical direction and in two horizontal directions.

Results: The analysis indicated that the penetrations were able to withstand all seismic stresses from a one and a one-half safe shutdown earthquake without any loss of functions.

Reference: Conax Report IPS-212, Rev. A and addendum to IPS-212, Rev. A.

Added by Amendment 35

TABLE 3.10-4

WATTS BAR SEISMIC QUALIFICATION

BALANCE OF PLANT INSTRUMENTATION AND CONTROL

EQUIPMENT LIST

1. Transmitters
2. Power Supplies
3. Summing Amplifiers
4. Current-to-Current Converters
5. Square Root Converters
6. Alarm Units
7. Recorders
8. Indicating Controllers
9. Manual Loading Stations
10. Panels (cabinets)
11. Dual Alarm Units
12. Square Root Converters
13. Proportional Amplifiers
14. Millivolt Transmitters
15. Power Supplies
16. Current Isolators
17. Controllers (single case)
18. Controllers (dual case)
19. Setpoint Stations
20. Manual Loaders
21. Recorders
22. Hi-Fi Relays
23. Instrumentation Racks (local panels)
24. Single and Four Bay Instrument Cabinets
25. Lighting Panel Boards & Cabinets

Added by Amendment 35

TABLE 3.10-4

WATTS BAR SEISMIC QUALIFICATION

Equipment: BOP I&C (see equipment list on page 1 of this table, items 11-22)

Mounting: All instruments were mounted in a rack mounting chassis which was modified for seismic use.

Seismic Testing:

1. A resonant search test was conducted in each of the three orthogonal directions. Each search consisted of two sweeps over the frequency range from 1 to 35 Hz and retrun to 1 Hz at a sweep rate of 1 octave/minute. The input "G" level to the vibration table was 0.5 g's.

2. A sine beat test was conducted at each resonant frequency found by step 1 and at the resonant frequencies found for the single and four-bay cabinets. The number of beats at each test frequency was 10 and the number of test frequencies cycled per beat was 10. The time between beats was of sufficient duration to preclude significant superimposition of motion. The input level was 3 g's horizontal and 2 g's vertical.

Monitoring:

1. A 30 MA signal was applied to the input of each analog device requiring an external input. The output of the analog devices was monitored on a brush recorder.

2. The electrical contact of the discrete output devices were monitored for discontinuity (chatter) in excess of 100 microseconds.

Results: There was no evidence of physical damage, contact chatter or output shift.

Reference: Action Environmental Testing Corp. Report No. 10348-2, -3, -4, -5, -6, -7, -8, -9, -10, -11, -12, and -13.

Added by Amendment 35

TABLE 3.10-4

WATTS BAR SEISMIC QUALIFICATION

Equipment: BOP I&C (See equipment list on page 1 of this table, items 1-10)

Mounting: Several separate tests were run to qualify the instruments and cabinets. Each instrument type was tested separately (that is not mounted in the cabinets) and the cabinets were tested fully loaded with a representation of most instrument types installed. Instruments as well as cabinets were mounted directly to the Wyle Lab seismic test device.

Seismic Test: An exploratory test was run in the form of a continuous sweep frequency search using a sinusoidal steady-state input at approximately 0.2 g. The search included two continuous sweeps from 1 to 35 to 1 Hz at a rate of one octave per minute.

The specimens were then subjected to sine beat tests consisting of ten osillations per beat with a time pause of approximately two seconds between each of the five beats. A sine beat test was performed two times, in each of the four orientations, at one-third octave frequencies of 1, 1.25, 1.6, 2.0, 2.5, 3.2, 4, 5, 6.3, 8, 10, 12.5, 16, 20, 25, 32, and at 35 Hz.

The test level was 4.25 g's or greater, within the limits of the test machine, at a location near the driving point of the actuator. The 4.25 g input yielded an effective g force of 3.0 g's in both the horizontal and vertical axes, simultaneously.

Monitoring: Simulated inputs were made during tests and outputs were monitored for each type instrument.

Results: All instruments (and the cabinet) performed satisfactorily with no loss of function or ability to function properly before, during, and after the test.

References: Wyle Lab test reports 43522-1
42434-1
43280-1
43675-1
43859-1

Added by Amendment 35

TABLE 3.10-4

WATTS BAR SEISMIC QUALIFICATION

Equipment: Instrumentation rack (local panel).

Mounting: The rack was bolted directly to the seismic simulator.

Seismic Testing:

1. Two low level (approximately 0.1g) single axis sine sweeps from 1 Hz to 35 Hz to 1 Hz were performed to establish major resonances for each major axis. The sweep rate was 1 octave per minute.

2. A sine beat test was conducted at each resonant frequency found by step 1. The sine beat tests consisted of five beats per test. Each beat contained two oscillations and was separated by a sufficient time span to allow all equipment motion to cease. The sine beat test levels were approximately 0.3 g for the vertical direction and 0.8 g for each horizontal direction.

3. The specimen was also subjected to 45-second simultaneous horizontal and vertical inputs of multi-frequency random motion consisting of frequencies spaced 1/3 octave apart over the frequency range of 1 to 40 Hz in the front-to-back/vertical and the side-to-side/vertical orientations. The excitation was biaxial and phase incoherent. The amplitude of each 1/3 octave acceleration was independently adjusted in each axis until the Test Response Spectra (TRS) enveloped the Required Response Spectra (RRS). The resulting TRS was analyzed at 2% damping by a spectrum analyzer and plotted at 1/3 octave intervals over the frequency range of interest.

   Approximately three one-half level or greater Safe Shutdown Earthquake (SSE) tests were performed. A minimum of one full level test was performed after completion of the one-half level tests.

Monitoring: None of the devices mounted on the rack were monitored.

Results: There was no evidence of any physical damage. The test indicated that the instrument mounting locations would not see "g" levels greater than 2 g's in the vertical direction and 3 g's in the horizontal direction during the postulated seismic event.

Reference: Wyle Laboratories' seismic simulation test report No. 42807-1.

Added by Amendment 35

WATTS BAR SEISMIC QUALIFICATION

Equipment: Single bay and four bay instrument cabinets.

Mounting: The test samples were mounted by their normal mounting means to the test fixture.

Seismic Testing:

1. A resonant search test was conducted in each of the three orthoganal directions. Each search consisted of two sweeps over the frequency range from 1 to 35 Hz and return to 1 Hz at a sweep rate of 1 octave/minute. The input "G" level to the vibration table was 0.2 g's.

2. A sine beat test was conducted at each resonant frequency found by step 1. The number of beats at each test frequency was 10 and the number of test frequencies cycled per beat was 10. The time between beats was of sufficient duration to preclude significant superimposition of motion. The input level was 0.36 g's horizontal and 0.24 g's vertical.

Monitoring: None of the devices mounted in the cabinets were monitored.

Results: There was no evidence of any physical damage and in no case did the "G" levels exceed 3.0g's in the horizontal axes or 2.0 g's in the vertical axis during the beat test.

Reference: Action Environmental Test Corporation report No. 10348 and 10348-1.

Added by Amendment 35

WATTS BAR SEISMIC QUALIFICATION

Equipment: Lighting Panel Boards and Cabinets

Electrical Rating: 125V DC Cabinets, 120/208V AC Panels, 60 Hz, 3-Phase

Mounting: Specimen was wall-mounted with commercially available bolts, nuts, and washers to a wall-mounting fixture which in turn was welded to the test table. Mounting simulated the in-service configuration.

Seismic Test: The specimens were subjected to the following tests:

1. Exploratory Test (Resonant Search) - Consists of low level (0.2 g horizontal and vertical) biaxial sine sweep from 1-33 Hz in front-to-back and side-to-side orientation to determine major equipment resonance points.
2. Proof Test (Multifrequency) - Consisting of simultaneous horizontal and vertical incoherent inputs of random motion at frequencies spaced 1/3 octave apart from 1-31.6 Hz in front-to-back and side-to-side orientations. Aging was obtained with three half-level SSE tests followed by one full-level SSE test performed in front-to-back and side-to-side orientations.

Monitoring: A multichannel recorder was used to monitor electrical continuity, contact chatter, and change of state before, during, and after the seismic test.

Results: The specimen's structural integrity was not compromised and circuit continuity was maintained.

Reference: Wyle Test Report 42979-1

Added by Amendment 35

WATTS BAR NUCLEAR PLANT

Mechanical Safety-Related Equipment List

System	Component	Drawing
Main Steam	Isolation Valves	47W801-1
	Safety Valves	47W801-1
	Relief Valves	47W801-1
SG Blowdown	Isolation Valves	47W801-2
Main Feedwater	Isolation Valves	47W803-1
Auxiliary Feedwater	Turbine-Driven Pumps	47W803-2
	Motor-Driven Pumps	47W803-2
	Valves	47W803-2
Chemical Volume and Control	NSSS Supplied	
Residual Heat Removal	NSSS Supplied	
Safety Injection	NSSS Supplied (Except Storage Tank	47W811-1)
Upper Head Injection	NSSS Supplied	
Containment Spray	NSSS Supplied	
Reactor Coolant	NSSS Supplied	
High Pressure Fire Protection	Pumps	47W832-1
	Valves	47W832-1
	Strainers	47W832-1
Ice Condenser	Doors and Passive Portion of System which is Required for LOCA	47W814-2
Control Rod Drive	NSSS Supplied	
Diesels	Generator	D-G Manual
	Engine	D-G Manual
	Coolers	D-G Manual
Essential Raw Cooling Water	Pumps	47W845-1
	Valves	47W845-1 to 5
	Traveling Water Screens	47W845-1
	Strainers	47W845-1
Control Air	Auxiliary Air Compressors	47W848-1
	After Coolers	47W848-1
	Air Receivers	47W848-1
	Air Dryers	47W848-1
	After Filters	47W848-1
	Valves	47W848-1
Diesel Starting Air	Motors	47W839-1
	Compressors	47W839-1
	Tanks	47W839-1
	Filters	47W839-1
	Valves	47W839-1

System	Component	Drawing
Standby Diesel Oil	7-Day Tanks	47W840-1
	Day Tanks	47W840-1
	Motor-driven Pumps	47W840-1
	Engine-driven Pumps	47W840-1
	Injectors	47W840-1
	Valves	47W840-1
Spent Fuel Pool Cooling	NSSS Supplied	
Component Cooling Water	Pumps	47W859-1
	Heat Exchangers	47W859-1
	Surge Tanks	47W859-1
	Valves	47W859-1 to 4
	Seal Leakage Return Pumps	47W859-1
	Thermal Barrier Booster Pumps	47W859-2
Main Control Room A/C	See Note 1	47W865-3
480V Bd. Room A/C	See Note 1	47W865-6
Elec. Bd. Room	See Note 1	47W865-7
Shutdown Bd. Room A/C	See Note 1	47W865-8
		47W866-3
Air Return System	Air Return Fans	47W866-1
	Hydrogen Recombiners	47W866-1
	Dampers	47W866-1
480V Transformer Rm Ventilation	Exhaust Fans	47W866-3
	Intakes	47W866-3
	Dampers	47W866-3
Vital Battery Rm Ventilation	Exhaust Fans	47W866-3
	Dampers	47W866-3
Emergency Gas Treatment System	Fans	47W866-1
	Filters	47W866-1
	Heaters	47W866-1
Aux Bldg Gas Treatment System	Fans	47W866-10
	Filters	
	Heaters	
	Dampers	
	Vacuum Relief	
	Demister	
Turbine-driven Aux. Feed Ventilation	Fans	47W866-2
Aux. Bldg Secondary Containment	Dampers	47W866
Control Bldg Ventilation (Pressurization, Emerg. Pressurization, Air Cleanup, Battery Exhaust)	Fans	47W866-4
	Dampers	47W866-4
	Filters	47W866-4
	Fire Dampers	47W866-4

System	Component	Drawing
Diesel Bldg Ventilation	Fans	47W866-9
	Dampers	47W866-9
Reactor Bldg Purge	Fans	47W866-1
	Filters	47W866-1
	Dampers	47W866-1
	Valves	47W866-1
Safety Feature Equipment Coolers (Serves RHR, SIS, CSS, AFW, SFPCS, and Centrifigal Charging Pumps and Pipe Chases and Penetration Rooms)	Air Handling Units	47W845-4 47W866-8
Flood Mode Boration and Makeup (See Note 2)	Pumps	47W809-7
	Tank	47W809-7
	Valves	47W809-7

Miscellaneous

- Cat. I Cranes
- Fuel Transfer Tube
- Fuel Transfer Conveyor
- New and Spent Fuel Racks
- Pressure Confining Doors
- Watertight Doors and Seals
- RHR Sump Manyways and Seals
- ERCW Personnel Access Doors and Seals
- Containment Personnel Access Doors and Seals
- Missile Barriers for A/C Enclosures
- Aux Bldg RR Access Hatches and Seals
- Equipment Access Doors and Seals
- Escape Hatches and Seals
- Shield Door and Enclosure
- Seal Between Ice Condenser and Containment Vessel
- Railroad Access Doors
- Spent Fuel Pit Bridge Crane
- Manipulator Crane

Note 1: The total system should be included; i.e., AHU;s, chillers, valves, dampers, filters, pumps, compressors, condensers, etc.

Note 2: Only a limited seismic requirement is applicable to this system.

Note 3: The listing does not include containment isolation valves in nonsafety-related systems.

Note 4: This list does not include monitoring equipment for radiation and neutron flux, nor does it include the reactor protection system.

TABLE 3.10-2

QUALIFICATION OF INSTRUMENTATION AND CONTROL EQUIPMENT

Equipment	Qualification Method*	Standard to Which Qualified*	Organization Performance Testing/Analys and Date of Completion
Reactor Trip and Bypass Breakers	1 & 3 testing		Westinghouse
Solid State Protection System	1 & 2 testing		Westinghouse
Process Instrument System	1 & 2 testing		Westinghouse
Nuclear Instrument System	1 & 2 testing		Westinghouse
Neutron Detectors	1 testing		Westinghouse
Process Transmitters	1 & 2 testing		Westinghouse
Containment Pressure Transmitters			
Solid State Protection System Output Relays	1 & 2 testing		Westinghouse
Engineered Safeguards Test Cabinets	1 testing		Westinghouse
Control Room Panels	1 & 4 testing and analysis		Westinghouse
Safety System Status Monitoring System			
Post Accident Monitoring System	1 & 2 testing		Westinghouse

TABLE 3.10-2

QUALIFICATION OF INSTRUMENTATION AND CONTROL EQUIPMENT

*Qualification Method	Description of Method
1	Sine beat. single axis Ref. WCAP-7558 WCAP-7817 and its, supplements, and WCAP-8373, as per IEEE-344-1971.
2	Demonstration Test Program biaxial test inputs with multifrequency forcing functions as per requirements of IEEE-344-1975.
3	IEEE-344-1975
4	Analysis

Equipment	Method of Qualification			Equipment Required For			
	Analysis		Test	Hot Standby	Cold Shutdown	Both	Neither
	Static	Dynamic					
Reactor Coolant System							
• Reactor vessel		G X				X	
• Full length CRDM housing		X				X	
• CRDM head adapter plugs	X					X	
• Steam generators							
Tube side		GX				X	
Shell side		X				X	
• Pressurizer		GX				X	
• Reactor coolant pipe		X				X	
• Reactor coolant fittings		X				X	
• Reactor coolant fabricated piping		X				X	
• Reactor coolant crossover legs		X				X	
• RTD bypass manifold		X				X	
• Reactor coolant thermowell			X			X	
• Thimble guide tubing		X				X	
• Thimble guide couplings	NA	NA	NA			X	
• Flux thimble assembly	NA	NA	NA			X	
• Loop bypass line		X				X	
• Pressurizer safety values	X					X	
• Power operated relief values	X					X	
• Pressurizer relief tank	NA	NA	NA				X

Equipment	Method of Qualification			Equipment Required For			
	Analysis		Test	Hot Standby	Cold Shutdown	Both	Neither
	Static	Dynamic					
Reactor Coolant System (cont)							
• Reactor coolant pumps							
RCP casing		X				X	
Bolting ring		X				X	
Thermal barrier		X				X	
Thermal barrier heat exchanger		X				X	
#1 seal housing & parts		X				X	
#2 seal housing & parts		X				X	
Pressure retaining bolting		X				X	
• RCP motor							
Motor rotor		X				X	
Motor shaft		X				X	
Shaft coupling		X				X	
Spool piece		X				X	
Flywheel		X				X	
Bearing (motor upper thrust)		X				X	
Motor bolting		X				X	
Motor stand		X				X	
Motor frame		X				X	
Upper oil reservoir		X					X
Upper oil cooler							
Tube side - cc		X					X
Shell side - oil		X					X

Equipment	Method of Qualification			Equipment Required For			
	Analysis		Test	Hot Standby	Cold Shutdown	Both	Neither
	Static	Dynamic					
Reactor Coolant System (cont)							
• RCP motor (cont)							
Lube oil piping		X					X
Lower oil reservoir (LOR)		X					X
LOR cooling coil - cc		X					X
Motor air coolers		X					X
Chemical & Volume Control System							
• Regenerative heat exchanger		X					X
• Letdown heat exchanger							
Tube side		X					X
Shell side		X					X
• Mixed bed demineralizer	NA	NA	NA				X
• Cation bed demineralizer	NA	NA	NA				X
• Reactor coolant filter		X					X
• Volume control tank		X					X
• Centrifugal charging pumps	X					X	
• Positive displacement pump	X					X	
• Seal water injection filter		X				X	
• Letdown orifices		5					X

Equipment	Method of Qualification			Equipment Required For			
	Analysis		Test	Hot Standby	Cold Shutdown	Both	Neither
	Static	Dynamic					
CVCS (cont)							
• Excess letdown heat exchanger							
Tube side		X					X
Shell side		X					X
• Seal water heat exchanger							
Tube side		X				X	
Shell side		X				X	
• Seal water return filter		X				X	
• Boric acid tank	X					X	
• Boric acid transfer pump	X					X	
• Boric acid filter		X				X	
• Resin fill tank	NA	NA	NA				X
• Boric acid batching tank	NA	NA	NA				X
• Chemical mixing tank	NA	NA	NA				X
• Boron injection makeup pump	X						X
• RC pump standpipe	NA	NA	NA				X
• Centrifugal charging pump minflow orifice		5				X	
• Moderating heat exchanger							
Tube side	NA	NA	NA				X
Shell side	NA	NA	NA				X
• Letdown chiller heat exchanger							
Tube side	NA	NA	NA				X
Shell side		X					X

Equipment	Method of Qualification			Equipment Required For			
	Analysis		Test	Hot Standby	Cold Shutdown	Both	Neither
	Static	Dynamic					
CVCS (cont)							
• Letdown reheat heat exchanger							
Tube side	NA	NA	NA				X
Shell side	NA	NA	NA				X
• Thermal regeneration demineralizer	NA	NA	NA				X
• Chiller pump	NA	NA	NA				X
• Chiller surge tank	NA	NA	NA				X
• Chiller unit	NA	NA	NA				X
Safety Injection System							
• Accumulator	X			X			
• High head SIS pumps	X			X			
• Boron injection surge tank	X						X
Boron injection flush orifice		5					X
• SI pump discharge orifice		5				X	
• SI pump minflow orifice		5				X	
Residual Heat Removal System							
• Residual heat removal pumps	X					X	
• Residual heat exchanger							
Tube side		X				X	
Shell side		X				X	

Equipment	Method of Qualification			Equipment Required For			
	Analysis		Test	Hot Standby	Cold Shutdown	Both	Neither
	Static	Dynamic					
Containment Spray System							
• Spray additive tank	X			X			
• Containment spray pump	X			X			
• Spray additive eductor	X			X			
• Containment spray heat exchanger							
Tube side	X			X			
Shell side	X			X			
Spent Fuel Pit Cooling System							
• Spent fuel pit heat exchanger							
Tube side	X						X
Shell side	X						X
• Spent fuel pit cooling pump	X						X
• Spent fuel pit filter	NA	NA	NA				X
• Spent fuel pit demineralizer	NA	NA	NA				X
• Spent fuel pit skimmer pump	NA	NA	NA				X
• Spent fuel pit skimmer strainer assembly	NA	NA	NA				X
• Spent fuel pit skimmer filter	NA	NA	NA				X
• Refueling water purification pump	X						X
• Spent fuel pit strainer	NA	NA	NA				X

Equipment	Method of Qualification						
	Analysis		Test	Hot Standby	Cold Shutdown	Both	Neither
	Static	Dynamic					
Boron Recycle System							
• Recycle holdup tank	X						X
• Recycle evap. feed pump	NA	NA	NA				X
• Recycle evap. feed demineralizer	NA	NA	NA				X
• Recycle evap. feed filter	NA	NA	NA				X
• Recycle evap. condensate demineralizer	NA	NA	NA				X
• Recycle evap. condensate filter	NA	NA	NA				X
• Recycle evap. concentrate filter	NA	NA	NA				X
• Recycle evap. reagent tank	NA	NA	NA				X
• Reactor makeup water storage tank	NA	NA	NA				X
• Reactor makeup water pump	NA	NA	NA				X
• Recycle holdup tank vent ejector	NA	NA	NA				X
• Recycle evaporator package							
Feed preheater							
Feed side	NA	NA	NA				X
Steam side	NA	NA	NA				X
Gas stripper	NA	NA	NA				X
Submerged tube evap.							
Feed side	NA	NA	NA				X
Steam side	NA	NA	NA				X
Evaporator condenser							
Distillate side	NA	NA	NA				X
Cooling water side	X						X

Equipment	Method of Qualification			Equipment Required For			
	Analysis		Test	Hot Standby	Cold Shutdown	Both	Neither
	Static	Dynamic					
Boron Recycle System (cont)							
• Recycle evaporator package (cont)							
Distillate cooler							
Distillate water side	NA	NA	NA				X
Cooling water side	NA	NA	NA				X
Absorption tower	NA	NA	NA				X
Vent condenser							
Gas side	NA	NA	NA				X
Cooling water side	X						X
Distillate pump	NA	NA	NA				X
Concentrate pump	NA	NA	NA				X
Piping							
Feed	NA	NA	NA				X
Distillate	NA	NA	NA				X
Concentrate	NA	NA	NA				X
Valves							
Feed	NA	NA	NA				X
Distillate	NA	NA	NA				X
Concentrate	NA	NA	NA				X
Cooling	X						X
Steam	NA	NA	NA				X

Equipment	Method of Qualification			Equipment Required For			
	Analysis		Test	Hot Standby	Cold Shutdown	Both	Neither
	Static	Dynamic					
Liquid Waste Processing System							
• Reactor coolant drain tank	NA	NA	NA				X
• Reactor coolant drain tank pump	NA	NA	NA				X
• Reactor coolant drain tank heat exchanger							
Tube side	NA	NA	NA				X
Shell side	NA	NA	NA				X
• Waste holdup tank	NA	NA	NA				X
• Waste evap. feed pump	NA	NA	NA				X
• Waste evap. feed filter	NA	NA	NA				X
• Waste evap. condensate demineralizer	NA	NA	NA				X
• Waste evap. condensate filter	NA	NA	NA				X
• Waste evap. condensate tank	NA	NA	NA				X
• Waste evap. condensate pump	NA	NA	NA				X
• Chemical drain tank	NA	NA	NA				X
• Chemical drain tank pump	NA	NA	NA				X
• Spent resin storage tank	NA	NA	NA				X
• Spent resin sluice pump	NA	NA	NA				X
• Spent resin sluice filter	NA	NA	NA				X
• Laundry & hot shower tank	NA	NA	NA				X
• Laundry & hot shower tank pump	NA	NA	NA				X

Equipment	Method of Qualification			Equipment Required For			
	Analysis		Test	Hot Standby	Cold Shutdown	Both	Neither
	Static	Dynamic					
Liquid Waste Processing System (cont)							
• Laundry & hot shower tank strainer	NA	NA	NA				X
• Laundry & hot shower tank filter	NA	NA	NA				X
• Floor drain tank	NA	NA	NA				X
• Floor drain tank pump	NA	NA	NA				X
• Waste monitor tank	NA	NA	NA				X
• Waste monitor tank pump	NA	NA	NA				X
• Waste monitor tank demineralizer	NA	NA	NA				X
• Waste monitor tank filter	NA	NA	NA				X
• Drumming header strainer	NA	NA	NA				X
• Floor drain tank filter	NA	NA	NA				X
• Floor drain tank strainer	NA	NA	NA				X
• Waste evap. reagent tank	NA	NA	NA				X
• Waste evaporator package							
Feed preheater							
Feed side	NA	NA	NA				X
Steam side	NA	NA	NA				X
Gas stripper	NA	NA	NA				X
Submerged tube evap.							
Feed side	NA	NA	NA				X
Steam side	NA	NA	NA				X
Evaporator condenser							
Distillate side	NA	NA	NA				X
Cooling water side	NA	NA	NA				X

Equipment	Method of Qualification			Equipment Required For			
	Analysis		Test	Hot Standby	Cold Shutdown	Both	Neither
	Static	Dynamic					
Liquid Waste Processing System (cont)							
• Waste evaporator package (cont)							
Distillate cooler							
Distillate water side	NA	NA	NA				X
Cooling water side	NA	NA	NA				X
Absorption tower	NA	NA	NA				X
Vent Condenser							
Gas side	NA	NA	NA				X
Cooling water side	NA	NA	NA				X
Distillate pump	NA	NA	NA				X
Concentrate pump	NA	NA	NA				X
Piping							
Feed	NA	NA	NA				X
Distillate	NA	NA	NA				X
Concentrate	NA	NA	NA				X
Valves							
Feed	NA	NA	NA				X
Distillate	NA	NA	NA				X
Concentrate	NA	NA	NA				X
Cooling	NA	NA	NA				X
Steam	NA	NA	NA				X

Equipment	Method of Qualification			Equipment Required For			
	Analysis		Test	Hot Standby	Cold Shutdown	Both	Neither
	Static	Dynamic					
Gaseous Waste Processing System							
• Waste gas compressor package	NA	NA	NA				X
• Gas decay tanks	NA	NA	NA				X
• Hydrogen recombiner	NA	NA	NA				X
• Gas trap							
1 inch	NA	NA	NA				X
2 inch	NA	NA	NA				X
• Waste gas drain filter	NA	NA	NA				X
• Gas decay tank drain pump	NA	NA	NA				X
Sampling System							
• Sample vessel	NA	NA	NA				X
• Sample heat exchanger							
Tube side – RC	NA	NA	NA				X
Shell side – CC	NA	NA	NA				X
Fuel Handling System							
• Semiautomatic refueling machine	NA	NA	NA				X
• Reactor vessel head and upper internals lifting device	X						X
• Fuel handling machine	X						X

Equipment	Method of Qualification			Equipment Required For			
	Analysis		Test	Hot Standby	Cold Shutdown	Both	Neither
	Static	Dynamic					
Fuel Handling System (cont)							
• RCC changing fixture	NA	NA	NA				X
• Reactor vessel stud tensioner	NA	NA	NA				X
• Telescoping fuel handling tool	X						X
• Fuel transfer system							
Fuel transfer tube & flange	X						X
Conveyor system (fuel building side)	NA	NA	NA				X
Remainder of system	NA	NA	NA				X
• New fuel elevator	X						X
• New fuel racks	X						X
• Spent fuel racks	NA	NA	NA				X
• Portable underwater lights	NA	NA	NA				X
• Load cell	NA	NA	NA				X
• Stud hole plug handling fixture	NA	NA	NA				X
• Stud hole plugs	NA	NA	NA				X
• Lower internals storage stand	NA	NA	NA				X
• Upper internals storage stand	NA	NA	NA				X
• RCC thimble plug tool	NA	NA	NA				X
• Source installation guide	NA	NA	NA				X
• Crane scales	NA	NA	NA				X
• Stud tensioner handling device	NA	NA	NA				X

Equipment	Method of Qualification			Equipment Required For			
	Analysis		Test	Hot Standby	Cold Shutdown	Both	Neither
	Static	Dynamic					
Fuel Handling System (cont)							
• Irradiation tube end plug seat jack	NA	NA	NA				X
• Burnable poison rod handling tool	NA	NA	NA				X
• Irradiation sample handling tool	NA	NA	NA				X
• Burnable poison assembly rack inserts	NA	NA	NA				X
• Control rod drive shaft handling fixture	NA	NA	NA				X
• Control rod drive shaft unlatching tool	NA	NA	NA				X
• New fuel elevator winch	NA	NA	NA				X
• Neutron detector positioners	X						X
• Refueling cavity seal ring	NA	NA	NA				X
• Rapid refueling missle shield	NA	NA	NA				X
• Rapid refueling cable tray, cables, and connectors	NA	NA	NA				X
• RV head shroud structure	NA	NA	NA				X
• New fuel assembly handling fixture	NA	NA	NA				X
• New RCC handling fixture	NA	NA	NA				X

Notation :

Dynamic Analysis

G - Equipment qualified on a generic basis

5 - Equipment qualified as part of piping system