3.9 MECHANICAL SYSTEMS AND COMPONENTS

3.9.1 General Topic for Analysis of Seismic Category I ASME Code and Non-Code Items

3.9.1.1 Design Transients

Transients used in the design and fatigue analysis for Westinghouse supplied ASME Code Class 1 components and RCS components are discussed and presented in Section 5.2.1.5. Specifically, the transients are identified for Class 1 components in Tables 5.2-2 and 5.2-3. The transients used in the design and analysis of RCS components are identified in Table 5.2-2.

3.9.1.2 Computer Programs Used in Analysis and Design

3.9.1.2.1 Other Than NSSS Systems, Components, Equipment, and Supports

1. The following computer programs are used in piping analyses:

a. TPIPE Program - TPIPE is a special purpose computer program capable of performing static and dynamic linear elastic analyses of power-related piping systems. The dynamic analysis option includes: (1) frequency extraction, (2) response spectrum, (3) time history modal superposition, and (4) time history direct integration methods.

   In addition to these basic analysis capabilities, the program can perform an ASME Section III, Class 1, 2, or 3 stress evaluation and perform thermal transient heat analysis to provide the linear thermal gradient, ΔT1, nonlinear thermal gradient, ΔT2, and gross discontinuity expansion difference, $\alpha_a T_a - \alpha_b T_b$, required for a Class 1 stress evaluation.

   This program is owned and maintained by TVA. It has been fully verified and documented and was compared with PISOL, SAP IV, PIPSD, STARDYNE, and SUPERPIPE with excellent correlation. These programs are well recognized and utilized throughout the industry. It is maintained and updates are verified in accordance with the TVA Quality Assurance Program for Computer Software.

b. Post Processors - The post processors are used in performing the stress evaluations and support load calculations made in the analysis of piping systems.

   The programs use moment, force, and deflection data generated by TPIPE. A stress evaluation is made for each joint on the analysis model. The appropriate stress intensifications/stress indices according to the ASME Section III code are utilized in evaluating stresses for the Normal, Upset, Emergency, and Faulted Conditions. Pipe rupture limits and active valve limits are also evaluated. The allowed stress difference for pipe lug attachments and the lug load is calculated for each load condition.

Support and anchor design loads are calculated for each support to meet the requirements given in Section 3.9.3.4.2.

c. The following computer programs are also used for piping analysis:

Program	Source	Program Description
ME-101	BECHTEL	Linear elastic analysis of piping systems - Bechtel Western Power Corp San Francisco, CA.
ANSYS	SWANSON	General purpose finite element program - Swanson Analysis Systems, Inc. Houston, PA.

2. The following computer programs are used in support design and equipment/component analysis.

ACRONYM	PROGRAM DESCRIPTION
FAPPS (ME150)	Frame Analysis For Pipe Supports
SMAPPS (ME152)	Standard Frame Analysis For Small Bore Pipe Supports
MAPPS (ME153)	Miscellaneous Applications For Pipe Supports
IAP	Integral Welded Attachments
CONAN	Allowable Tensile Load For Anchor Bolt Group With Shear Cone Overlap
BASEPLATE II	Finite Element Analysis Of Base Plates And Anchor Bolts
GT STRUDL	Structural Analysis Program
CASD	TVA Computer Aided Support Design Program
SUPERSAP	Structural Finite Element Analysis Program
ANSYS	Structural Finite Element Analysis Program
STARDYNE	Structural Analysis Program

3.9.1.2.2 Programs Used for Category I Components of NSSS

Computer programs that Westinghouse uses in analysis to determine structural and functional integrity of Seismic Category I systems, components, equipment and supports are presented in WCAP-8252, Revision 1[1] and WCAP-8929 [10].

3.9.1.3 Experimental Stress Analysis

No experimental stress analysis was used per se, for the reactor internals. However, Westinghouse makes extensive use of measured results from prototype plants and various scale model tests as discussed in the following Sections 3.9.2.4, 3.9.2.5, and 3.9.2.6.

3.9.1.4 Consideration for the Evaluation of the Faulted Condition

3.9.1.4.1 Subsystems and Components Analyzed by Westinghouse

The analytical methods used to evaluate stresses for ASME Class 1 systems and components are presented in Section 5.2.1.10. The results of the analyses are documented in the stress reports that describe the system or component.

For reactor internals the faulted condition was evaluated based on a non-linear elastic system analysis and conforms to the requirements of Appendix F of the ASME Code Section III. Analytical methods are described in Section 3.9.2.5.

3.9.1.4.2 Subsystems and Components Analyzed by TVA

1. Piping Systems - The methods employed in the analysis of ASME Class 1 and Class 2/3 piping systems are elastic analytical methods as described by the equations of Sections NB-3600 and NC-3600 of the ASME Code.

   The faulted condition stress limits specified for Class 1 and Class 2/3 systems are in compliance with the elastic method limits set forth in Appendix F subsection F-1360 of the ASME Section III Code.

2. Piping System Supports - The methods employed in the analysis of ASME Code Classes 1, 2, and 3 piping system supports are as follows:

   a. Linear Type - Elastic methods as described by Part I of the AISC, "Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings," February 12, 1969. (Supplements 1, 2, & 3) (Later edition of the AISC code may be utilized when design safety is not compromised.)

   b. Standard Components - Elastic or load-rated methods as described by Manufacturers' Standardization Society (MSS) SP-58, 1967 edition, "Pipe Hangers and Supports."

The faulted condition stress limits for Class 1, 2, and 3 pipe supports are specified in Section 3.9.3.4.2. For linear supports these faulted condition limits meet the intent and requirements of the elastic method limits set forth in Appendix F, subsection F-1320 or F-1370, of the ASME Section III Code. See Section 3.9.3.4.2. For standard components, the allowable stresses or load ratings of MSS-SP-58 are based on a factor of safety of five based on normal operating conditions. Upset, emergency, faulted, and test conditions were evaluated using Table 3.9-21. This low allowable stress is adequate to assure that active components are properly supported for faulted conditions.

3. Mechanical Equipment

No plastic instability allowable limits given in ASME Section III have been used when dynamic analysis is performed. The limit analysis methods have the limits established by ASME Section III for Normal, Upset and Emergency Conditions. For these cases, the limits are sufficiently low to assure that the elastic system analysis is not invalidated. For ASME Code Class 1 mechanical equipment, the stress limits for faulted loading conditions are specified in Sections 3.9.3.1.2 and 5.2. For ASME Code Class 2 and 3 mechanical equipment the stress limits for faulted loading conditions are specified in Section 3.9.3.1.2. These faulted condition limits are established in such a manner that there is equivalence with the adopted elastic system analysis. Particular cases of concern are checked by readjusting the elastic system analysis.

4. Mechanical Equipment Supports

The stress limits for the faulted loading condition of mechanical equipment supports are given in Section 3.9.3.4.1 of Westinghouse's scope of supply, and Section 3.9.3.4.2 for TVA's scope of supply.

3.9.2 Dynamic Testing and Analysis

3.9.2.1 Preoperational Vibration and Dynamic Effects Testing on Piping

ASME Code Section III, Subparagraph NB-3622.3, "Vibration," requires that vibration effects in piping systems shall be visually observed and where questionable shall be measured and corrected as necessary.

The preoperational piping dynamic effects test program at this plant is as follows:

a. The dynamic (steady state and transient) behavior of safety related piping systems designated as ASME Class 1, 2, and 3 is observed during the preoperational testing program. Sample and instrument lines beyond the root valves are normally not included. Also included in the program are those portions of ANSI B31.1 piping which has a potential to exhibit excessive vibrations.

b. Preoperational tests involving critical piping systems will be in compliance with Regulatory Guide 1.68, "Preoperational and Initial Startup Test Programs for Water-Cooled Power Reactors."

c. For the piping systems discussed in Item a., visual observation of the piping will be performed by trained personnel during predetermined, steady-state and transient modes of operation. The maximum point(s) of representative vibration, as determined by the visual observation, will be instrumented and measurement will be taken to determine actual magnitudes, if it is judged to be excessive.

d. The allowable criteria for measurements shall be either a maximum half-amplitude displacement or velocity value based on an endurance limit stress as defined in the ASME B&PV Code (refer to Section 3.7.3.8.1).

e. Should the measured magnitudes actually exceed the allowable, corrective measures will be performed for the piping system. Any new restraints, as required by corrective measures, will be incorporated into the piping system analysis.

f. The flow mode which produced the excessive vibrations will be repeated to assure that vibrations have been reduced to an acceptable level.

g. The flow modes to which the system components will be subjected are defined, in general terms, in the preoperational test program.

h. Vibration measurements will also be taken on the vital pumps at baseline and on a periodic basis so that excessive vibration can be corrected early in the program and/or detected if it gradually becomes a problem.

i. Vibrations of the affected portions of the main steam system during MS isolation valve trip will be tested and the results will be evaluated.

j. Thermal expansion tests will be conducted on the following piping systems:

Reactor Coolant System (RCS)
Main Steam
Steam Supply to Auxiliary Feedwater Pump Turbine
Main Feedwater
Pressurizer Relief Line
RHR in Shutdown Cooling Mode
Steam Generator Blowdown
Safety Injection System (those lines adjoining RCS which experience temperature > 200°F)
Auxiliary Feedwater
CVCS (Charging line from Regen. Hx to RCS, Letdown Line from RCS to Letdown Hx)

During the thermal expansion test, pipe deflections will be measured or observed at various locations based on the location of snubbers and hangers and expected large displacement. One complete thermal cycle (i.e., cold position to hot position to cold position) will be monitored. For most systems, the thermal expansion will be monitored at cold conditions and at normal operating temperature. Intermediate temperatures are generally not practical due to the short time during which the normal operating temperature is reached. For the RCS and the main steam system, measurements will be made at cold, 250°F, 350°F, 450°F and normal operating temperatures.

Acceptance criteria for the thermal expansion test verify that the piping system is free to expand thermally (i.e., piping does not bind or lock at spring hangers and snubbers nor interfere with structures or other piping), and to confirm that piping displacements do not exceed design limits, as described by ASME Section III (i.e., the induced stresses do not exceed the sum of the basic material allowable stress at design temperature and the allowable stress range for expansion stresses).

If thermal motion is not as predicted, the support system will be examined to verify correct function or to locate points of binding of restraints. If binding is found, the restraints will be adjusted to eliminate the unacceptable condition or reanalyzed to verify that the existing condition is acceptable.

3.9.2.2 Seismic Qualification Testing of Safety-Related Mechanical Equipment

Design of Category I mechanical equipment to withstand seismic, accident, and operational vibratory loadings is provided either by analysis or dynamic testing.

Generally tests are run with either of the following two objectives:

1. To obtain information on parts or systems necessary to perform the required analysis, or

2. To prove the design (stress or operability) adequacy of a given equipment or structure without performing any analysis of this particular equipment or structure.

The need for the first type of tests is dictated by lack of information on some of the inputs vital to the performance of an analysis. These tests can be either static (to obtain spring constants) or dynamic (to obtain impedance characteristics).

The need for the second type of test is mainly dictated by the complexity of the structure/equipment under design. This vibration testing is usually performed in a laboratory or shop on a prototype basis, using various sources of energy.

For general seismic qualification requirements for mechanical and electrical equipment, see Section 3.7.3.16.

Laboratory vibration testing can be conducted by employing various forms of shakers, the variation depending on the source of the driving force. Generally, the primary source of motion may be electromagnetic, mechanical, or hydraulic-pneumatic. Each is subject to inherent limitations which usually dictate the choice.

To properly simulate the seismic disturbance, the waveform must be carefully defined. The waveform seen by a given piece of equipment depends on:

1. The earthquake motion specified for a given site.

2. The soil-structure interaction.

3. The building in which the component is housed.

4. The floor on which the equipment is located.

5. The support and attachments to the equipment.

Components located on rocks or on stiff lower floors of buildings founded on rock are subjected to random-type vibrations. Components located on the upper floors of flexible buildings, in flexible subsystems, or in buildings on soft foundations are roughly subjected to sine beats with a frequency close to fundamental frequency of the building or subsystem.

In cases where random vibration inputs are used, extreme care is paid to the selection of random forcing functions having frequency content and energy conservatively approaching those of the ground or buildings motion caused by the specified earthquake(s).

The most common and readily available vibration testing facilities could only carry simple harmonic motion. By analytical comparison with time history response obtained with a number of real earthquake motions, it has been found that these time histories can be approximately simulated with wave forms having the shape of sine beats with 5 or 10 cycles per beat, a frequency equal to the component natural frequencies, and maximum amplitude equal to the maximum seismic acceleration to which the component needs to be qualified. For equipment located on building floors, the maximum seismic input acceleration is the maximum floor acceleration. This is obtained from the dynamic analysis of the building or from the appropriate floor response spectrum at the zero period of the equipment.

The above procedure adheres closely to the IEEE 344-1971 "IEEE Guide for Seismic Qualification of Class 1 Electric Equipment for Nuclear Power Generating Stations." This standard was specified for equipment for the Watts Bar Nuclear Plant contracted for up to September 1, 1974. New contracts after this date specified IEEE 344-1975 "IEEE Recommended Practices for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations." The first test to the IEEE 344-1975 was run in March 1974 on 6.9 kV switch gear. On local panels, test qualification to both standards was used because some instruments and controls mounted there on were procured to each version. This one test revealed that the 1971 version of IEEE 344 was the more severe.

As an example, seismic qualification and the demonstration of operability of active Class 2 and 3 pumps, active Class 1, 2, or 3 valves, and their respective drives, operators and vital auxiliary equipment is shown by satisfying the criteria given in Section 3.9.3.2. Other active mechanical equipment will be shown operable by either testing, analysis or a combination of testing and analysis. The operability programs implemented on this other active equipment will be similar to the program described in Section 3.9.3.2 for pumps and valves. Testing procedures similar to the procedures outlined in Section 3.10 for electrical equipment will be used to demonstrate operability if the component is mechanically or structurally complex such that its response cannot be adequately predicted analytically. Analysis may be used if the equipment is amenable to modeling and dynamic analysis.

Inactive Seismic Category I equipment will be shown to have structural integrity during all plant conditions in one of the following manners: 1) by analysis satisfying the stress criteria applicable to the particular piece of equipment, or 2) by test showing that the equipment retains its structural integrity under the simulated seismic environment.

A list of Category I mechanical equipment and the original method of qualification is provided in the Table 3.7-25.

3.9.2.3 Dynamic Response Analysis of Reactor Internals Under Operational Flow Transients and Steady-State Conditions

The vibration characteristics and behavior due to flow induced excitation are very complex and not readily ascertained by analytical means alone. Reactor components are excited by the flowing coolant which causes oscillatory pressures on the surfaces. The integration of these pressures over the applied area should provide the forcing functions to be used in the dynamic analysis of the structures. In view of the complexity of the geometries and the random character of the pressure oscillations, a closed form solution of the vibratory problem by integration of the differential equation of motion is not always practical and realistic. Therefore, the determination of the forcing functions as a direct correlation of pressure oscillations can not be practically performed independently of the dynamic characteristics of the structure. The main objective, then, is to establish the characteristics of the forcing functions that essentially determine the response of the structures. By studying the dynamic properties of the structure from previous analytical and experimental work, the characteristics of the forcing function can be deduced. These studies indicate that the most important forcing functions are flow turbulence, and pump-related excitation. The relevance of such excitations depends on many factors such as type and location of component and flow conditions.

The effects of these forcing functions have been studied from test runs on models, prototype plants and in component tests. [2,4,5]

The Indian Point Unit 2 plant has been established as the prototype for four-loop plant internals verification program and was fully instrumented and tested during initial startup.[4] In addition, the Sequoyah Unit 1 and Trojan Nuclear Plants have also been instrumented to provide prototype data applicable to Watts Bar.[5]

Although the Watts Bar plant is similar to Indian Point Unit 2, significant differences are the modifications resulting from the use of 17 x 17 fuel, the replacement of the annular thermal shield with neutron shielding panels, and reactor vessel barrel/baffle upflow flow design. These differences are addressed below.

1. 17 x 17 Fuel

   The only structural changes in the internals resulting from the design change from the 15 x 15 to the 17 x 17 fuel assembly are the guide tube and control rod drive line. The new 17 x 17 guide tubes are stronger and more rigid, hence they are less susceptible to flow induced vibration. The fuel assembly itself is relatively unchanged in mass and spring rate, and thus no significant deviation is expected from the 15 x 15 fuel assembly vibration characteristics.

2. Neutron Shielding Pads Lower Internals

   The primary cause of core barrel excitation is flow turbulence, which is not affected by the upper internals [3]. The vibration levels due to core barrel excitation for Trojan and Watts Bar both having neutron shielding pads, are expected to be similar. Since Watts Bar has greater velocities than Trojan, vibration levels due to the core barrel excitation is expected to be somewhat greater than that for Trojan (proportional to flow velocity raised to a small power). However, scale model test results and preliminary results from Trojan show that core barrel vibration of plants with neutron shielding pads is significantly less than that of plants with thermal shields. This information and the fact that low core barrel flange stresses with large safety margins were measured at Indian Point Unit 2 (thermal shield configuration) lead to the conclusion that stresses approximately equal to those of Indian Point Unit 2 will result on the Watts Bar internals with the attendant large safety margins.

3. Reactor Vessel Barrel/Baffle Upflow Conversion

The upflow conversion consists of changes to the reactor vessel components, which are to plug the core barrel inlet flow holes and to provide holes in the top former plate. These modifications change the flow path from being down flow to upflow between the core barrel and the baffle plate and increase core bypass flow by 1.5%. Changing the flow path reduces the pressure differential across the baffle plate, eliminating the jetting of coolant between the joints between the baffle plates. Although defined as a difference between Indian Point 2 and Watts Bar internals, the conversion of the Watts Bar internals to the upflow configuration has no direct impact on the reactor core system under earthquake conditions. Therefore, the fuel assembly structural integrity during a seismic event is not affected by the modification. The potential effects due to the LOCA contribution, as a result of the upflow modification, has been demonstrated by evaluation that the impact of the change in forces from the initial down flow design to upflow are insignificant. Therefore, the modifications associated with the upflow conversion do not increase the seismic or LOCA induced loads significantly compared to that of the downflow design, and the fuel assembly structural integrity and coolable geometry are maintained. This issue has been reviewed and approved by the NRC.[11 & 12]

3.9.2.4 <u>Preoperational Flow-Induced Vibration Testing of Reactor Internals</u>

Because the Watts Bar reactor internals design configuration is well characterized, as was discussed in Section 3.9.2.3, it is not considered necessary to conduct instrumented tests of the Watts Bar plant hardware. The requirements of Regulatory Guide 1.20 will be met by conducting the confirmatory preoperational testing examination for integrity per Paragraph D, of Regulatory Guide 1.20, "Regulation for Reactor Internals Similar to the Prototype Design." This examination will include some 34 points for Unit 1 (Figure 3.9-1a and 29 points for Unit 2 (Figure 3.9-1b) with special emphasis on the following areas.

1. All major load-bearing elements of the reactor internals relied upon to retain the core structure in place.

2. The lateral, vertical and torsional restraints provided within the vessel.

3. Those locking and bolting devices whose failure could adversely affect the structural integrity of the internals.

4. Those other locations on the reactor internal components which are similar to those which were examined on the prototype Indian Point Unit 2 design.

5. The inside of the vessel will be inspected before and after the hot functional test, with all the internals removed, to verify that no loose parts or foreign material are in evidence.

A particularly close inspection will be made on the following items or areas using a 5X or 1OX magnifying glass or penetrant testing where applicable.

1. Lower Internals

    a. Upper barrel to flange girth weld.

    b. Upper barrel to lower barrel girth weld.

    c. Upper core plate aligning pin. Examine bearing surfaces for any shadow marks, burnishing, buffing or scoring. Inspect welds for integrity.

    d. Irradiation specimen guide screw locking devices and dowel pins. Check for lockweld integrity.

    e. Baffle assembly locking devices. Check for lock weld integrity.

    f. Lower barrel to core support girth weld.

    g. Neutron shield panel screw locking devices and dowel pin cover plate welds. Examine the interface surfaces for evidence of tightness and for lock weld integrity.

    h. Radial support key welds.

    i. Insert screw locking devices. Examine soundness of lock welds.

    j. Core support columns and instrumentation guide tubes. Check the joints for tightness and soundness of the locking devices.

    k. Secondary core support assembly screw locking devices for lock weld integrity.

    l. Lower radial support keys and inserts. Examine for any shadow marks, burnishing, buffing or scoring. Check the integrity of the lock welds. These members supply the radial and torsional constraint of the internals at the bottom relative to the reactor vessel while permitting axial and radial growth between the two. One would expect to see, on the bearing surfaces of the key and keyway, burnishing, buffing or shadow marks which would indicate pressure loading and relative motion between the two parts. Some scoring of engaging surfaces is also possible and acceptable.

m. Gaps at baffle joints. Check for gaps between baffle and top former and at baffle to baffle joints.

2. Upper Internals

a. Thermocouple conduits, clamps and couplings. (Unit 1 Only)

b. Guide tube, support column, orifice plate, and thermocouple assembly locking devices. (Unit 1 Only)

c. Support column (Units 1 and 2) and thermocouple conduit assembly clamp (Unit 1 Only) welds.

d. Upper core plate alignment inserts. Examine for any shadow marks, burnishing, buffing or scoring. Check the locking devices for integrity of lock welds.

e. Thermocouple conduit gusset and clamp welds (where applicable). (Unit 1 Only)

f. Thermocouple conduit end-plugs. Check for tightness. (Unit 1 Only)

g. Guide tube enclosure welds, tube-transition plate welds and card welds.

h. Guide tube, support column, orifice plate, and flow restrictor locking devices. (Unit 2 Only)

Acceptance standards are the same as required in the shop by the original design drawings and specifications.

During the hot functional test, the internals will be subjected to a total operating time at greater than normal full-flow conditions (four pumps operating) of at least 240 hours. This provides a cyclic loading of approximately 10^7 cycles on the main structural elements of the internals. In addition there will be some operating time with only one, two and three pumps operating.

When no signs of abnormal wear, no harmful vibrations are detected and no apparent structural changes take place, the four-loop core support structures are considered to be structurally adequate and sound for operation.

3.9.2.5 Dynamic System Analysis of the Reactor Internals Under Faulted Conditions

3.9.2.5.1 Design Criteria

The basic requirement of any LOCA including the double-ended severance of a reactor coolant pipe, is that sufficient integrity be maintained to permit the safe and orderly shutdown of the reactor. This implies that the core must remain essentially intact and the deformations of the internals must be sufficiently small so that primary loop flow, and particularly, adequate safety injection flow, is not impeded. The ability to insert control rods, to the extent necessary, to provide shutdown following the accident must be maintained. Maximum allowable deflection limitations are established for those regions of the internals that are critical for plant shutdown. The allowable and no loss of function deflection limits under dead weight loads plus the maximum potential earthquake and/or blowdown excitation loads are presented in Table 3.9-5. These limits have been established by correlating experimental and analytical results.

With the acceptance of Leak-Before Break by NRC, References [6][7][8][9][10][11] and [12] of Section 3.6B.1, the dynamic effects of main coolant loop piping are no longer considered in the design basis analysis. Only the dynamic effects of the next most limiting breaks of auxiliary lines need to be considered; and consequently the components will experience considerably less loads and deformations than those from the main loop line breaks.

3.9.2.5.2 Internals Evaluation

The horizontal and vertical forces exerted on reactor internals and the core, following a LOCA, are computed by employing the MULTIFLEX 3.0, which is an enhancement and extension of MULTIFLEX 1.0,[14] NRC reviewed and approved computer code developed for the space-time dependent analysis of nuclear power plants. MULTIFLEX 3.0 has been accepted by NRC for several other applications[15], [16], [17], [18] and also has been extensively used for the LOCA analyses of reactor internals components of numerous other 2, 3, and 4 loop nuclear power plants.

3.9.2.5.3 LOCA Forces Analysis

MULTIFLEX[14] is a digital computer program for calculation of pressure, velocity, and force transients in reactor primary coolant systems during the subcooled, transition, and early saturation portion of blowdown caused by a LOCA. During this phase of the accident, large amplitude rarefaction waves are propagated through the system with the velocity of sound causing large differences in local pressures. As local pressures drop below saturation, causing formation of steam, the amplitudes and velocities of these waves drastically decrease. Therefore, the largest forces across the reactor internals due to wave propagation occur during the subcooled portions of the blowdown transient. MULTIFLEX includes mechanical structure models and their interaction with the thermal-hydraulic system.

MULTIFLEX Code

The thermal-hydraulic portion of MULTIFLEX is based on the one dimensional homogeneous flow model which is expressed as a set of mass, momentum, and energy conservation equations. These equations are quasi-linear first order partial-differential equations that are solved by the method of characteristics. The numerical method employed is the explicit scheme; consequently time steps for stable numerical integration are restricted by sonic propagation.

In MULTIFLEX, the structural walls surrounding a hydraulic path may deviate from their neutral positions depending on the force differential on the wall. The wall displacements are represented by those of one-dimensional mass points which are described by the mechanical equations of vibration.

MULTIFLEX is a generalized program for analyzing and evaluating thermal-hydraulic-structure system dynamics. The thermal-hydraulic system is modeled with an equivalent pipe network consisting of one-dimensional hydraulic legs which define the actual system geometry. The actual system parameters of length, area, and volume are represented with the pipe network.

MULTIFLEX computes the pressure response of a system during a decompression transient. The asymmetric pressure field in the down-comer annulus region of a PWR can be calculated. This pressure field is integrated over the core support barrel area to obtain total dynamic load on the core support barrel. The pressure distributions computed by MULTIFLEX can also be used to evaluate the reactor core assembly and other primary coolant loop component support integrity.

MULTIFLEX evaluates the pressure and velocity transients for locations throughout the system. The pressure and velocity transients are made available to the programs LATFORC and FORCE-2 (described in Reference [14], Appendix A and B), which used detailed geometric descriptions to evaluate hydraulic loading on reactor internals.

<u>Horizontal/Lateral Forces - LATFORC</u>

LATFORC, described in Reference [14], Appendix A, calculates the lateral hydraulic loads on the reactor vessel wall, core barrel, and thermal shield, resulting from a postulated LOCA in the primary RCS. A variation of the fluid pressure distribution in the down-comer annulus region during the blowdown transient produces significant asymmetrical loading on the reactor vessel internals. The LATFORC computer code is used in conjunction with MULTIFLEX, which provides the transient pressures, mass velocities, and other thermodynamic properties as a function of time.

<u>Vertical Forces – FORCE-2</u>

FORCE-2, described in Reference [14], Appendix B, determines the vertical hydraulic loads on the reactor vessel internals. Each reactor component for which force calculations are required is designated as an element and assigned an element number. Forces acting upon each of the elements are calculated summing the effects of:

1. The pressure differential across the element.
2. Flow stagnation on, and unrecovered orifice losses across, the element.
3. Friction losses along the element.

Input to the code, in addition to the MULTIFLEX pressure and velocity transients, includes the effective area of each element on which acts the force due to the pressure differential across the element, a coefficient to account for flow stagnation and unrecovered orifice losses, and the total area of the element along which the shear forces act.

3.9.2.5.4 Structural Response of Reactor Internals During LOCA and Seismic Conditions

Structural Model and Methods of Analysis

The response of reactor vessel internals due to an excitation produced by a complete severance of auxiliary loop piping is analyzed. With the acceptance of Leak-Before-Break (LBB) by NRC, Reference [12] of Section 3.6B.1, the dynamic effects of main coolant loop piping no longer have to be considered in the design basis analysis. Only the dynamic effects of the next most limiting breaks of auxiliary lines need to be considered; and consequently the components will experience considerably less loads than those from the main loop line breaks.

Assuming that such a pipe break in cold leg occurs in a very short period of time (1 ms), the rapid drop of pressure at the break produces a disturbance that propagates through the reactor vessel nozzle into the down-comer (vessel and barrel annulus) and excites the reactor vessel and the reactor internals. The characteristics of the hydraulic excitation combined with those of the structures affected present a unique dynamic problem. Because of the inherent gaps that exist at various interfaces of the reactor vessel/reactor internals/fuel, the problem becomes that of nonlinear dynamic analysis of the reactor pressure vessel system. Therefore, nonlinear dynamic analyses (LOCA and Seismic) of the reactor pressure vessel system include the development of LOCA and seismic forcing functions.

Structural Model

Figure 3.9-1 is schematic representation of the reactor pressure vessel system. In this figure, the major components of the system are identified. The reactor pressure vessel system finite element model for the nonlinear time history dynamic analysis consists of three concentric structural sub-models connected by nonlinear impact elements and linear stiffness matrices. The first sub-model, shown in Figure 3.9-2a and 3.9-2b represents the reactor vessel shell and its associated components. The reactor vessel is restrained by four reactor vessel supports (situated beneath alternate nozzles) and by the attached primary coolant piping. Also shown in Figure 3.9-2a is a typical reactor pressure vessel support mechanism.

The second sub-model, shown in Figure 3.9-3a represents the reactor core barrel, lower support plate, tie plates, and the secondary support components for Watts Bar Unit 1. These sub-models are physically located inside the first, and are connected by stiffness matrices at the vessel/internals interfaces. Core barrel to reactor vessel shell impact is represented by nonlinear elements at the core barrel flange, upper support plate flange, core barrel outlet nozzles, and the lower radial restraints.

The third and innermost sub-model, shown in Figure 3.9-3b represents the upper support plate assembly consisting of guide tubes, upper support columns, upper and lower core plates, and the fuel. The fuel assembly simplified structural model incorporated into the reactor pressure vessel system model preserves the dynamic characteristics of the entire core. For each type of fuel design the corresponding simplified fuel assembly model is incorporated into the system model. The third sub-model is connected to the first and second by stiffness matrices and nonlinear elements. Finally, Figure 3.9-3c shows the reactor pressure vessel system model representation.

Analysis Technique

The WECAN Computer Code[10] which is used to determine the response of the reactor vessel and its internals, is a general purpose finite element code. In the finite element approach, the structure is divided into a finite number of discrete members or elements. The inertia and stiffness matrices, as well as the force array, are first calculated for each element in the local coordinates. Employing appropriate transformations, the element global matrices and arrays are assembled into global structural matrices and arrays, and used for dynamic solution of the differential equation of motion for the structure.

$$[M]\{U\} + [D]\{U\} + [K]\{U\} = \{F\} \quad (1)$$

The WECAN Code solves equation of motions (1) using the nonlinear modal superposition theory. Initial computer runs such as dead weight analysis and the vibration (modal) analyses are made to set the initial vertical interface gaps and to calculate eigenvalues and eigenvectors. The modal analysis information is stored on magnetic tapes, and is used in a subsequent computer runs which solves equation of motions. The first time step performs the static solution of equations to determine steady state solution under normal operating hydraulic forces. After the initial time step, WECAN calculates the dynamic solution of equations of motions and nodal displacements and impact forces are stored on tape for post-processing.

The fluid-solid interactions in the LOCA analysis are accounted through the hydraulic forcing functions generated by MULTIFLEX Code. Following a postulated LOCA pipe rupture, forces are imposed on the reactor vessel and its internals. These forces result from the release of the pressurized primary system coolant. The release of pressurized coolant results in traveling depressurization waves in the primary system. These depressurization waves are characterized by a wave front with low pressure on one side and high pressure on the other.

The LOCA loads applied to the reactor vessel system for the auxiliary line breaks consist of:

(a) reactor internals hydraulic loads (vertical and horizontal, and
(b) reactor coolant loop mechanical loads.

These loads are calculated individually and combined in a time history manner.

Reactor Pressure Vessel Internal Hydraulic Loads

Depressurization waves propagate from the postulated break location into the reactor vessel through either a hot leg or a cold leg nozzle. After a postulated cold leg break the depressurization path for waves entering the reactor vessel is through the nozzle which contains the broken pipe and into the region between the core barrel and the reactor vessel (i.e., down-comer region). The initial waves propagate up, around, and down the down-comer annulus, then up through the region circumferentially enclosed by the core barrel, that is, the fuel region.

In the case of cold leg break, the region of the down-comer annulus close to the break depressurizes rapidly but, because of the restricted flow areas and finite wave speed (approximately 3000 feet per second), the opposite side of the core barrel remains at a high pressure. This results in a net horizontal force on the core barrel and the reactor vessel. As the depressurization wave propagates around the down-comer annulus and up through the core, the core barrel differential pressure reduces and, similarly, the resulting hydraulic forces drop.

In the case of a postulated break in the hot leg, the wave follows a similar depressurization path, passing through the outlet nozzle and directly into the upper internals region depressurizing the core and entering the down-comer annulus from the bottom exit of the core barrel. Thus, after a reactor pressure vessel outlet nozzle break, the down-comer annulus would be depressurized with very little difference in pressure forces across the outside diameter of the core barrel. A hot leg break produces less horizontal force because the depressurization wave travels directly to the inside of the core barrel (so that the down-comer annulus is not directly involved) and internal differential pressures are not as large as for a cold leg break of the same size. Since the differential pressure is less for a hot leg break, the horizontal force applied to the core barrel is less for hot leg break than for a cold leg break. For breaks in both the hot leg and cold leg, the depressurization waves continue to propagate by reflection and translation through the reactor vessel and loops.

The MULTIFLEX computer code, calculates the hydraulic transients within the entire primary coolant system. It considers subcooled, transition, and early two-phase (saturated) blowdown regimes. The MULTIFLEX code employs the method of characteristics to solve the conservation laws, and assumes one-dimensionality of flow and homogeneity of the liquid-vapor mixture. The MULTIFLEX code considers a coupled fluid-structure interaction by accounting for the deflection of constraining boundaries, which are represented by separate spring-mass oscillator system. A beam model of the core support barrel has been developed from the structural properties of the core barrel; in this model, the cylindrical barrel is vertically divided into equally spaced segments and the pressures as well as the wall motions are projected onto the plane parallel to the broken nozzle. Horizontally, the barrel is divided into 10 segments; each segment consists of three separate walls. The spatial pressure variation at each time step is transformed into 10 horizontal forces which act on the 10 mass points of the beam model. Each flexible wall is bounded on either side by a hydraulic flow path. The motion of the flexible wall is determined by solving the global equations of motions for the masses representing the forced vibration of an undamped beam.

Reactor Coolant Loop Mechanical Loads

The loop mechanical loads result from the release of normal operating forces present in the pipe prior to the separation as well as transient hydraulic forces in the RCS. The magnitudes of the loop release forces are determined by performing a reactor coolant loop analysis for normal operating loads (pressure, thermal, and deadweight). The load existing in the pipe at the postulated break location are calculated and are “released” at the initiation of the LOCA transient by application of the loads to the broken piping ends. These forces are applied with a ramp time of one millisecond because of the assumed instantaneous break opening time.

In order to obtain the response of reactor pressure vessel system (vessel/internals/fuel), the LOCA horizontal and vertical forces obtained from the LATFORC and FORCE-2 Codes, which were described earlier, together with the loop mechanical loads are applied to the finite element system model shown in Figure 3.9-3c. The transient response of the reactor internals consists of time history nodal displacements and time history impact forces.

3.9.2.5.5 Seismic Analysis

The basic mathematical model for seismic analysis is essentially similar to the LOCA model except for some minor differences. In LOCA model, as mentioned earlier, the fluid-structure interactions are accounted though the MULTIFLEX Code; whereas in the seismic model the fluid-structure interactions are included through the hydrodynamic mass matrices in the down-comer region. Another difference between the LOCA and seismic models is the difference in loop stiffness matrices. The seismic model uses the unbroken loop stiffness matrix, whereas the LOCA model uses the broken loop stiffness matrix. Except for these two differences, the reactor pressure vessel system seismic model is identical to that of LOCA model.

The horizontal fluid-structure or hydroelastic interaction is significant in the cylindrical fluid flow region between the core barrel and the reactor vessel annulus. Mass matrices with off-diagonal terms (horizontal degrees-of-freedom only) attach between nodes on the core barrel, thermal shield and the reactor vessel. The mass matrices for the hydroelastic interactions of two concentric cylinders are developed using the work of Reference [20]. The diagonal terms of the mass matrix are similar to the lumping of water mass to the vessel shell, thermal shield, and core barrel. The off-diagonal terms reflect the fact that all the water mass does not participate when there is no relative motion of the vessel and core barrel. It should be pointed out that the hydrodynamic mass matrix has no artificial virtual mass effect and is derived in a straight forward, quantitative manner.

The matrices are a function of the properties of two cylinders with the fluid in the cylindrical annulus, specifically, inside and outside radius of the annulus, density of the fluid and length of the cylinders. Vertical segmentation of the reactor vessel and the core barrel allows inclusion of radii variations along their heights and approximates the effects of beam mode deformation. These mass matrices were inserted between the selected nodes on the core barrel, thermal shield, and the reactor vessel. The seismic evaluations are performed by including the effects of simultaneous application of time history accelerations in three orthogonal directions. The WECAN computer code, which is described earlier, is also used to obtain the response for the reactor pressure vessel system under seismic excitations.

3.9.2.5.6 Results and Acceptance Criteria

The reactor internals behave as a highly nonlinear system during horizontal and vertical oscillations of the LOCA forces. The nonlinearities are due to the coulomb friction at the sliding surfaces and due to gaps between components causing discontinuities in force transmission. The frequency response is consequently a function not only of the exciting frequencies in the system but also of the amplitude. Different break conditions excite different frequencies in the system. This situation can be seen clearly when the response under LOCA forces is compared with the seismic response. Under seismic excitations, the system response is not as nonlinear as LOCA response because various gaps do not close during the seismic excitations.

The results of the nonlinear LOCA and seismic dynamic analyses include the transient displacements and impact loads for various elements of the mathematical model. These displacements and impact loads, and the linear component loads (forces and moments) are then used for detailed component evaluations to assess the structural adequacy of the reactor vessel, reactor internals, and the fuel.

The stresses due to the safe shutdown earthquake (SSE) are combined in the most unfavorable manner with the LOCA stresses in order to obtain the largest principal stresses and deflections. These results indicate that the maximum deflections and stress in the critical structures are below the established allowable limits. For transverse excitation of the core barrel, it is shown that the upper core barrel does not buckle during hot leg break.

The results also show that the guide tubes will deform well within the limits established experimentally to assure control rod insertion. Seismic deflections of the guide tubes are generally negligible by comparison with the no loss of function limit.

3.9.2.5.7 Structural Adequacy of Reactor Internals Components

The reactor internal components of Watts Bar Unit 1 are not ASME Code components. This is due to the fact that Sub-section NG of the ASME Boiler and Pressure Code edition applicable to Watts Bar reactor internals did not include design criteria for the reactor internals since its design preceded Subsection NG of the ASME Code. However, these components were originally designed to meet the intent of the 1971 Edition of Section III of the ASME Boiler and Pressure Vessel Code with addenda through the Winter 1971. As noted previously, that with the acceptance of LBB by NRC, the dynamic effects of the main reactor coolant loop piping are no longer considered in the design basis analysis. Only the dynamic effects of the next most limiting breaks of the auxiliary lines (accumulator line, pressurizer surge line, and RHR lines) are to be considered.

It should be noted that LBB discussed in Section 3.6A.2.1.5 also refers to the elimination of pressurizer surge line break from the design basis of Watts Bar Unit 1. Therefore, LOCA response of Watts Bar Unit 1 was determined for the auxiliary line breaks consisting of accumulator line and an RHR line. Consequently, the components experience considerably less loads and deformations than those from the main loop breaks which were considered in the original design of the reactor internals.

Allowable Deflection and Stability Criteria

The criterion for acceptability with regard to mechanical integrity analyses is that adequate core cooling and core shutdown must be ensured. This implies that the deformation of reactor internals must be sufficiently small so that the geometry remains substantially intact. Consequently, the limitations established on the reactor internals are concerned principally with the maximum allowable deflections and stability of the components.

For faulted conditions, deflections of critical reactor internal components are limited to the values given in Table 3.9-5. In a hypothesized vertical displacement of internals, energy-absorbing devices limit the displacement to 1.25 inches by contacting the vessel bottom head.

Core Barrel Response Under Transverse Excitations

In general, there are two possible modes of dynamic response of the core barrel during LOCA conditions:

a) During a cold leg break the inside pressure of the core barrel is much higher than the outside pressures, thus subjecting the core barrel to outward deflections.

b) During a hot leg break the pressure outside the core barrel is greater than the inside pressure thereby subjecting the core barrel to compressive loading.

Therefore, this condition requires the dynamic stability check of the core barrel during a hot leg break.

(1) To ensure shutdown and cooldown of the core during cold leg blowdown, the basic requirement is a limitation on the outward deflection of the barrel at the locations of the inlet nozzles connected to unbroken lines. A large outward deflection of the upper barrel in front of the inlet nozzles, accompanied with permanent strains, could close the inlet area and restrict the cooling water coming from the accumulators. Consequently, a permanent barrel deflection in front of the unbroken inlet nozzles larger than a certain limit, called “no loss of function” limit, could impair the efficiency of the ECCS.

(2) During the hot leg break, the rarefaction wave enters through the outlet nozzle into the upper internals region and thus depressurizes the core and then enters the down-comer annulus from the bottom exit of the core barrel. This depressurization of the annulus region subjects the core barrel to external pressures and this condition requires a stability check of the core barrel during hot leg break. Therefore, to ensure rod insertion and to avoid disturbing the control rod cluster guide structure, the barrel should not interfere with the guide tubes.

Table 3.9-5 summarizes the allowable and no loss of function displacement limits of the core barrel for both the cold leg and hot leg breaks postulated in the main line loop piping. With the acceptance of LBB, the reactor internal components such as core barrel will experience much less loads and deformations than those obtained from main loop piping.

Control Rod Cluster Guide Tubes

The deflection limits of the guide tubes which were established from the test data, and for fuel assembly thimbles, cross-section distortion (to avoid interference between the control rood and the guides) are given in Table 3.9-5

Upper Package

The local vertical deformation of the upper core plate, where a guide tube is located, shall be below 0.100 inch. This deformation will cause the plate to contact the guide tube since the clearance between the plate and the guide tube is 0.100 inch. This limit will prevent the guide tubes from undergoing compression. For a plate local deformation of 0.150 inch, the guide tube will be compressed and deformed transversely to the upper limit previously established. Consequently, the value of 0.150 inch is adopted as the no loss function local deformation with an allowable limit of 0.100 inch.

3.9.2.6 Correlations of Reactor Internals Vibration Tests With the Analytical Results

The dynamic behavior of reactor components has been studied using experimental data obtained from operating reactors along with results of model tests and static and dynamic tests in the fabricators shops and at plant site. Extensive instrumentation programs to measure vibration of reactor internals (including prototype units of various reactors) have been carried out during preoperational flow tests, and reactor operation.

From scale model tests, information on stresses, displacements, flow distribution, and fluctuating differential pressures is obtained. Studies have been performed to verify the validity and determine the prediction accuracy of models for determining reactor internals vibration due to flow excitation. Similarity laws were satisfied to assure that the model response can be correlated to the real prototype behavior.

Vibration of structural parts during prototype plants preoperational tests is measured using displacement gages, accelerometers, and strain transducers. The signals are recorded with F.M. magnetic tape records. On site and offsite signal analysis is done using both hybrid real time and digital techniques to determine the (approximate) frequency and phase content. In some structural components the spectral content of the signals include nearly discrete frequency or very narrow-band, usually due to excitation by the main coolant pumps and other components that reflect the response of the structure at a natural frequency to broad bands, mechanically and/or flow-induced excitation. Damping factors are also obtained from wave analyses.

It is known from the theory of shells that the normal modes of a cylindrical shell can be expressed as sine and cosine combinations with indices m and n indicating the number of axial half waves and circumferential waves, respectively. The shape of each mode and the corresponding natural frequencies are functions of the numbers m and n. The general expression for the radial displacement of a simply supported shell is:

$$w(x,\psi,t) = \ddot{\Sigma}_{n=0}\ddot{\Sigma}_{m=1}[A_{nm}(t)\ \cos n\psi + B_{nm}(t)\sin n\psi]\ \sin \frac{M\pi x}{L}$$

The shell vibration at a natural frequency depends on the boundary conditions at the ends. The effect of the ends is negligible for long shells or for higher order m modes, and long shells have the lowest frequency for n = 2 (elliptical mode). For short shells, the effects of the ends are more important, and the shell will tend to vibrate in modes corresponding to values of n > 2.

In general, studies of the dynamic behavior of components follow two parallel procedures: 1) obtain frequencies and spring constants analytically, and 2) confirm these values from the results of the tests. Damping coefficients are established experimentally. Once these factors are established, the response can be computed analytically. In parallel, the responses of important reactor structures are measured during preoperational reactor tests and the frequencies and mode shapes of the structures are obtained.

Theoretical and experimental studies have provided information on the added apparent mass of the water, which has the effect of decreasing the natural frequency of the component. For both cases, cross and parallel, the response is obtained after the forcing function and the damping of the system is determined.

Pre- and post-hot functional inspection results, in the case of plants similar to prototypes, serve to confirm predictions that the internals are well behaved. Any gross motion or undue wear would be evident following the application of approximately 10^7 cycles of vibration expected during the test period.

3.9.3 ASME Code Class 1, 2 and 3 Components, Component Supports and Core Support Structures

3.9.3.1 Loading Combinations, Design Transients, and Stress Limits

3.9.3.1.1 Subsystems and Components Supplied by Westinghouse

Design transients are presented in Section 5.2.1.5.

For ASME Code Class 1 components, systems, and supports, loading conditions are presented in Section 5.2.1.10.1, and stress criteria are provided in Section 5.2.1.10.7. Additional information concerning methods of analysis is presented throughout Section 5.2.1.10. Results of analyses are documented in the stress reports that describe the system or components.

For core support structures, design loading conditions are given in Section 4.2.2.3. Loading conditions are discussed in Section 4.2.2.4.

In general, for reactor internals components and for core support structures, the criteria for acceptability, with regard to mechanical integrity analyses, are that adequate core cooling and core shutdown must be assured. This implies that the deformation of the reactor internals must be sufficiently small so that the geometry remains substantially intact. Consequently, the limitations established on the internals are concerned principally with the maximum allowable deflections and stability of the parts, in addition to a stress criterion to assure integrity of the components.

For the LOCA plus the SSE condition, deflections of critical internal structures are limited. In a hypothesized downward vertical displacement of the internals, energy absorbing devices limit the displacement after contacting the vessel bottom head, ensuring that the geometry of the core remains intact.

The following mechanical functional performance criteria apply:

1. Following the design basis accident, the functional criterion to be met for the reactor internals was that the plant shall be shutdown and cooled in an orderly fashion so that fuel cladding temperature was kept within specified limits. This criterion implies that the deformation of critical components must be kept sufficiently small to allow core cooling.

2. For large breaks, the reduction in water density greatly reduces the reactivity of the core, thereby shutting down the core whether the rods are tripped or not. The subsequent refilling of the core by the emergency core cooling system uses borated water to maintain the core in a subcritical state. Therefore, the main requirement was to assure effectiveness of the emergency core cooling system. Insertion of the control rods, although not needed, gives further assurance of ability to shut the plant down and keep it in a safe shutdown condition.

3. The inward upper barrel deflections are controlled to ensure no contacting of the nearest rod cluster control guide tube. The outward upper barrel deflections are controlled in order to maintain an adequate annulus for the coolant between the vessel inner diameter and core barrel outer diameter.

4. The rod cluster control guide tube deflections are limited to ensure operability of the control rods.

5. To ensure no column loading of rod cluster control guide tubes, the upper core plate deflection is limited.

Methods of analysis and testing for core support structures are discussed in Sections 3.9.1.3, 3.9.1.4.1, 3.9.2.3, 3.9.2.5, and 3.9.2.6. Stress limits and deformation criteria are given in Sections 4.2.2.4 and 4.2.2.5.

3.9.3.1.1.1 Plant Conditions and Design Loading Combinations For ASME Code Class 2 and 3 Components Supplied by Westinghouse

Design pressure, temperature, and other loading conditions that provide the bases for design of fluid systems Code Class 2 and 3 components are presented in the sections which describe the systems.

3.9.3.1.1.2 Design Loading Combinations by Westinghouse

The design loading combinations for ASME Code Class 2 and 3 equipment and supports are given in Table 3.9-1. The design loading combinations are categorized with respect to Normal, Upset, Emergency, and Faulted Conditions.

Stress limits for each of the loading combinations are equipment oriented and are presented in Tables 3.9-2, 3.9-3, 3.9-4, and 3.9-6 for tanks, inactive pumps, valves, and active pumps, respectively. The definition of the stress equations and limits are in accordance with the ASME Code as follows:

a.. For tanks and all other equipment, Section III of the ASME Code, 1971 Edition through Summer 1973 Addenda, and Code Cases 1607-1, 1635-1 and 1636-1 were utilized to establish stress limits for Normal, Upset, Emergency, and Faulted Conditions. In addition, Code Case 1657 was used for WBN Unit 2.

b. Some equipment was provided in accordance with the Code Edition and Addenda in effect on the date of the contract.

For the actual numerical values of the allowables for specific equipment, the ASME Code Edition applicable to the time period of equipment procurement as specified on the procurement documents was used for the qualification.

Active (Active components are those whose operability is relied upon to perform a safety function (as well as reactor shutdown function) during the transients or events considered in the respective operating condition categories) pumps and valves are discussed in Section 3.9.3.2. The equipment supports are designed in accordance with the requirements specified in Section 3.9.3.4.

3.9.3.1.1.3 Design Stress Limits By Westinghouse

The design stress limits established for equipment are sufficiently low to assure that violation of the pressure retaining boundary will not occur. These limits, for each of the loading combinations, are equipment oriented and are presented in Tables 3.9-2 through 3.9-4, and 3.9-6. See Section 3.9.3.1.1.2 for discussion of applicable code editions.

3.9.3.1.2 Subsystems and Components Analyzed or Specified by TVA

A. ASME Code Class 1, 2, and 3 Piping.

The analytic procedures and modeling of piping systems is discussed in Sections 3.7.3.8 and 3.7.3.3.* As discussed in Section 3.7.3.8.1 the TVA analysis effort has been categorized into two approaches: Rigorous and Alternate. The loading sources, conditions, and stress limits are described below for each category and the results are summarized for each.

* Generated reactor coolant loop response spectra curves and movements enveloping the Set B + Set C curves are used for the analysis or reanalysis of auxiliary piping systems attached to the reactor coolant loops. The ASME Code Case N-411 or Regulatory Guide 1.61 damping values can be used when Set B + Set C spectra are considered.

1. Loading Conditions, Stress Limits and Requirements for Rigorous Analysis

a. The loading sources considered in the rigorous analysis of a piping system are defined in Table 3.9-7.

b. The piping was analyzed to the requirements of applicable codes as defined in Section 3.7.3.8.1.

c. The design load combinations are categorized with respect to Normal, Upset, Emergency, and Faulted Conditions. Class 1 piping was analyzed using the limits established in Table 3.9-8 for all applicable loading conditions. The pressurizer surge line was also evaluated for the thermal stratification and thermal striping in response to the NRC Bulletin 88-11. Other rigorously analyzed piping meets the limits established in Table 3.9-9 for all applicable loading conditions.

d. Consideration was given to the sequence of events in establishing which load sources are taken as acting concurrently.

e. Equipment nozzle loads are within vendor and/or TVA allowable values. This ensures that functionality and 'Active' equipment operability requirements are met.

f. All equipment (i.e., valves, pumps, bellows, flanges, strainers, etc.) was checked to ensure compliance with vendor limitations.

g. The pipe/valve interface at each active valve was evaluated and the pipe stresses are limited to the levels indicated in Table 3.9-10 unless higher limits are technically justified on a case-by-case basis.

h. Documentation of rupture stress was provided for the locations in the system being analyzed where the stress exceeds the limits for which pipe rupture postulation was required (See Section 3.6). The tabulation identifies the point and tabulates the stress for each point exceeding the limits.

i. Valves with extended operators or structures (including handwheels) meet the dynamic plus gravitational acceleration limits of 3g along the stem axis and 3g (vectorial summation) in the plane perpendicular to the valve stem axis. For 1-inch and smaller valves with handwheels, the dynamic plus gravitational acceleration limit is 3g in each of the three global (or local) directions. These limits apply to any valve orientation and must be maintained during piping analysis.

   For steel body check valves (which have no external operators or structures) the limit for dynamic plus gravitational acceleration was 10g (vectorial summation of all three orthogonal directions).

   The valves as a minimum are qualified to the acceleration limits specified above. Higher accelerations are approved based on case-by-case technical justification.

j. Excessive pipe deformation was avoided.

k. Welded attachment loads and stresses for TVA Class 1 piping were evaluated in accordance with ASME Code Cases N-122 and N-391.

For Class 2 and 3 piping, loads and stresses from welded attachments were evaluated in accordance with ASME Code Cases N-318 and N-392.

Special cases of other welded attachments were evaluated by detailed finite element analysis or other applicable methods to assure that ASME Code stress allowables were met.

The attachment welds are full penetration, partial penetration, or fillet welded as detailed on the support drawings. Attachments are used generally on all piping systems, and locations can be determined from the support drawings.

2. <u>Loading Conditions and Stress Limits for Alternate Analysis</u>

   a. The scope of the alternate analysis application is generally limited to systems having the following load sources: self-weight, internal pressure, seismic event, end point displacement, and limited thermal expansion. (Other load sources may be considered for special cases.)

b. The design load combinations are categorized with respect to Normal, Upset, Emergency, and Faulted Conditions. The criteria are developed to meet the stress limits given in Table 3.9-9 considering the applicable load sources.

c. The general limitations imposed on the piping by the application of the Alternate Analysis method are discussed in Section 3.7.3.8.3. For ASME Category I piping designed by alternate analysis, the same levels of valve acceleration and interface/nozzle load requirements of Section 3.9.3.1.2.A shall be maintained. Non-ASME, Category I(L) piping designed by alternate analysis is described in Sections 3.7.3.8.3 and 3.2.1.

3. Considerations for the Faulted Condition

Tables 3.9-8 through 3.9-10 identify the load sources and allowed stresses associated with the faulted condition. The stress limits used are those limits established in ASME Section III for the faulted condition.

The feedwater system inside containment, from the check valves to the steam generators including the piping components are evaluated for pressure boundary integrity to withstand the postulated water hammer event due to the feedwater check valve slam following pipe rupture at the main header (Turbine Building) using the ASME Section III Appendix F (1980 Edition through Winter 1982 Addenda) rules and limits.

The four main feedwater check valves were evaluated for structural integrity following the feedwater pipe rupture. Energy equivalence methods, in conjunction with nonlinear finite element and linear hand analyses, were used. The evaluations demonstrated that deformations in three of the four valves are within acceptable strain levels following the slam. With the assumption that the fourth valve is not functional, the transient effects of the resulting one steam generator blowdown are bounded by the "Major Rupture of a Main Feedwater Pipe inside containment" per Section 15.4.2.2.

Note that during the rigorous analysis phase of most piping systems, the postulated break locations are unknown and the jet impingement loads are unavailable and thus not included in the evaluation of the faulted condition. However, where it was determined by the guidelines of Section 3.6 that jet impingement must be evaluated, the effect of the loads on pipe stress was evaluated during the pipe rupture analysis.

4. Summary of Results - Rigorous Analysis of Class 1 and Class 2/3 Piping Performed by TVA

The results of the piping system analyses performed in accordance with the above paragraphs are presented and consolidated in calculations with the following documentation:

a. Certification Report for ASME Code Class 1 Analyses.

b. Owner's review for ASME Code Class 1 Analyses.

c. Statement of Compliance with code requirements for ASME Code Class 2/3 Analyses.

d. Problem revision status form - for maintaining the traceability of revision performed on analysis, and correlating various forms affected by each revision.

e. Piping input data for recording all physical data used in the analysis.

f. Table of system operating modes - for identifying the various thermal conditions required and included in analysis.

g. Stress summary - for summarizing the maximum stresses for various loading combinations.

h. Equipment nozzle load qualification to demonstrate satisfaction of limits.

i. Valve acceleration qualification to demonstrate satisfaction of limits.

j. Summary of loads and movements at pipe supports.

A record copy of these problem calculations is maintained at TVA and is available for review upon request.

B. Category I ASME Code Class 2 and 3 Mechanical Equipment

1. Plant Conditions and Design Loading Combinations

Design pressure, temperature, and other loading conditions that provide the bases for design of fluid systems Code Class 2 and 3 components are presented in the sections which describe the systems.

2. Design Loading Combinations

The design loading combinations for ASME Code Class 2 and 3 equipment and supports are given in Table 3.9-13B. The design loading combinations are categorized with respect to Normal, Upset, Emergency and Faulted Conditions.

Stress limits for each of the loading combinations are equipment oriented and are presented in Tables 3.9-14, 3.9-15 and 3.9-16 for tanks, inactive* pumps, and inactive* valves respectively. The definition of the stress equations and limits are in accordance with the ASME Code as follows:

* Inactive components are those whose operability are not relied upon to perform a safety function during the transients or events considered in the respective operating condition category.

a. For tanks and all other equipment, Section III of the ASME Code, 1971 Edition through Summer 1973 Addenda, and Code Cases 1607-1, 1635-1 and 1636-1 were utilized to establish stress limits for Normal, Upset, Emergency, and Faulted Conditions. In addition, Code Case 1657 was used for WBN Unit 2.

b. Some equipment was provided in accordance with the Code Edition and Addenda in effect on the date of the award of contract.

   For the actual numerical values of the allowables for specific equipment, the ASME Code Edition applicable to the time period of equipment procurement as specified on the procurement documents was used for the qualification.

Active pumps and valves are discussed in Section 3.9.3.2.1. The vendor supplied equipment/component supports stress levels are limited to the allowable stress of AISC or ASME Section III subsection NF or other comparable stress limits as delineated in the applicable design specification. Section 3.8.4 describes the allowable stresses used for TVA-designed equipment/component supports.

The design stress limits established for the components are sufficiently low to assure that violation of the pressure retaining boundary will not occur. These limits, for each of the loading combinations, are component oriented and are presented in Tables 3.9-14 through 3.9-16.

3.9.3.2 Pumps and Valve Operability Assurance

3.9.3.2.1 Active ASME Class 1, 2, & 3 Pumps and Valves

Active components are those whose operability is relied upon to perform a safety function (as well as reactor shutdown function) during the transients or events considered in the respective operating condition categories.

The list of active valves for primary fluid (i.e., water and steam containing components) systems in the Westinghouse scope of supply is presented in Table 3.9-17. The list of active pumps supplied by Westinghouse is presented in Table 3.9-28. The list of pumps and valves for fluid systems within TVA scope of supply are presented in Tables 3.9-25 and 3.9-27. Only ASME Section III pumps and valves that were purchased after September 1, 1974, were considered to be within the scope of WBN compliance with Regulatory Guide 1.48. These pumps and valves meet the special design requirements verifying operability as specified in Regulatory Guide 1.48. The remaining components in Tables 3.9-17, 3.9-25, 3.9-27, and 3.9-28 meet the appropriate qualification requirements in accordance with the guidelines of IEEE 344-1971 and consistent with the ASME Code applicable at the time of the contract date for procuring the component. These qualifications provide an adequate level of operability assurance for all active pumps and valves.

The following rules were used to identify active pumps and valves:

1. Only UFSAR Chapter 15 Design Basis Events (DBE's) were assumed. These DBE's were studied to identify the active pumps and valves required to mitigate the DBE and place the plant in a safe shutdown condition.

2. Reactor Coolant Pressure Boundary (RCPB) - Valves that are a part of the RCPB (defined by 10 CFR Section 50.2) and require movement to isolate the RCS were identified as active.

3. Containment Isolation - Containment isolation valves that require movement to isolate the containment were identified as active.

4. Check Valves - Any check valve required to close or cycle when performing its system safety function was identified as active.

   Any check valve that was only required to open in the performance of its system safety function was not identified as active. This position was justified by: (a) the free-swinging nature of the valves and (b) the normal stress over-design of the valve body.

5. Achieve and Maintain a Safe Shutdown Condition - The minimum redundant complement of equipment required to achieve and maintain safe shutdown was selected.

3.9.3.2.2 Operability Assurance

3.9.3.2.2.1 Westinghouse Scope of Supply

Mechanical equipment classified as safety-related must be shown capable of performing its function during the life of the plant under postulated plant conditions. Equipment with faulted condition functional requirements include 'active' pumps and valves in fluid systems such as the residual heat removal system, safety injection system, and the containment spray system. Seismic analysis is presented in Section 3.7 and covers all safety-related mechanical equipment.

Operability is assured by satisfying the requirements of the programs specified below. Additionally, equipment specifications include requirements for operability under the specified plant conditions and define appropriate acceptance criteria to ensure that the program requirements defined below are satisfied.

Pump and Valve Qualification for Operability Program

Active pumps are qualified for operability by first, being subjected to rigid tests both prior to installation in the plant and after installation in the plant. The in-shop tests include: 1) hydrostatic tests of pressure retaining parts to 150 percent times the design pressure times the ratio of material allowable stress at room temperature to the allowable stress value at the design temperature, 2) seal leakage tests, and 3) performance tests to determine total developed head, minimum and maximum head, net positive suction head (NPSH) requirements and other pump parameters. Also monitored during these operating tests are bearing temperatures and vibration levels. Bearing temperature limits are determined by the manufacturer, based on the bearing material, clearances, oil type, and rotational speed. These limits are approved by Westinghouse. Vibration limits are also determined by the manufacturer and are approved by Westinghouse. After the pump is installed in the plant, it undergoes the cold hydro-tests, hot functional test, and the required periodic inservice inspection and operation. These tests demonstrate that the pump will function as required during all normal operating conditions for the design life of the plant. In addition to these tests, the safety-related active pumps, are qualified for operability by assuring that the pump will start up, continue operating, and not be damaged during the faulted condition.

The pump manufacturer was required to show by analysis correlated by test, prototype tests or existing documented data that the pump will perform its safety function when subjected to loads imposed by the maximum seismic accelerations and the maximum faulted nozzle loads. It was required that test or dynamic analysis be used to show that the lowest natural frequency of the pump is greater than 33 Hz. The pump, when having a natural frequency above 33 Hz, is considered essentially rigid. This frequency is sufficiently high to avoid problems with amplification between the component and structure for all seismic areas. A static shaft deflection analysis of the rotor was performed with the conservative SSE accelerations of 3g horizontal and 2g vertical acting simultaneously. The deflections determined from the static shaft analysis were compared to the allowable rotor clearances. The nature of seismic disturbances dictates that the maximum contact will be of short duration. If rubbing or impact is predicted, it is required that it be shown by prototype tests or existing documented data that the pump will not be damaged or cease to perform its design function. The effect of impacting on the operation of the pump was evaluated by analysis or by comparison of the impacting surfaces of the pump to similar surfaces of pumps which had been tested.

In order to avoid damage during the faulted plant condition, the stresses caused by the combination of normal operating loads, SSE, dynamic system loads are limited to the limits indicated in Table 3.9-6. In addition, the pump casing stresses caused by the maximum faulted nozzle loads are limited to the stresses outlined in Table 3.9-6.

The changes in operating rotor clearances caused by casing distortions due to these nozzle loads were considered. The maximum seismic nozzle loads combined with the loads imposed by the seismic accelerations were considered in an analysis of the pump supports. Furthermore, the calculated misalignment was shown to be less than that misalignment which could cause pump misoperation. The stresses in the supports are below those in Table 3.9-6; therefore, the support distortion is elastic and of short duration (equal to the duration of the seismic event).

Performing these analyses with the conservative loads stated and with the restrictive stress limits of Table 3.9-6 as allowables, assure that critical parts of the pump are not damaged during the short duration of the faulted condition and that, therefore, the reliability of the pump for post-faulted condition operation is not impaired by the seismic event.

If the natural frequency was found to be below 33 Hz, an analysis was performed to determine the amplified input accelerations necessary to perform the static analysis. The adjusted accelerations were determined using the same conservatisms contained in the 3g horizontal and 2g vertical accelerations used for 'rigid' structures. The static analysis was performed using the adjusted accelerations; the stress limits stated in Table 3.9-6 were satisfied.

To complete the seismic qualification procedures, the pump motor was qualified for operation during the maximum seismic event. Any auxiliary equipment identified to be vital to the operation of the pump or pump motor, and which is not proven adequate for operation by the pump or motor qualifications, was separately qualified by meeting the requirements of IEEE Standard 344-1971 or -1975, as applicable, with the additional requirements and justifications outlined in this section.

The program above gives the required assurance that the safety-related pump/motor assemblies will not be damaged and will continue operating under SSE loadings, and, therefore, will perform their intended functions. These proposed requirements take into account the complex characteristics of the pump and are sufficient to demonstrate and assure the seismic operability of the active pumps.

Since the pump is not damaged during the faulted condition, the functional ability of active pumps after the faulted condition is assured since only normal operating loads and steady state nozzle loads exist. Since it is demonstrated that the pumps would not be damaged during the faulted condition, the post-faulted condition operating loads will be identical to the normal plant operating loads. This is assured by requiring that the imposed nozzle loads (steady-state loads) for normal conditions and post-faulted conditions are limited by the magnitudes of the normal condition nozzle loads. The post-faulted condition ability of the pumps to function under these applied loads is proven during the normal operating plant conditions for active pumps.

Safety-related active valves must perform their mechanical motion at times of an accident. Assurance is supplied that these valves will operate during a seismic event. Tests and analyses were conducted to qualify active valves.

The safety-related active valves were subjected to a series of stringent tests prior to service and during the plant life. Prior to installation, the following tests were performed: shell hydrostatic test to ASME Section III requirements, backseat and main seat leakage tests, disc hydrostatic test, and operational tests to verify that the valve will open and close.

For the active valves qualification of electric motor operators for the environmental conditions (i.e., aging, radiation, accident environment simulation, etc.) refer to Section 3.11 and Regulatory Guide 1.73. Cold hydro tests, hot functional qualifications tests, periodic inservice inspections, and periodic inservice operations are performed in-situ to verify and assure the functional ability of the valve. These tests guarantee reliability of the valve for the design life of the plant. The valves are constructed in accordance with the ASME Boiler and Pressure Vessel Code, Section III.

On all active valves, an analysis of the extended structure was performed for static equivalent seismic SSE loads applied at the center of gravity of the extended structure. The stress limits allowed in these analyses show structural integrity. The limits used for active Class 2 and 3 valves are shown in Table 3.9-4.

In addition to these tests and analyses, a representative electric motor operated valve was tested for verification of operability during a simulated plant faulted condition event by demonstrating operational capabilities within the specified limits. The testing procedures are described below.

The valve was mounted in a manner which represents typical valve installations. The valve included operator and limit switches if such are normally attached to the valve in service. The faulted condition nozzle loads were considered in the test in either of two ways: 1) loads equivalent to the faulted condition nozzle loads were limited such that the operability of the valve was not affected.

The operability of the valve during a faulted condition was demonstrated by satisfying the following criteria:

1. All the active valves were designed to have a first natural frequency which is greater than 33 Hz, if it was practical to do so. If the lowest natural frequency of an active valve was less than 33 Hz, then the valve's mathematical model was included in the piping dynamic analysis, so as to assure the calculated valve acceleration does not exceed the values used in the static tests of the manufacturer's qualification program and to reflect the proper valve dynamic behavior.

2. The actuator and yoke of the representative motor operated valve system was statically deflected using an equivalent static load that simulates those conditions applied to the valve under faulted condition accelerations applied at the center of gravity of the operator alone in the direction of the weakest axis of the yoke. The design pressure of the valve was simultaneously applied to the valve during the static deflection tests.

3. The valve was cycled while in the deflected position. The time required to open or close the valve in the defected position was compared to similar data taken in the undeflected condition to evaluate the significance of any change.

The accelerations used for the static valve qualification are 3g horizontal and 2g vertical with the valve yoke axis vertical. The piping designer maintained the operator accelerations to these levels unless higher limits were technically justified on a case-by-case basis.

The testing was conducted on the valves with extended structures which are most affected by acceleration, according to mass, length and cross-section of extended structures. Valve sizes which cover the range of sizes in service were qualified by the tests and the results are used to qualify all valves within the intermediate range of sizes.

Valves which are safety-related but can be classified as not having an extended structure, such as check valves and safety valves, were considered separately. Check valves are characteristically simple in design and their operation will not be affected by seismic accelerations or the applied nozzle loads. The check valve design is compact and there are no extended structures or masses whose motion could cause distortions which could restrict operation of the valve. The nozzle loads due to seismic excitation will not affect the functional ability of the valve since the valve disc is typically designed to be isolated from the body wall. The clearance supplied by the design around the disc will prevent the disc from becoming bound or restricted due to any body distortions caused by nozzle loads. Therefore, the design of these valves is such that once the structural integrity of the valve is assured using standard design or analysis methods, the ability of the valve to operate is assured by the design features. In addition to these design considerations, the valve was subjected to the following tests and analysis: 1) in-shop hydrostatic test, 2) in-shop seat leakage test, and 3) periodic in-situ valve exercising and inspection to assure the functional ability of the valve.

The pressurizer safety valves were qualified by the following procedures (these valves are also subjected to tests and analysis similar to check valves): stress and deformation analyses of critical items which may affect operability for faulted condition loads, in-shop hydrostatic and seat leakage tests, and periodic in-situ valve inspection. In addition to these tests, a static load equivalent to that applied by the faulted condition was applied at the top of the bonnet and the pressure will be increased until the valve mechanism actuates. Successful actuation within the design requirements of the valve assured its overpressurization safety capabilities during a seismic event.

Using these methods, active valves were qualified for operability during a faulted event. These methods conservatively simulate the seismic event and assure that the active valves will perform their safety-related function when necessary. The above testing program for valves is conservative. Alternate valve operability testing, such as dynamic vibration testing, was allowed if it was shown to adequately assure the faulted condition functional ability of the valve system.

Pump Motor and Valve Operator Qualification

Active pump motors (and vital pump appurtenances) and active valve electric motor operators (and limit switches and pilot solenoid valves), were seismically qualified by meeting the requirements of IEEE Standard 344-1971 or 1975, as applicable. If the testing option was chosen, sine-beat testing was justified. This justification was provided by satisfying one or more of the following requirements to demonstrate that multi-frequency response is negligible or the sine-beat input is of sufficient magnitude to conservatively account for this effect.

1. The equipment response is basically due to one mode.

2. The sine-beat response spectra envelopes the floor response spectra in the region of significant response.

3. The floor response spectra consists of one dominant mode and has a peak at this frequency.

If the degree of coupling in the equipment is small, then single axis testing may have been justified. Multi-axis testing was required if there is considerable cross coupling; however, if the degree of coupling can be determined, then single axis testing will be used with the input sufficiently increased to include the effect of coupling on the response of the equipment.

Seismic qualification by analysis alone, or by a combination of analysis and testing, has been used when justified. The analysis program can be justified by: 1) demonstrating that equipment being qualified is amendable to analysis, and 2) that the analysis be correlated with test or be performed using standard analysis techniques.

3.9.3.2.2.2 TVA Scope of Supply

TVA used the following criteria to prescribe a suitable program to assure the functional adequacy of active Category I fluid system components (pumps and valves) under combined loading conditions. These criteria supplement or amend previously stated requirements for fluid system components in those cases where fluid system components are judged to be active (i.e., if they perform a required mechanical motion during the course of accomplishing a safety function). These criteria assure that all active seismic Category I fluid system components will maintain structural integrity and perform their safety functions under loadings, including seismic, associated with normal, upset, and faulted conditions. These criteria are similar to the accepted response to NRC Position for the TVA's Bellefonte Nuclear Plant units 1 and 2 concerning compliance with the requirements of Regulatory Guide 1.48. The exception is that the seismic qualification for Watts Bar is for a 2-dimensional earthquake, while for Bellefonte it is for a 3-dimensional earthquake.

3.9.3.2.3 Criteria For Assuring Functional Adequacy of Active Seismic Category I Fluid System Components (Pumps and Valves) and Associated Essential Auxiliary Equipment

1. The seismic design adequacy of Category I electrical power and control equipment and instrumentation directly associated with the active Category I pumps and valves is assured by seismically qualifying the components by analysis and/or testing in accordance with the requirements of IEEE Standard 344 (for applicable edition, refer to Section 3.9.2.2).

2. When either analysis or testing is used to demonstrate the seismic design adequacy of Category I components, the characteristics of the required input motion is specified by either response spectra, power spectral density function or time history data derived from the structure or system seismic analysis. When the testing method is used, random vibration input motion shall be used, but single frequency input, such as sine beats, may be used provided that:

    a. The characteristics of the required input motion indicate that the motion is dominated by one frequency.

    b. The anticipated response of equipment is adequately represented by one mode.

    c. The input has sufficient intensity and duration to excite all modes to the required magnitude, such that the testing response spectra will envelop the corresponding response spectra of the individual modes.

For equipment with more than one dominant frequency and for equipment supported near the base of the structure where some random components of the earthquake may remain, single frequency testing may still be applicable provided that the input has sufficient intensity and duration to excite all modes to the required magnitude, such that the testing response spectra will envelop the corresponding response spectra of the individual modes. When equipment responses along one direction are sensitive to the vibration frequencies along another perpendicular direction, in the case of single frequency testing, the time phasing of the inputs in the vertical and horizontal directions is such that a purely rectilinear resultant output is avoided.

In both the testing and analysis procedure, the possible amplified design loads for vendor supplied equipment is considered as follows:

    a. If supports are tested, they were tested with the actual components mounted and operating or if the components are inoperative during the support test, the response at the equipment mounting locations were monitored and components were tested separately and the actual input to the equipment was more conservative in amplitude and frequency content than the monitored responses.

b. The support analysis includes the component loads. Seismic restraints were used as applicable with their adequacy verified by either testing or analysis as described above.

3. Active Category I pumps were subjected to tests both prior to installation in the plant and after installation in the plant. The in-shop tests include (a) hydrostatic tests of pressure-retaining parts, (b) seal leakage tests, and (c) performance tests, while the pump is operated with flow, to determine total developed head, minimum and maximum head, net positive suction head (NPSH) requirements and other pump/motor parameters. Bearing temperatures and vibration levels were monitored during these operating tests. Both were shown to be below appropriate limits specified to the manufacturer for design of the pump. After the pump was installed in the plant, it was subject to cold hydro tests, or operational tests, hot functional tests, and the required periodic in-service inspection and operation.

4. Active Category I pumps were analyzed to show that the pump will operate normally when subjected to the maximum seismic accelerations and maximum seismic nozzle loads. Tests or dynamic analysis show that the lowest natural frequency of the pump is above 33 Hz, and thus considered essentially rigid. A static shaft deflection analysis of the rotor was performed with the conservative seismic accelerations of 1.5 times the applicable plant floor response spectra. The deflections determined from the static shaft analysis were compared to the allowable rotor clearances. Stresses caused by the combination of normal operating loads, seismic, and dynamic system loads were limited to the material elastic limit, as indicated in Table 3.9-18. The primary membrane stress (P_m) for the faulted condition loads were limited to $1.2S_h$, or approximately 0.75 S (S = yield stress). The primary membrane stress plus the primary bending stress (P_b) was limited to $1.8S_h$, or approximately 1.l S. In addition, the pump nozzle stresses caused by the maximum seismic nozzle loads were limited to stresses outlined in Table 3.9-18. The maximum seismic nozzle loads were considered in an analysis of the pump supports to assure that a system misalignment cannot occur.

   If the natural frequency is found to be below 33 Hz, then analyses are performed to determine the amplified input accelerations necessary to perform the static analysis. The adjusted accelerations were determined using the same conservatism contained in the accelerations used for "rigid" structures. The static analysis was performed using the adjusted accelerations; the stress limits stated in Table 3.9-18 were satisfied.

5. Each type of active Category I pump motor is independently qualified for operating during the maximum seismic event. Any appurtenances which are identified to be vital to the operation of the pump or pump motor and which are not qualified for operation during the pump analysis or motor qualifications, shall also be separately qualified for operation at the accelerations each would see at its mounting. The pump motor and vital appurtenances are qualified by meeting the requirements of IEEE Standard 344-1971 or 1975 edition, depending on the procurement date (see Section 3.9.2.2.). If the testing option was chosen, sine-beat testing was justified by satisfying one or more of the following requirements to demonstrate that multi-frequency response is negligible or the sine-beat input is of sufficient magnitude to conservatively account for this effect.

    a. The equipment response is basically due to one mode.

    b. The sine-beat response spectra envelops the floor response spectra in the region of significant response.

    c. The floor response spectra consist of one dominant mode and have a peak at this frequency. The degree of mass or stiffness coupling in the equipment will, in general, determine if a single or multi-axis test is required. Multi-axis testing was required if there is considerable cross coupling. If coupling is very light, then single axis testing is justified; or, if the degree of coupling can be determined, then single axis testing was used with the input sufficiently increased to include the effect of coupling on the response of the equipment.

6. The post-faulted condition operating loads for active Category I pumps was considered identical to the normal plant operating loads. This was assured by requiring that the imposed nozzle loads (steady-state loads) for normal conditions and post-faulted conditions be limited by the magnitudes of the normal condition nozzle loads. Thus, the post-faulted condition ability of the pumps to function under these applied loads was proven during the normal operating plant conditions.

7. Active Category I valves, except check valves, were subjected to a series of stringent tests prior to installation and after installation in the plant. Prior to installation, the following tests were performed: (a) shell hydrostatic test, (b) backseat and main seat leakage tests, (c) disc hydrostatic test, (d) functional tests to verify that the valve will operate within the specified time limits when subjected to the design differential pressure prior to operating, and (e) operability qualification of motor and air operator control valves for the conditions over their installed life (i.e., aging, radiation, accident environment simulation, etc.) in accordance with the requirements of IEEE Standard 382 (see Section 3.11). Cold hydro qualification tests, preoperational tests, hot functional qualification tests, periodic inservice inspections, and periodic inservice operation were performed after installation to verify and assure functional ability of the valves. To the extent practicable, functional tests are performed after installation to verify that the valve will open and/or close in a time consistent with required safety functions.

8. Active Category I valves are designed using either stress analyses or the pressure containing minimum wall thickness requirements. An analysis of the extended structure is performed for static equivalent seismic loads applied at the center of gravity of the extended structure. The maximum stress limits allowed in these analyses confirms structural integrity and were the limits developed and accepted by the ASME for the particular ASME class of valve analyzed. The stress limits used for active Class 2 and 3 valves are given in Table 3.9-19. Class 1 valves were designed according to the rules of the ASME Boiler and Pressure Vessel Code, Section III, NB-3500.

9. Representative active Category I valves of each design type with overhanging structures (i.e., motor or pneumatic operator) were tested for verification of operability during a simulated seismic event by demonstrating operational capabilities within specified limits. The testing is conducted on a representative number of valves. Valves from each of the primary safety-related design types (e.g., motor- operated gate valves) were tested. Valve sizes which cover the range of sizes in service were qualified by the tests and the results were used to qualify all valves within the intermediate range of sizes. Stress and deformation analyses are used to support the interpolation.

   The valve was mounted in a manner which is conservatively representative of a typical plant installation. The valve includes the operator and all appurtenances normally attached to the valve in service. The operability of the valve during a seismic event was verified by satisfying the following requirements:

   a. All active valves are designed to have a first natural frequency which is greater than 33 Hz if practical to do so. This may be shown by suitable test or analysis.

      If the lowest natural frequency of an active valve is less than 33 Hz, the valve's mathematical model is included in the piping dynamic analysis. This assures the calculated valve acceleration does not exceed the values used in the static tests of the manufacturers qualification program and reflects the proper valve dynamic behavior.

   b. The actuator and yoke of the valve system were statically loaded an amount greater than that determined by an analysis as representing the applicable seismic accelerations applied at the center of gravity of the operator alone in the direction of the weakest axis of the yoke. The design pressure of the valve is simultaneously applied to the valve during the static deflection tests.

   c. The valve was operated while in the deflected position, i.e., from the normal operating mode to the faulted operating mode. The valve performed its safety-related function within the specified operating time limits.

   d. Motor operators and other electrical appurtenances necessary for operation were qualified as operable during the seismic event by analysis and/or testing in accordance with the requirements of IEEE Standard 344 (refer to Section 3.9.2.2 for the applicable edition).

The accelerations used for the static valve qualification are 3.0 g horizontal and 2.0 g vertical with the valve yoke axis vertical. The piping designer shall maintain the motor operator accelerations to equivalent levels. If the valve accelerations exceed these levels, an evaluation of the valve is performed to document acceptability on a case-by-case basis.

If the frequency of the valve, by test or analysis, was less than 33 Hz, a dynamic analysis of the valve was performed to determine the equivalent acceleration to be applied during the static test. The analysis provided the amplification of the input acceleration considering the natural frequency of the valve and piping along with the frequency content of the applicable plant floor response spectra. The adjusted accelerations were determined using the same conservatism contained in the accelerations used for "rigid" valves. The adjusted accelerations were then used in the static analysis and the valve operability was assured by the methods outlined in steps (b), (c), and (d) above using the modified acceleration input.

10. The design of each active Category I check valve was such that once the structural integrity of the valve was assured using standard design or analysis methods, the ability of the valve to operate was assured by the design features. In addition to design considerations, each active check valve undergoes:

    a. Stress analysis including the applicable seismic loads

    b. In-shop hydrostatic tests for parts that could affect the operability of the valve,

    c. In-shop seat leakage tests, and

    d. Preoperational and periodic in-situ testing and inspection to assure functional ability of the valves.

11. The design of the pressurizer safety valve (Category I) was such that once the structural integrity of the valves was assured using standard design or analysis methods, the ability of the valve to operate was assured by the design features. In addition to design considerations, the pressurizer safety valve was subjected to:

    a. Stress and/or deformation analyses for parts that could affect the operability of the valve for the applicable seismic loads,

    b. In-shop hydrostatic and seal leakage tests, and

    c. Periodic in-situ valve inspection.

    In addition to these tests, a static load equivalent to the seismic load was applied to the top of the bonnet and the pressure was increased until the valve mechanism actuated. Successful actuation within the design requirements of the valve has been demonstrated.

12. Wherever practicable, prototype test and analytical results are utilized to assure functional adequacy of active Category I pumps and valves and their appurtenances.

3.9.3.3 Design and Installation Details for Mounting of Pressure Relief Devices

The design and installation of pressure relieving devices are consistent with the requirements established by Regulatory Guide 1.67, "Installation of Overpressure Protective Devices."

Each main steam line is provided with one power operated atmospheric relief valve and five safety valves sized in accordance with ASME, B&PV, Section III.

The safety valves are set for progressive relief in intermediate steps of pressure within the allowed range (100% to 105% of the design pressure) of pressure settings to prevent more than one valve actuating simultaneously. The valve pressure settings at which the individual valves open are tabulated in Table 10.1-1 in the column identified as "Set Pressure." The valves are designed to reseat at the pressure values identified in the column "Blowdown Pressure."

Valves are connected to a rigidly supported common header that is in turn connected to the main steam piping through branch piping equal in size to the main steam piping. The header and valves are located immediately outside containment in the main steam valve building.

The safety valves are mounted on the header such that the valves produce torsion, bending, and thrust loads in the header during valve operation. The header has been designed to accommodate both dynamic and static loading effects of all valves blowing down simultaneously.

The stress produced by the following loading effects assumed to act concurrently are within the code allowable.

1. Deadweight effects
2. Thermal loads and movements
3. Seismic loads and movements
4. Safety valve thrust, moments, torque loading[1]
5. Internal pressure

Note 1. The safety valve thrust loads are assumed to occur in the upset plant condition, and do not occur concurrently with an OBE.

The nozzles connecting each valve to the header are analyzed to assure that for both dynamic and static loading situations, the stresses produced in the nozzle wall are within the code allowable for the same loading consideration as the header.

The safety valves and power-operated atmospheric relief valves are Seismic Category I components. They have been seismically qualified by analyses per criteria presented in Section 3.7.3.16 and Table 3.9-19.

Pressure relief valves in auxiliary safety related systems have been installed considering loads carried in the support members produced by:

1. Deadweight of valve and appurtenances,

2. Thermal effects,

3. Seismic effects,

4. Maximum valve thrust, moment, and torque loading effects, and

5. Internal pressure.

Relief valves that discharge to the atmosphere are either rigidly supported by their own individual support, or the nozzle and component to which the valve is attached (vessel, tank, or pipe) has been designed to carry the valve static and dynamic loads. Individual supports have been designed to stress levels in accordance with Section 3.9.3.4.2. Stresses in nozzles and components produced by the valve loads considered above are determined per the method delineated in Welding Research Council Bulletin No. 107 or equivalent and are combined with normal loading operational loads for the component. Relief valves blowing down are considered as an upset loading condition for the plant. Therefore, the allowable stress intensity for the component supporting the valve loads is in accordance with those tabulated in Tables 3.9-2, 3.9-8, 3.9-9, or 3.9-14, as applicable.

Loading associated with relief valves discharging through piping components to a collector tank are analyzed considering the surge effects of the initial discharge through the pipe. This condition is considered as an upset loading condition for the piping components connecting to the valve and the allowable stress intensity is in accordance with those for piping components tabulated in Tables 3.9-8 and 3.9-9.

Pressure relief valves and pertinent operating information for the valves that have been considered in the installation requirements of the valve are tabulated in Table 3.9-20.

As related to the design and installation criteria of pressure relieving devices, Westinghouse interfaces with TVA by providing the following:

1. Overpressure Protection Report[13]. This report documents the compliance for overpressure protection requirements as per the ASME Boiler and Pressure Vessel Code, Section III, NB-7300 and NC-7300, and provides the maximum relieving requirements.

2. Mounting brackets on the pressurizer. These brackets can be used as structural supports, if needed.

3. Criteria and guidelines. Supplementary criteria specifically applicable to the design and fabrication of nuclear plant safety and relief valve installations are provided.

4. Review of system layout and resultant loads for acceptability, where applicable.

3.9.3.4 Component Supports

3.9.3.4.1 Subsystem and Component Supports Analyzed or Specified by Westinghouse

1&2. The criteria for Westinghouse supplied supports for ASME Code Class 1 Mechanical Equipment is presented in Section 5.2.1.10.7.

3. ASME Code - Class 2 and 3 supports are designed as follows:

A. Linear

a. Normal - The allowable stresses of AISC-69 Part 1, a reference basis for Subsection NF of ASME Section III, are employed for normal condition limits.

b. Upset - Stress limits for upset conditions are the same as normal condition stress limits. This is consistent with Subsection NF of ASME Section III (see NF-3320).

c. Emergency - For emergency conditions, the allowable stresses or load ratings are 33% higher than those specified for normal conditions. This is consistent with Subsection NF of ASME Section III in which (see NF-3231) limits for emergency conditions are 33% greater than the normal condition limits.

d. Faulted - Section 5.2.1.10 specifies limits which assure that no large plastic deformations will occur (stress $\leq 1.2S_y$). If any inelastic behavior is considered in the design, detailed justification is provided for this limit. Otherwise, the supports for active components are designed so that stresses are less than or equal to S_y. Thus the operability of active components is not endangered by the supports during faulted conditions.

Welding was in accordance with the American Welding Society, (AWS) "Structural Welding Code," AWS D1.1, with revisions 1-73 and 1-74, except later editions may be used for prequalified joint details, base materials, and qualification of welding procedures and welders. Nuclear Construction Issues Group documents NCIG-01 and NCIG-02 may be used after June 26, 1985, for weldments that were designed and fabricated to the requirements of AISC/AWS. Visual inspection of structural welds will meet the minimum requirements of NCIG-01 and NCIG-02 as specified on the design drawings or other design output. Inspectors performing visual examination to the criteria of NCIG-01 are trained in the subject criteria.

B. Plates and Shells

The stress limits used for ASME Class 2 and 3 plate and shell component supports are identical to those used for the supported component. These allowed stresses are such that the design requirements for the components and the system structural integrity are maintained.

For active Class 2 or 3 pumps, support adequacy was proven by satisfying the criteria in Section 3.9.3.2.1. The requirements consist of both stress analysis and an evaluation of pump/motor support misalignment.

Active valves are, in general, supported only by the pipe attached to the body. Exterior supports on the valve are not used.

3.9.3.4.2 Subsystem and Component Supports Analyzed or Specified by TVA

1. ASME Code Class 1, 2, and 3 Piping Supports

a. Loading Conditions

The following conditions have been assigned for support load evaluation for Watts Bar Nuclear Plant support design (not including pipe whip restraints): normal, upset, emergency, faulted, and test condition. The piping support design loads and combinations are given in Table 3.9-13A.

b. Support Types, Loading Combinations, Stress Limits, and Applicable Codes

1) Linear Supports

The allowed stresses are defined in Table 3.9-21. The load combinations and allowable stresses are based on and exceed the requirements of NRC Regulatory Standard Review Plan, Section 3.9.3. The design load is determined by the condition yielding the most conservative support design.

Welding was in accordance with the American Welding Society, (AWS) "Structural Welding Code," AWS D1.1 with revisions 1-73 and 1-74, except later editions may be used for prequalified joint details, base materials, and qualification of welding procedures and welders. Nuclear Construction Issues Group documents NCIG-01 and NCIG-02 may be used after June 26, 1985, for weldments that were designed and fabricated to the requirements of AISC/AWS. Visual inspection of structural welds will meet the minimum requirements of NCIG-01 and NCIG-02 as specified on the design drawings or other design output. Inspectors performing visual examination to the criteria of NCIG-01 are trained in the subject criteria.

2) Standard Support

The allowable stresses are defined in Table 3.9-21. The load combinations consider all applicable load sources which induce load into the appropriate type support. The design conforms to the requirements of MSS-SP-58, 1967 edition or ASME Boiler and Pressure Vessel Code, Section III, subsection NF.

3) Pre-engineered Support Element

Pre-engineered support elements are defined as standard hardware items such as rods, clamps, clevises, and struts used in the installation of either a linear support or a standard support component.

The design load is determined from the tabulated loads described above for the linear or standard support component. The allowable stresses are given in Table 3.9-21.

c. General Design Requirements

1) The gravitational or actual loads are considered to consist of pipe, fittings, pipe covering, contents of pipe systems, and valves.

2) All thermal modes of operation are considered in load evaluation. Thermal loads are not considered to relieve primary loads induced by gravity, other sustained loads, or seismic events.

3) Installation tolerances are not considered a source of load reduction unless special installation requirements are required.

4) The required movement in unrestrained directions for the line being supported is tabulated in the table of support loads. The support design is arranged to accommodate this required movement of the piping. Hangers are designed in such a manner that they cannot become disengaged by any movement of the supported pipe.

5) If ASME Code Case N-318-3 is used in the design of integral welded attachments to the piping pressure boundary, the requirements of Regulatory Guide 1.84 are documented in TVA calculations.

d. Deformation Limits

Pipe support stiffness/deflection limitations are required for seismic Category I.

The following criteria are used for support stiffness requirements:

1) All pipe support structural steel, except as described below, was designed to limit the maximum deflection to 0.0625" (based on the greater of the seismic/dynamic load components of the upset or faulted loading conditions, or based on the minimum design load). In addition, the maximum deflection is limited to 0.125" (based on the total design load). These analyses were performed independently for each restrained direction (axis) at the point of load application.

2) The first dynamic support in each lateral direction adjacent to strain sensitive equipment (i.e., pump, compressor or turbine nozzle) is designed to limit the maximum deflection to 0.0625" (based on the total design load). This analysis was performed independently for each restrained direction (axis) at the point of load application.

3) Except for the unbraced cantilevers, baseplate rotation or deflection due to baseplate flexibility are considered insignificant and, therefore, are not considered. Anchor bolt stiffness is not considered for this evaluation.

4) For supports with a common member (i.e., gang supports) the deflection at the point under consideration due to the simultaneous application of each pipe's dead weight and thermal loads added algebraically are evaluated to determine the maximum deflection for both the hot and cold pipe conditions. The deflection at the point under consideration resulting from the simultaneous application of each pipe's dynamic loads is determined by SRSS method. The total deflection due to dead weight plus thermal, and dynamic loads is evaluated based on absolute summation of the two deflections calculated above.

5) Support components carrying load primarily in axial tension or compression meet the requirements for stiffness without further evaluation. Also, the stiffness/deflection limitations do not apply in the unrestrained support direction (i.e., due to friction loads).

6) Component standard support elements are considered rigid and therefore, no stiffness/deflection evaluation is necessary except as provided in approved design standards.

7) Higher deflection limits may be used if justified on a case-by-case basis.

e. <u>Considerations for the Faulted Condition</u>

Table 3.9-21 identifies the allowed stresses associated with the faulted condition. The faulted load conditions, represented by postulated pipe whip and jet impingement, were evaluated as described in Section 3.6 for all systems, piping, equipment, and structures shown on issued TVA drawings. Piping, systems, pipe supports and other structures that are the targets of postulated pipe whip or jet impingement may require protection to assure safe plant shutdown. This protection is provided by evaluation on a case-by-case basis.

For evaluation of field routed piping or other field located equipment a different method was used. For these cases, a minimum allowable separation method was used for screening piping systems, conduit, and instrument lines to assure that adequate separation exists between these systems and postulated breaks or through-wall leakage cracks in fluid piping. Where adequate separation is not available, piping is relocated, supports were strengthened, supports added, or mitigative devices are provided to prevent unacceptable loads.

Piping and supports subjected to a jet force from a break in piping of equal or less nominal size and wall thickness are assumed to receive no unacceptable damage, provided the target piping and supports were designed in accordance with accepted codes; i.e. ASME Section III, ANSI B31.1, AISC, etc.

f. Results

The design information for pipe supports of systems analyzed by TVA was tabulated on tables of support design loads and included in the problem file as indicated in Section 3.9.3.1.2.

2. Mechanical Equipment and Component Supports

TVA-designed supports for Category I equipment and components satisfy the AISC allowable stress limits described in Section 3.8.4.5.2 and the stiffness requirements described in Section 3.7.3.16.5. Valve actuator supports were designed as pipe supports. Valve actuator tiebacks have special stiffness requirements to limit valve extended, structure stresses under load.

Vendor-supplied equipment and component supporting structures that were provided as part of the equipment assembly, were seismically qualified as part of the equipment package. This qualification is described in Section 3.9.3.1.2.

3.9.4 Control Rod System

3.9.4.1 Descriptive Information of CRDS

Refer to Section 4.2.3.

3.9.4.2 Applicable CRDS Design Specifications

Refer to Sections 4.2.3.1.4 and 4.2.3.2.2.

3.9.4.3 Design Loadings, Stress Limits, and Allowable Deformations

Refer to Section 4.2.3.3.1.

3.9.4.4 CRDS Performance Assurance Program

Refer to Section 4.2.3.4.2.

3.9.5 Reactor Pressure Vessel Internals

3.9.5.1 Design Arrangements

For verification that changes in design from those in previously licensed plants of similar design do not affect the flow-induced vibration behavior, refer to Section 3.9.2.3.

3.9.5.2 Design Loading Conditions

Refer to Section 4.2.2.3.

3.9.5.3 Design Loading Categories

Refer to Section 4.2.2.4.

3.9.5.4 Design Basis

Refer to Section 4.2.2.5.

3.9.6 Inservice Testing of Pumps and Valves

For Unit 1, inservice testing of ASME Code Class 1, 2, and 3 pumps and valves will be conducted to the extent practical in accordance with the 2001 Edition of the ASME OM Code with Addenda through 2003, as required by 10 CFR 50.55a(f). For Unit 2, inservice testing of ASME Code Class 1, 2, and 3 pumps and valves will be conducted to the extent practical in accordance with the 2004 Edition through 2006 addenda of the ASME OM Code[25], as required by 10 CFR 50.55a(f). Since the Watts Bar piping systems were designed before the Code was issued, some valves and pump parameters cannot be tested in accordance with the ASME OM Code. These exceptions have been noted in the Inservice Testing Program submittal made to NRC.

The following safety-related pumps will be tested:

1. Centrifugal Charging Pumps
2. Safety Injection Pumps
3. Residual Heat Removal Pumps
4. Containment Spray Pumps
5. Component Cooling System Circulation Pumps
6. Auxiliary Feedwater Pumps
7. Essential Raw Cooling Water Pumps
8. Boric Acid Transfer Pumps
9. ERCW Screenwash Pumps
10. Main Control Room Chilled Water Pumps
11. Electrical Board Room Chilled Water Pumps
12. Shutdown Board Room Chilled Water Pumps

Table 3.9-26 is a tabulation of the various category valves in each of the systems.

REFERENCES

1. "Documentation of Selected Westinghouse Structural Analysis Computer Codes", WCAP-8252, April 1977.

2. WCAP-8317-A, "Prediction of the Flow-Induced Vibration of Reactor Internals by Scale Model Tests," March 1974.

3. WCAP-8517, "UHI Plant Internals Vibration Measurement Program and Pre and Post Hot Functional Examinations," March 1975.

4. WCAP-7879, "Four Loop PWR Internals Assurance and Test Program," July 1972.

5. Trojan Final Safety Analysis Report, Appendix A-12.

6. Fabic, S., "Description of the BLODWN-2 Computer Code," WCAP-7918, Revision 1, October 1970.

7. Fabic, S., "Computer Program WHAM for Calculation of Pressure Velocity, and Force Transients in Liquid Filled Piping Networks, "Kaiser Engineers Report No. 67-49-R, November 1967.

8. Bohn, G. J., "Indian Point Unit No. 2 Internals Mechanical Analysis for Blowdown Excitation," WCAP-7332-AR-P. November, 1973 (Proprietary) and WCAP-7822-AR, November, 1973 (Non-Proprietary)

9. Bohm, G. J. and LaFaille, J. P., "Reactor Internals Response Under a Blowdown Accident," First Intl. Conf. on Structural Mechanics in Reactor Technology, Berlin, September 20-24, 1971.

10. "Bench Mark Problem Solutions Employed for Verification of WECAN Computer Program", WCAP-8929, June 1977.

11. WCAP-11627, "Upflow Conversion Safety Evaluation Report - Watts Bar Units 1 & 2," September 1987.

12. Letter from Peter S. Tam, NRC, to M. O. Medford, TVA, "Watts Bar Nuclear Plant - Upflow Conversion Modification to Reactor Internals (TAC M85802 & M85803)", dated July 28, 1993.

13. WCAP-7769, “Topical Report Overpressure Protection for Westinghouse Pressurized Water Reactors,” Revision 1, June, 1972.

14. WCAP-8708-PA (Westinghouse Proprietary), WCAP-8709-A (Non-Proprietary), “MULTIFLEX A FORTRAN Computer Program for Analyzing Thermal-Hydraulic Structure System Dynamics,” Takeuchi, K., et al., September 1977.

15. WCAP-15029-P-A/WCAP-15030-NP-A, “Westinghouse Methodology for Evaluating the Acceptability of Baffle-Former-Barrel Bolting Distribution Under Faulted Load Conditions,” R. E. Schwirian, et al., January 1999.

16. WCAP-15245 (Proprietary)/WCAP-15246 (Non-Proprietary), “Control Rod Insertion Following a Cold Leg LBLOCA, D. C, Cook Units 1 and 2,” J. A. Barsic, D. C. Garner, Y. C. Lee, K. B. Neubert, C. Yu, February 28, 1999.

17. WCAP-11004-P/WCAP-11005 (NP), “Comparison of DATA for Beaver Valley Power Station Unit 2 with WCAP-9735 Data, Prepared for NRC Review in Conjunction with Review of WCAP-9735, Docket No. 50-412,” D. R. Bhandari, K. Takeuchi, M. E. Wills, November 1985.

18. WCAP-11522 (Proprietary)/WCAP-11523 (Non-Proprietary), “Response to NRC Questions on the LOCA Hydraulic Forces Analysis of the Beaver Valley Power Station Unit 2, Prepared for NRC Review in Conjunction with Review of WCAP-9735, Docket No. 50-412,” D. C. Garner, M. P. Kachmar, M. R. Wengerd, June 1987.

19. DELETED AMENDMENT 11

20. Fritz, R. J., “The Effects of Liquids on the Dynamic Motions of Immersed Solids,” Trans. ASME, Journal of Engineering for Industry, 1972, pp. 167-173.

21. WCAP-5890, Revision 1, “Ultimate Strength Criteria to Ensure No Loss of Function of Piping and Vessel Under Seismic Loading,” October 1967.

22. Watts Bar Reload Transition Safety Report, Westinghouse’s Letter to TVA dated December 13, 2002.

23. WCAP-7332-L-AR, “Topical Report – Indian Point Unit 2 Reactor Internals Mechanical Analysis for Blowdown Excitations,” November 1973.

24. WCAP-15102 Volume 2, "Electricite de France 1300 Mwe Plants Reactor Internals Functional Criteria," December 1997.

25. TVA to NRC letter dated May 8, 2014, "Watts Bar Nuclear Plant (WBN) Unit 2 - Inservice Test (IST) Program/Preservice Test (PST) Program."

TABLE 3.9-1

DESIGN LOADING COMBINATIONS FOR ASME CODE CLASS 2 AND 3 COMPONENTS AND SUPPORTS ANALYZED BY WESTINGHOUSE, (EXCLUDING PIPE SUPPORTS) (A)

Condition Classification	Loading Combination (B, C)
Design and Normal	Design pressure Design temperature, Dead weight, nozzle loads
Upset	Upset condition pressure, Upset condition metal temperature, deadweight, OBE, nozzle loads
Emergency	Emergency condition pressure, emergency condition metal temperature, deadweight, nozzle loads
Faulted	Faulted condition pressure, faulted condition metal temperature, deadweight, SSE, nozzle loads

(A) The responses for each loading combination are combine using the absolute sum method. On a case-by-case basis, algebraic summation may be used when signs are known for final design evaluations.

(B) Temperature is used to determine allowable stress only.

(C) Nozzle loads are those loads associated with the particular plant operating conditions for the component under consideration.

TABLE 3.9-2

STRESS CRITERIA FOR SAFETY RELATED ASME
CLASS 2 AND 3 TANKS ANALYZED BY WESTINGHOUSE

Condition	Stress Limits
Design and Normal	$[_m \leq 1.0$ S $([_m$ or $[_L) + [_b \leq 1.5$ S
Upset	$[_m \leq 1.1$ S $([_m$ or $[_L) + [_b \leq 1.65$ S
Emergency	$[_m \leq 1.5$ S $([_m$ or $[_L) + [_b \leq 1.8$ S
Faulted	$[_m \leq 2.0$ S $([_m$ or $[_L) + [_b \leq 2.4$ S

TABLE 3.9-3

STRESS CRITERIA FOR CATEGORY I ASME CODE CLASS 2 AND CLASS 3
NONACTIVE PUMPS AND PUMP SUPPORTS ANALYZED BY WESTINGHOUSE

Condition	Stress Limits*	Pmax**
Design and Normal	&m ≤ 1.0 S (&m or &L) + &b ≤ 1.5 S	1.0
Upset	&m ≤ 1.1 S (&m or &L) + &b ≤ 1.65 S	1.1
Emergency	&m ≤ 1.5 S (&m or &L) + &b ≤1.80 S	1.2
Faulted	&m ≤ 2.0 S (&m or &L) + &b ≤ 2.4 S	1.5

* Stress limits are taken from ASME III, Subsections NC and ND, or, for pumps procured prior to the incorporation of these limits into ASME III, from Code Case 1636-1.

** The maximum pressure shall not exceed the tabulated factors listed under Pmax times the design pressure.

TABLE 3.9-4 (SHEET 1 of 2)

STRESS CRITERIA FOR SAFETY RELATED ASME CODE CLASS 2
AND CLASS 3 VALVES ANALYZED BY WESTINGHOUSE

Condition	Stress Limits (Notes 1-6)	P_{max} (Note 7)
Design & Normal	Valve bodies shall conform to the requirements of ASME Section III, NC-3500 (or ND-3500)	
Upset	$[_m \leq 1.1\ S$ $([_m \text{ or } [_L) + [_b \leq 1.65\ S$	1.1
Emergency	$[_m \leq 1.5\ S$ $([_m \text{ or } [_L) + [_b \leq 1.80\ S$	1.2
Faulted	$[_m \leq 2.0\ S$ $([_m \text{ or } [_L) + [_b \leq 2.4\ S$	1.5

Notes:

1. Valve nozzle (piping load) stress analysis is not required when both the following conditions are satisfied by calculation: (1) section modulus and area of a plane, normal to the flow, through the region of valve body crotch is at least 10% greater than the piping connected (or joined) to the valve body inlet and outlet nozzles; and, (2) code allowable stress, S, for valve body material is equal to or greater than the code allowable stress, S, of connected piping material. If the valve body material allowable stress is less than that of the connected piping, the valve section modulus and area as calculated in (1) above shall be multiplied by the ratio of S pipe/S valve. If unable to comply with this requirement, the design by analysis procedure of NB-3545.2 is an acceptable alternate method.

2. Casting quality factor of 1.0 shall be used.

3. These stress limits are applicable to the pressure retaining boundary, and include the effects of loads transmitted by the extended structures, when applicable.

4. Design requirements listed in this table are not applicable to valve discs, stems, seat rings, or other parts of valves which are contained within the confines of the body and bonnet, or otherwise not part of the pressure boundary.

TABLE 3.9-4 (SHEET 2 of 2)

STRESS CRITERIA FOR SAFETY RELATED ASME CODE CLASS 2
AND CLASS 3 VALVES ANALYZED BY WESTINGHOUSE (Cont'd)

Notes (continued):

5. These rules do not apply to Class 2 and 3 safety relief valves. Safety relief valves are designed in accordance with ASME Section III requirements.

6. Stress limits are taken from ASME III, Subsections NC and ND, or, for valves procured prior to the incorporation of these limits into ASME III, from Code Case 1635-1.

7. The maximum pressure resulting from upset, emergency or faulted conditions shall not exceed the tabulated factors listed under Pmax times the design pressure or the rated pressure at the applicable operating condition temperature. If the pressure rating limits are met at the operating conditions, the stress limits in Table 3.9-4 are considered to be satisfied.

TABLE 3.9-5

INTERNALS DEFLECTIONS UNDER ABNORMAL OPERATION (in) [1,2,3,4]

		Allowable Limit	No Loss-of-Function Limit
Upper Barrel, Expansion/Compression (to ensure sufficient inlet flow area/ and to prevent the barrel from touching any guide tube to avoid disturbing the rod cluster control guide structure)	Inward	4.1	8.2
	Outward	1.0	1.0
Upper Package, Axial Deflection (to maintain the control rod guide structure geometry)[3,4]		0.100	0.150
Rod Cluster Control Guide Tube Deflection As a Beam (to be consistent with conditions under which ability to trip has been tested)[4]		1.0	1.75
Fuel Assembly Thimbles Cross-Section Distortion (to avoid interference between the Control Rods and the guides)[4]		0.036	0.072

Notes:

1. The allowable limit deflection values given above correspond to stress levels for internals structure well below the limiting criteria given by the collapse curves in WCAP-5890.[21] Consequently, for the internals the geometric limitations established to ensure safe shutdown capability are more restrictive than those given by the failure stress criteria.

2. All dimensions in inches.

3. See Reference [22].

4. See Reference [23].

*Only to assure that the plate will not touch a guide tube. (Unit 2 only)

TABLE 3.9-6

DESIGN CRITERIA FOR ACTIVE PUMPS AND PUMP SUPPORTS
ANALYZED BY WESTINGHOUSE

Condition	Design Criteria[1]
Design, Normal and Upset	$\sigma_m \leq 1.0$ S $\sigma_m + \sigma_b \leq 1.5$ S
Emergency	$\sigma_m \leq 1.2$ S $\sigma_m + \sigma_b \leq 1.65$ S
Faulted	$\sigma_m \leq 1.2$ S $\sigma_m + \sigma_b \leq 1.8$ S

Note:

(1) The stress limits specified for active pumps are more restrictive than the ASME III limits, to provide assurance that operability will not be impaired for any operating condition.

TABLE 3.9-7

LOAD SOURCES

Load	Description
BUILDING SETTLEMENT	Predicted or Measured Settlement of the Building
DBA	Design Basis Accident Loading
DEADWEIGHT	Weight of Pipe, Insulation, and Fluid
FLUID TRANSIENTS	Transient Loads Due to Valve Operation, Water Hammer
LOCA	Reactor Coolant Loop Movements Due to Loss of Coolant Accident
OBE	Operating Basis Earthquake
PRESSURE	Internal (or External) Pressure in Pipe
SAM	Seismic Anchor Motions
SSE	Safe Shutdown Earthquake
THERMAL	Operating Temperature, Environmental Temperature, Thermal Anchor Movements
VALVE THRUST	Relief Valve Discharge Thrust Loads
PIPE RUPTURE	Jet Impingement and Pipe Whip Loads

TABLE 3.9-8 (SHEET 1 of 2)

LOADING CONSTITUENTS AND STRESS LIMITS
FOR ASME CLASS 1 PIPING

CONDITION	LOADING CONSTITUENTS[1]	STRESS LIMIT	NB-3650 EQUATION[2]	NOTES
PRIMARY STRESS				
DESIGN (Normal & Upset)	PRESSURE, DEADWEIGHT, OTHER SUSTAINED LOADS, OBE INERTIA, VALVE THRUST, FLUID TRANSIENTS	$1.5S_m$	9	
EMERGENCY	PRESSURE, DEADWEIGHT, OTHER SUSTAINED LOADS, OBE INERTIA, VALVE THRUST, FLUID TRANSIENTS	$2.25S_m$	9	
FAULTED	PRESSURE, DEADWEIGHT, OTHER SUSTAINED LOADS SSE INERTIA, VALVE THRUST, FLUID TRANSIENTS, DBA INERTIA, LOCA, PIPE RUPTURE	$3.0S_m$	9	5
PRIMARY AND SECONDARY STRESS				
NORMAL & UPSET	PRESSURE, THERMAL, THERMAL ANCHOR MOVEMENT, THERMAL LINEAR GRADIENT, THERMAL DISCONTINUITY, VALVE THRUST, FLUID TRANSIENT, OBE, OBE SAM	$3.0S_m$	0	3
	PRESSURE, THERMAL, THERMAL ANCHOR MOVEMENT, THERMAL NONLINEAR GRADIENT, THERMAL LINEAR GRADIENT, THERMAL DISCONTINUITY, VALVE THRUST, FLUID TRANSIENT, OBE, OBE SAM		11	4,8
	THERMAL, THERMAL ANCHOR MOVEMENTS	$3.0S_m$	12	3

TABLE 3.9-8 (SHEET 2 of 2)

LOADING CONSTITUENTS AND STRESS LIMITS
FOR ASME CLASS 1 PIPING

CONDITION	LOADING CONSTITUENTS[1]	STRESS LIMIT	NB-3650 EQUATION[2]	NOTES
PRIMARY AND SECONDARY STRESS (continued)				
NORMAL & UPSET	PRESSURE, DEADWEIGHT, OTHER SUSTAINED LOADS, OBE INERTIA, VALVE THRUST, FLUID TRANSIENTS, THERMAL DISCONTINUITY	$3.0S_m$	13	3
TESTING	PRESSURE	$0.9S_y$		7,8
	PRESSURE, DEADWEIGHT, OTHER SUSTAINED LOADS	$1.35S_y$		
PRESSURE DESIGN		PRESSURE LIMITS		
DESIGN	DESIGN PRESSURE	P_a		6
UPSET	Max. Service PRESSURE	P_a		6
EMERGENCY	Max. Service PRESSURE	$1.5P_a$		6
FAULTED	Max. Service PRESSURE	$2.0P_a$		6

NOTES

1. Loads which are not concurrent need not be combined.
2. All references are for ASME Code, Subsection NB for Class 1 piping.
3. If the requirements of equation 10 are not met, then the requirements of equations 12 & 13 must be met.
4. Salt for all load sets are calculated per NB-3653.3 and then, the cumulative usage factor per NB-3653.4 and NB-3653.5. The cumulative usage factor shall not exceed 1.0.
5. The design measures taken to protect against pipe rupture loads and the evaluation of these loads is described in Section 3.6.
6. The maximum allowable internal pressure value Pa is calculated per NB-3640, 3655 and 3656.
7. The testing limits are per NB-3226.
8. If there are more than 10 hydrostatic, pneumatic or other tests, then such extra tests shall be included in the fatigue evaluation of the component.

TABLE 3.9-9 (SHEET 1 of 2)

LOADING CONSTITUENTS AND STRESS LIMITS
FOR CATEGORY I ASME CLASS 2 AND 3 PIPING

CONDITION	LOADING CONSTITUENTS[1]	STRESS LIMIT	NC-3652 EQUATION[2]	NOTES
NORMAL	PRESSURE, DEADWEIGHT, OTHER SUSTAINED LOADS	$1.0\ S_h$	8	
UPSET	PRESSURE, DEADWEIGHT, OTHER SUSTAINED LOADS, OBE INERTIA, VALVE THRUST, FLUID TRANSIENTS	$1.2S_h$	9	4
EMERGENCY	PRESSURE, DEADWEIGHT, OTHER SUSTAINED LOADS, OBE INERTIA, VALVE THRUST, FLUID TRANSIENTS	$1.8S_h$	9	
FAULTED	PRESSURE, DEADWEIGHT, OTHER SUSTAINED LOADS, SSE INERTIA, VALVE THRUST, FLUID TRANSIENTS, DBA INERTIA, LOCA, PIPE RUPTURE	$2.4S_h$	9	5
SECONDARY				
EXPANSION	THERMAL, OBE SAM	S_A	10	3,4
PRESSURE + SUSTAINED + EXPANSION	PRESSURE, DEADWEIGHT, OTHER SUSTAINED LOADS, THERMAL, OBE SAM	S_A+S_h	11	3,4
ONE TIME SECONDARY	BUILDING SETTLEMENT, DBA SCV MOVEMENT COLD SPRING	$3.0S_c$ $0.5(S_A + S_h)$	10A NA	

TABLE 3.9-9 (SHEET 2 of 2)

LOADING CONSTITUENTS AND STRESS LIMITS
FOR CATEGORY I ASME CLASS 2 AND 3 PIPING

CONDITION	LOADING CONSTITUENTS(1)	STRESS LIMIT	NC-3652 EQUATION2	NOTES
TEST	PRESSURE, DEADWEIGHT, OTHER SUSTAINED LOADS	$1.2S_h$	NA	
TEST	PRESSURE, DEADWEIGHT, THERMAL, OTHER SUSTAINED LOADS	S_A+S_h	NA	

NOTES

1. Loads which are not concurrent need not be combined.

2. All references are for ASME Code, Subsection NC for Class 2 piping. The corresponding equations in ASME Code Subsection ND for Class 3 should be used as applicable.

3. The requirements of either Equation 10 or Equation 11 must be met.

4. The effects of OBE Seismic Anchor Movements may be excluded from Equations 10 and 11 if they are included in Equation 9 Upset.

5. The design measures taken to protect against pipe rupture loads and the evaluation of these loads is described in Section 3.6.

TABLE 3.9-10

LOADING CONSTITUENTS AND STRESS LIMITS
FOR ACTIVE VALVE EVALUATION

LOADING CONSTITUENTS[1]	STRESS LIMIT[3]
PRESSURE, DEADWEIGHT, OTHER SUSTAINED LOADS, THERMAL, SSE INERTIA, SSE SAM, VALVE THRUST, FLUID TRANSIENTS, DBA INERTIA, LOCA, PIPE RUPTURE[2]	$0.76S_y$[4] $1.0S_y$[4] (for swing check valves)

NOTES

(1) Loads which are not concurrent need not be combined.

(2) The design measures taken to protect against pipe rupture loads and the evaluation of these loads are described in Section 3.6.

(3) The stress is calculated using the section modulus of the attached pipe.

(4) The value of pipe yield stress, S_y, in this table is determined from the code of record for piping analysis (reference Section 3.7.3.8.1).

TABLE 3.9-11
TABLE 3.9-12

DELETED

TABLE 3.9-13A

DESIGN LOADS FOR CATEGORY I PIPING SUPPORTS

CONDITION	LOADING CONSTITUENTS[1]	NOTES
NORMAL	DEADWEIGHT, OTHER SUSTAINED, LOADS, THERMAL, COLD SPRING BUILDING SETTLEMENT	
UPSET	DEADWEIGHT, OTHER SUSTAINED LOADS, THERMAL, OBE INERTIA, OBE SAM, VALVE THRUST, FLUID TRANSIENTS, COLD SPRING	
EMERGENCY	DEADWEIGHT, OTHER SUSTAINED LOADS, THERMAL, OBE INERTIA, OBE SAM, VALVE THRUST, FLUID TRANSIENTS, COLD SPRING	
FAULTED	DEADWEIGHT, OTHER SUSTAINED LOADS, THERMAL, SEE INERTIA, SSE SAM, VALVE THRUST, FLUID TRANSIENTS, DBA INERTIA, LOCA, PIPE RUPTURE,COLD SPRING	2
TEST	DEADWEIGHT, OTHER SUSTAINED LOADS, THERMAL, COLD SPRING	

NOTES:

1. Loads which are not concurrent need not be combined.

2. The design measures taken to protect against pipe rupture loads and the evaluation of these loads is described in Section 3.6.

TABLE 3.9-13B

DESIGN LOADING COMBINATIONS FOR CATEGORY I ASME CODE CLASS 2 AND 3 LINE MOUNTED*** COMPONENTS AND COMPONENT SUPPORTS ANALYZED BY TVA

Condition Classification	Loading Combination
Design and Normal	Design pressure Design temperature* Dead weight, nozzle loads,** Operating Loads
Upset	Upset condition pressure, Upset condition metal temperature*, deadweight, OBE, nozzle loads,** Operating Loads
Emergency	Emergency condition pressure, emergency condition metal temperature*, deadweight, OBE, nozzle loads,** Operating Loads
Faulted	Faulted condition pressure, faulted condition metal temperature*, deadweight, SSE, nozzle loads,** Operating Loads, DBA

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* Temperature is used to determine allowable stress only.

** Nozzle loads are those loads associated with the particular plant operating conditions for the component under consideration.

*** Line-mounted component (valve) design load combinations correspond to the attached piping load combinations for normal, upset, emergency, and faulted conditions.

TABLE 3.9-14

STRESS CRITERIA FOR CATEGORY I
ASME CLASS 2 AND CLASS 3 TANKS ANALYZED BY TVA

Condition	Stress Limits[1]	P_{max}[2]
Design and Normal	$P_m \leq 1.0\ S_h$ $(P_m \text{ or } P_L) + P_b \leq 1.5\ S_h$	1.0
Upset	$P_m \leq 1.1\ S_h$ $(P_m \text{ or } P_L) + P_b \leq 1.65\ S_h$	1.1
Emergency	$P_m \leq 1.5\ S_h$ $(P_m \text{ or } P_L) + P_b \leq 1.8\ S_h$	1.2
Faulted	$P_m \leq 2.0\ S_h$ $(P_m \text{ or } P_L) + P_b \leq 2.4\ S_h$	1.5

Pm, PL, Pb, and Sh are as defined in Table 3.9-18.

NOTES

(1) The stress allowable values given above were permitted for design, evaluation, and modification activities. As an alternative, a simplified approach was also permitted. By the alternative approach, in addition to meeting the applicable design condition requirements, the tank was analyzed for the faulted condition and tank stresses were limited to 1.2 times the applicable ASME code design/normal condition primary stress allowables.

(2) The maximum pressure was not permitted to exceed the tabulated factors listed under P_{max} times the design pressure.

TABLE 3.9-15

STRESS CRITERIA FOR CATEGORY I ASME CODE CLASS 2 AND CLASS 3 NONACTIVE PUMPS ANALYZED BY TVA

Condition	Stress Limits[(2)]	P_{max}[(1)]
Design and Normal	$P_m \leq 1.0\ S_h$ $(P_m \text{ or } P_L) + P_b \leq 1.5\ S_h$	1.0
Upset	$P_m \leq 1.1\ S_h$ $(P_m \text{ or } P_L) + P_b \leq 1.65\ S_h$	1.1
Emergency	$P_m \leq 1.5\ S_h$ $(P_m \text{ or } P_L) + P_b \leq 1.8\ S_h$	1.2
Faulted	$P_m \leq 2.0\ S_h$ $(P_m \text{ or } P_L) + P_b \leq 2.4\ S_h$	1.5

P_m, P_L, P_b, and S_h are as defined in Table 3.9-18.

Notes:

(1) The maximum pressure was not permitted to exceed the tabulated factors listed under P_{max} times the design pressure.

(2) The stress allowable values given above were permitted for design, evaluation, and modification activities. As an alternative, a simplified approach was permitted for pumps procured prior to September 1, 1974. By this alternative approach, in addition to meeting applicable ASME code design condition requirements, the pump was analyzed for the faulted condition and pump stresses were limited to 1.2 times the applicable ASME code design/normal condition primary stress allowables.

TABLE 3.9-16 (SHEET 1 of 2)

STRESS CRITERIA FOR CATEGORY I ASME CODE CLASS 2 AND CLASS 3 NONACTIVE VALVES ANALYZED BY TVA

Condition	Stress Limits (Notes 1-6)	Pmax(note 7)
Design and Normal	Pm = Sh (Pm or PL) + Pb = 1.5 Sh	1.0
Upset	Pm=1.1 Sh (Pm or PL) + Pb = 1.65 Sh	1.1
Emergency	Pm = 1.5 Sh (Pm or PL) + Pb = 1.8 Sh	1.2
Faulted	Pm =2.0 Sh (Pm or PL) + Pb = 2.4 Sh	1.5

Pm, PL, Pb, and Sh are as defined in Table 3.9-18.

Notes:

1. Valve nozzle (Piping load) stress analysis is not required when both the following conditions are satisfied by calculation: (1) section modulus and area of a plane, normal to the flow, through the region of valve body crotch is at least 10% greater than the piping connected (or joined) to the valve body inlet and outlet nozzles; and, (2) code allowable stress, S, for valve body material is equal to or greater than the code allowable stress, S, to connected piping material. If the valve body material allowable stress is less than that of the connected piping, the valve section modulus and area as calculated in (1) above shall be multiplied by the ratio of Spipe/Svalve. If unable to comply with this requirement, the design by analysis procedure of NB-3545.2 is an acceptable alternate method.

2. Casting quality factor of 1.0 shall be used.

3. These stress limits are applicable to the pressure retaining boundary, and include the effects of loads transmitted by the extended structures, when applicable. Non-pressure boundary components are evaluated against the stress limits of AISC or other justifiable reference. The 33% increase permitted by AISC for abnormal loads is applicable for upset, emergency and faulted conditions.

4. Design requirements listed in this table are not applicable to valve discs, stems, seat rings, or other parts of valves which are contained within the confines of the body and bonnet, or otherwise not part of the pressure boundary.

5. These rules do not apply to Class 2 and 3 safety relief valves. Safety relief valves are designed in accordance with ASME Section III requirements.

TABLE 3.9-16 (SHEET 2 of 2)

STRESS CRITERIA FOR CATEGORY I ASME CODE CLASS 2
AND CLASS 3 NONACTIVE VALVES ANALYZED BY TVA

6. The stress allowable values given above were permitted for design, evaluation, and modification activities. As an alternative, a simplified approach was permitted for valves procured prior to September 1, 1974. By this alternative approach, in addition to meeting the applicable ASME code design condition requirements, the valve was analyzed or tested per IEEE 344-1971 requirements for the faulted condition. When qualified by analysis using this alternative, the valve stresses were limited to 1.2 times the applicable ASME code design/normal condition primary stress allowables and the valve extended structure stresses were limited to 1.33 times the AISC code normal stress allowables.

7. The maximum pressure resulting from upset or faulted conditions shall not exceed the tabulated factors listed under Pmax times the design pressure or the rated pressure at the applicable operating condition temperature. If the pressure rating limits are met at the operating conditions, the stress limits in this table are considered to be satisfied.

TABLE 3.9-17 (Sheet 1 of 7)
UNIT 1

ACTIVE VALVES FOR PRIMARY FLUID SYSTEMS

System Name	TVA Valve No.	W Valve No.	Size Inches	Actuation	Type	Function/Description
Chemical and Volume Control System (62)	FCV-62-61	8112	4	Motor	Gate	Containment Isolation
	FCV-62-63	8100	4	Motor	Gate	Containment Isolation
	FCV-62-69	LCV-460	3	Air	Globe	Letdown Isolation
	FCV-62-70	LCV-459	3	Air	Globe	Letdown Isolation
	FCV-62-72	8149A	2	Air	Globe	Containment Isolation
	FCV-62-73	8149B	2	Air	Globe	Containment Isolation
	FCV-62-74	8149C	2	Air	Globe	Containment Isolation
	FCV-62-77	8152	2	Air	Globe	Containment Isolation
	FCV-62-84	8145	3	Air	Globe	Aux Spray Isolation
	FCV-62-90	8105	3	Motor	Gate	ECCS Flowpath Integrity
	FCV-62-91	8106	3	Motor	Gate	ECCS Flowpath Integrity
	FCV-62-76	8306A	2	Air	Globe	Containment Isolation
	LCV-62-132	LCV-112B	4	Motor	Gate	CVCS Charging Pump Suction
	LCV-62-133	LCV-112C	4	Motor	Gate	CVCS Charging Pump Suction
	LCV-62-135	LCV-112D	8	Motor	Gate	CVCS Charging Pump Suction
	LCV-62-136	LCV-112E	8	Motor	Gate	CVCS Charging Pump Suction
	CKV-62-504	8546	8	Self Actuated	Check	CVCS Charging Pump Suction
	RFV-62-505	8124	3/4	Self Actuated	Relief	CCP Suction Relief Valve
	CKV-62-543[1]	8381	3	Self Actuated	Check	Containment Isolation
	CKV-62-560[1]	8368A	2	Self Actuated	Check	Containment Isolation
	CKV-62-561[1]	8368B	2	Self Actuated	Check	Containment Isolation
	CKV-62-562[1]	8368C	2	Self Actuated	Check	Containment Isolation
	CKV-62-563[1]	8368D	2	Self Actuated	Check	Containment Isolation
	CKV-62-576	8367A	2	Self Actuated	Check	CCP Discharge Header Integrity
	CKV-62-577	8367B	2	Self Actuated	Check	CCP Discharge Header Integrity
	CKV-62-578	8367C	2	Self Actuated	Check	CCP Discharge Header Integrity
	CKV-62-579	8367D	2	Self Actuated	Check	CCP Discharge Header Integrity
	CKV-62-638	8557	3	Self Actuated	Check	Normal Charging Isolation
	1-CKV-62-639	---	¾	Self Actuated	Check	Seal Water 1-FCV-62-61 Bypass
	CKV-62-640	8556	3	Self Actuated	Check	Alternate Charging Isolation
	1-RFV-62-649	---	2	Self Actuated	Relief	Seal Water Hx Relief Valve

TABLE 3.9-17 (Sheet 2 of 7)
UNIT 1

ACTIVE VALVES FOR PRIMARY FLUID SYSTEMS

System Name	TVA Valve No.	W Valve No.	Size Inches	Actuation	Type	Function/Description
	CKV-62-659	8378	3	Self Actuated	Check	Normal Charging Isolation
	CKV-62-660	8379	3	Self Actuated	Check	Alternate Charging Isolation
	CKV-62-661	8377	3	Self Actuated	Check	Auxiliary Spray Isolation
	CKV-62-525	8481A	4	Self Actuated	Check	Prevent Backflow thru Centrifugal Charging Pump
	CKV-62-532	8481B	4	Self Actuated	Check	Prevent Backflow thru Centrifugal Charging Pump
	FCV-62-1228	8870B	1	Air	Globe	Hydrogen vent header isolation valve
	FCV-62-1229	8870A	1	Air	Globe	Hydrogen vent header isolation Valve
	1-RFV-62-662	8117	2	Self Actuated	Relief	Cntmt Isolation Thermal Relief
	1-RFV-62-1221		3/4	Self Actuated	Relief	CCP 1A-A Over Pressure
	1-RFV-62-1222		3/4	Self Actuated	Relief	CCP 1B-B Over Pressure
SafetyInjection (63)	FCV-63-1	8812	14	Motor	Gate	Prevent Radioactive Release in Recirc Mode
	FCV-63-3	8813	2	Motor	Globe	Prevent Radioactive Release in Recirc Mode
	FCV-63-4	8814	2	Motor	Globe	Prevent Radioactive Release in Recirc Mode
	FCV-63-5	8806	8	Motor	Gate	Prevent Radioactive Release in Recirc Mode
	FCV-63-6	8807B	4	Motor	Gate	Sis Recirc Flowback Integrity
	FCV-63-7	8807A	4	Motor	Gate	Sis Recirc Flowback Integrity
	FCV-63-8	8804A	8	Motor	Gate	Sis Recirc Flowpath Integrity
	FCV-63-11	8804B	8	Motor	Gate	Sis Recirc Flowpath Integrity
	FCV-63-23	8888	1	Air	Globe	Containment Isolation
	FCV-63-25	8801B	4	Motor	Gate	ECCS Flowpath Integrity
	FCV-63-26	8801A	4	Motor	Gate	ECCS Flowpath Integrity
	FCV-63-47	8923A	6	Motor	Gate	ECCS Flowpath Integrity
	FCV-63-48	8923B	6	Motor	Gate	ECCS Flowpath Integrity
	FCV-63-64	8880	1	Air	Globe	Containment Isolation
	FCV-63-71	8871	3/4	Air	Globe	Containment Isolation
	FCV-63-72	8811A	18	Motor	Gate	CNTMT Sump Isolation
	FCV-63-73	8811B	18	Motor	Gate	CNTMT Sump Isolation
	FCV-63-84	8964	3/4	Air	Globe	Containment Isolation
	FCV-63-93	8809A	8	Motor	Gate	RHR Cold Leg Injection Line Isolation

WBN

TABLE 3.9-17 (Sheet 3 of 7)
UNIT 1

ACTIVE VALVES FOR PRIMARY FLUID SYSTEMS

System Name	TVA Valve No.	W Valve No.	Size Inches	Actuation	Type	Function/Description
	FCV-63-94	8809B	8	Motor	Gate	RHR Cold Leg Injection Line Isolation
	FCV-63-152	8821A	4	Motor	Gate	ECCS Flowpath Integrity
	FCV-63-153	8821B	4	Motor	Gate	ECCS Flowpath Integrity
	FCV-63-156	8802A	4	Motor	Gate	ECCS Flowpath Integrity
	FCV-63-157	8802B	4	Motor	Gate	ECCS Flowpath Intgrity
	FCV-63-172	8840	12	Motor	Gate	RHR Hot Leg Recirc
	FCV-63-175	8920	3/4	Motor	Globe	Prevent Radioactive Release in Recirc Mode
	FCV-63-185	---	3/4	Air	Globe	Leak Test Line Isolation
	CKV-63-524	8922A	4	Self Actuated	Check	Prevent Backflow thru Nonoperating Train
	CKV-63-526	8922B	4	Self Actuated	Check	Prevent Backflow thru Nonoperational Train
	CKV-63-543	8905A	2	Self Actuated	Check	ECCS Flowpath Integrity/RCS Press. Bound. Prot
	CKV-63-545	8905C	2	Self Actuated	Check	ECCS Flowpath Integrity/RCS Press. Bound. Prot
	CKV-63-547	8905B	2	Self Actuated	Check	ECCS Flowpath Integrity/RCS Press. Bound. Prot
	CKV-63-549	8905D	2	Self Actuated	Check	ECCS Flowpath Integrity/RCS Press. Bound. Prot
	CKV-63-551	8819A	2	Self Actuated	Check	ECCS Flowpath Integrity/RCS Press. Bound. Prot
	CKV-63-553	8819B	2	Self Actuated	Check	ECCS Flowpath Integrity/RCS Press. Bound. Prot
	CKV-63-555	8819C	2	Self Actuated	Check	ECCS Flowpath Integrity/RCS Press. Bound. Prot
	CKV-63-557	8819D	2	Self Actuated	Check	ECCS Flowpath Integrity/RCS Press. Bound. Prot
	CKV-63-558	8949D	6	Self Actuated	Check	ECCS Flowpath Integrity/RCS Press. Bound. Prot
	CKV-63-559	8949B	6	Self Actuated	Check	ECCS Flowpath Integrity/RCS Press. Bound. Prot
	CKV-63-560	8948A	10	Self Actuated	Check	ECCS Flowpath Integrity/RCS Press. Bound. Prot
	CKV-63-561	8948B	10	Self Actuated	Check	ECCS Flowpath Integrity/RCS Press. Bound. Prot
	CKV-63-562	8948C	10	Self Actuated	Check	ECCS Flowpath Integrity/RCS Press. Bound. Prot
	CKV-63-563	8948D	10	Self Actuated	Check	ECCS Flowpath Integrity/RCS Press. Bound. Prot
	CKV-63-581	8805	3	Self Actuated	Check	ECCS Flowpath Integrity/RCS Press. Bound. Prot
	CKV-63-586	8900A	1-1/2	Self Actuated	Check	ECCS Flowpath Integrity/RCS Press. Bound. Prot
	CKV-63-587	8900B	1-1/2	Self Actuated	Check	ECCS Flowpath Integrity/RCS Press. Bound. Prot
	CKV-63-588	8900C	1-1/2	Self Actuated	Check	ECCS Flowpath Integrity/RCS Press. Bound. Prot
	CKV-63-589	8900D	1-1/2	Self Actuated	Check	ECCS Flowpath Integrity/RCS Press. Bound. Prot
	CKV-63-622	8956A	10	Self Actuated	Check	ECCS Flowpath Integrity/RCS Press. Bound. Prot

TABLE 3.9-17 (Sheet 4 of 7)
UNIT 1

ACTIVE VALVES FOR PRIMARY FLUID SYSTEMS

System Name	TVA Valve No.	W Valve No.	Size Inches	Actuation	Type	Function/Description
	CKV-63-623	8956B	10	Self Actuated	Check	ECCS Flowpath Integrity/RCS Press. Bound. Prot
	CKV-63-624	8956C	10	Self Actuated	Check	ECCS Flowpath Integrity/RCS Press. Bound. Prot
	CKV-63-625	8956D	10	Self Actuated	Check	ECCS Flowpath Integrity/RCS Press. Bound. Prot
	CKV-63-632	8818B	6	Self Actuated	Check	ECCS Flowpath Integrity/RCS Press. Bound. Prot
	CKV-63-633	8818A	6	Self Actuated	Check	ECCS Flowpath Integrity/ RCS Press. Bound. Prot
	CKV-63-634	8818C	6	Self Actuated	Check	ECCS Flowpath Integrity/RCS Press. Bound. Prot
	CKV-63-640	8841A	8	Self Actuated	Check	ECCS Flowpath Integrity/RCS Press Bound. Prot
	CKV-63-635	8818D	6	Self Actuated	Check	ECCS Flowpath Integrity/RCS Press Bound. Prot
	CKV-63-641	8949A	6	Self Actuated	Check	ECCS Flowpath Integrity/RCS Press Bound. Prot
	CKV-63-643	8841B	8	Self Actuated	Check	ECCS Flowpath Integrity/RCS Press Bound. Prot
	CKV-63-644	8949C	6	Self Actuated	Check	ECCS Flowpath Integrity/RCS Press Bound. Prot
	CKV-63-502[3]	8958	12	Self Actuated	Check	ECCS Flowpath Integrity
	CKV-63-510[3]	8926	8	Self Actuated	Check	ECCS Flowpath Integrity
	RFV-63-511[3]	8858	3/4	Self Actuated	Angle	SI Pressure Release
	RFV-63-534[3]	8853A	3/4	Self Actuated	Angle	SI Pressure Release
	RFV-63-535[3]	8851	3/4	Self Actuated	Angle	SI Pressure Release
	RFV-63-536[3]	8853B	3/4	Self Actuated	Angle	SI Pressure Release
	RFV-63-577[3,4]	8852	1	Self Actuated	Angle	SI Pressure Release
	RFV-63-602[3]	8855A	1	Self Actuated	Angle	SI Pressure Release
	RFV-63-603[3]	8855B	1	Self Actuated	Angle	SI Pressure Release
	RFV-63-604[3]	8855C	1	Self Actuated	Angle	SI Pressure Release
	RFV-63-605[3]	8855D	1	Self Actuated	Angle	SI Pressure Release
	RFV-63-626[3]	8856A	2	Self Actuated	Angle	SI Pressure Release
	RFV-63-627[3]	8856B	3	Self Actuated	Angle	SI Pressure Release
	RFV-63-637[3]	8842	3/4	Self Actuated	Angle	SI Pressure Release
	RFV-63-835	----	¾	Self Actuated	Angle	SI Pressure Release
	CKV-63-868	---	1	Self Actuated	Check	Containment Isolation

TABLE 3.9-17 (Sheet 5 of 7)
UNIT 1

ACTIVE VALVES FOR PRIMARY FLUID SYSTEMS

System Name	TVA Valve No.	W Valve No.	Size Inches	Actuation	Type	Function/Description
Reactor Coolant System (68)	FCV-68-305	8033	3/4	Air	Daphragm	Containment Isolation
	FCV-68-307	8025	3/8	Air	Globe	Containment Isolation
	FCV-68-308	8026	3/8	Air	Globe	Containment Isolation
	FCV-68-332	8000A	3	Motor	Gate	PORV Isolation
	FCV-68-333	8000B	3	Motor	Gate	PORV Isolation
	PCV-68-334	PCV-456	3	Solenoid	Globe	PORV
	PCV-68-340A	PCV-455	3	Solenoid	Globe	PORV
	CKV-68-559	8097	4	Self Actuated	Check	Containment Isolation
	RFV-68-563	8010C	6	Self Actuated	Angle	RCS Pressure Release
	RFV-68-564	8010B	6	Self Actuated	Angle	RCS Pressure Release
	RFV-68-565	8010A	6	Self Actuated	Angle	RCS Pressure Release
	FSV-68-394	8012A	1	Solenoid	Globe	Head Vent
	FSV-68-395	8012B	1	Solenoid	Globe	Head Vent
	FSV-68-396	8014B	1	Solenoid	Globe	Head Vent
	FSV-68-397	8014A	1	Solenoid	Globe	Head Vent
	CKV-68-849	---	3/4	Self Actuated	Check	Containment Isolation
Containment Spray System (72)	FCV-72-2	9001B	10	Motor	Gate	Containment Isolation
	FCV-72-21	9017B	12	Motor	Gate	Containment Sump Recirculation
	FCV-72-22	9017A	12	Motor	Gate	Containment Sump Recirculation
	FCV-72-39	9001A	10	Motor	Gate	Containment Isolation
	FCV-72-40	9026A	8	Motor	Gate	Containment Isolation
	FCV-72-41	9026B	8	Motor	Gate	Containment Isolation
	FCV-72-44	9020A	12	Motor	Gate	Containment Sump Recirculation
	FCV-72-45	9020B	12	Motor	Gate	Containment Sump Recirculation
	CKV-72-506	9018A	12	Self Actuated	Check	Containment Sump Recirculation
	CKV-72-507	9018B	12	Self Actuated	Check	Containment Sump Recirculation
	RFV-72-508	9019A	0.75	Self Actuated	Relief	Containment Spray PMP A Suction Pressure Relief
	RFV-72-509	9019B	0.75	Self Actuated	Relief	Containment Spray PMP B Suction Pressure Relief
	CKV-72-548	9011A	10	Self Actuated	Check	Containment Isolation
	CKV-72-549	9011B	10	Self Actuated	Check	Containment Isolation
	CKV-72-562	9022A	8	Self Actuated	Check	RHR Isolation
	CKV-72-563	9022B	8	Self Actuated	Check	RHR Isolation

TABLE 3.9-17 (Sheet 6 of 7)
UNIT 1

ACTIVE VALVES FOR PRIMARY FLUID SYSTEMS

System Name	TVA Valve No.	W Valve No.	Size Inches	Actuation	Type	Function/Description
Residual Heat Removal System (74)	FCV-74-1	8702	14	Motor	Gate	RCS Pressure Boundary Protection
	FCV-74-2	8701	14	Motor	Gate	RCS Pressure Boundary Protection
	FCV-74-3	8700A	14	Motor	Gate	ECCS Flowpath Integrity
	FCV-74-8	8703	10	Motor	Gate	RCS Pressure Boundary Protection
	FCV-74-9	8704	10	Motor	Gate	RCS Pressure Boundary Protection
	FCV-74-12	FCV-610	3	Motor	Globe	RHR Mini-Flow
	FCV-74-21	8700B	14	Motor	Gate	ECCS Flowpath Integrity
	FCV-74-24	FCV-611	3	Motor	Globe	RHR Mini-Flow
	FCV-74-33	8716A	8	Motor	Gate	ECCS Flowpath Integrity
	FCV-74-35	8716B	8	Motor	Gate	ECCS Flowpath Integrity
	RFV-74-505	8708	3	Self Actuated	Relief	RHR Pump Suction
	CKV-74-514	8730A	8	Self Actuated	Check	Prevent Backflow thru Nonoperating Train
	CKV-74-515	8730B	8	Self Actuated	Check	Prevent Backflow thru Nonoperating Train
	CKV-74-544		8	Self Actuated	Check	Prevents pump-to-pump Interaction
	CKV-74-545		8	Self Actuated	Check	Prevents pump-to-pump Interaction
Waste Disposal System (77)	FCV-77-9	9170	3	Air	Diaphragm	Containment Isolation
	FCV-77-10	FCV-1003	3	Air	Diaphragm	Containment Isolation
	FCV-77-16	9159A	3/4	Air	Globe	Containment Isolation
	FCV-77-17	9159B	3/4	Air	Globe	Containment Isolation
	FCV-77-18	9160A	1	Air	Globe	Containment Isolation
	FCV-77-19	9160B	1	Air	Globe	Containment Isolation
	FCV-77-20	9157	1	Air	Globe	Containment Isolation
	FCV-77-127		2	Air	Plug	Containment Isolation
	FCV-77-128		2	Air	Plug	Containment Isolation
	RFV-77-2875		1/2	Self Actuated	Relief	Thermal Relief Valve Penetration X41

TABLE 3.9-17 (Sheet 7 of 7)
UNIT 1

ACTIVE VALVES FOR PRIMARY FLUID SYSTEMS

System Name	TVA Valve No.	W Valve No.	Size Inches	Actuation	Type	Function/Description
Spent Fuel Pool Cooling (78)	0-CKV-78-509		8	Self Actuated	Check	Pump A-A Discharge Check Valve
	0-CKV-78-510		8	Self Actuated	Check	Pump B-B Discharge Check Valve
	0-ISV-78-581		10	Manual	Gate	Standby Pump Train A Suction Isolation Valve
	0-ISV-78-582		10	Manual	Gate	Standby Pump Train B Suction Isolation Valve
	0-CKV-78-586		8	Self Actuated	Check	Pump C-S Discharge Check Valve
	0-ISV-78-587		8	Manual	Gate	Standby Pump Train B Discharge Isolation Valve
	0-ISV-78-588		8	Manual	Gate	Standby Pump Train A Discharge Isolation Valve

[1] Testing not required to meet 10 CFR 50 Appendix J.
[2] Testing not required as part of Inservice Testing Program. Testing not required to meet 10 CFR 50 Appendix J. See Table 6.2.4-1.
[3] These components were not committed to meet the requirements of RG 1.48 since these were procured under contracts issued prior to September 1, 1974.
[4] Valve 1-RFV-63-577 is not required to open to mitigate the consequences of an accident. However, the valve must be in the closed position to mitigate the consequences of an accident.

TABLE 3.9-17 (Sheet 1 of 7)
UNIT 2

ACTIVE VALVES FOR PRIMARY FLUID SYSTEMS

System Name	TVA Valve No.	W Valve No.	Size Inches	Actuation	Type	Function/Description
Chemical and Volume Control System (62)	FCV-62-61	8112	4	Motor	Gate	Containment Isolation
	FCV-62-63	8100	4	Motor	Gate	Containment Isolation
	FCV-62-69	LCV-460	3	Air	Globe	Letdown Isolation
	FCV-62-70	LCV-459	3	Air	Globe	Letdown Isolation
	FCV-62-72	8149A	2	Air	Globe	Containment Isolation
	FCV-62-73	8149B	2	Air	Globe	Containment Isolation
	FCV-62-74	8149C	2	Air	Globe	Containment Isolation
	FCV-62-77	8152	2	Air	Globe	Containment Isolation
	FCV-62-84	8145	3	Air	Globe	Aux Spray Isolation
	FCV-62-90	8105	3	Motor	Gate	ECCS Flowpath Integrity
	FCV-62-91	8106	3	Motor	Gate	ECCS Flowpath Integrity
	FCV-62-76	8306A	2	Air	Globe	Containment Isolation
	LCV-62-132	LCV-112B	4	Motor	Gate	CVCS Charging Pump Suction
	LCV-62-133	LCV-112C	4	Motor	Gate	CVCS Charging Pump Suction
	LCV-62-135	LCV-112D	8	Motor	Gate	CVCS Charging Pump Suction
	LCV-62-136	LCV-112E	8	Motor	Gate	CVCS Charging Pump Suction
	CKV-62-504	8546	8	Self Actuated	Check	CVCS Charging Pump Suction
	RFV-62-505	8124	-	Self Actuated	Relief	CCP Suction Relief Valve
	CKV-62-507	---	1	Self Actuated	Check	CCP Suction Chem Feed Check Valve
	CKV-62-543	8381	3	Self Actuated	Check	Containment Isolation
	CKV-62-560[1]	8368A	2	Self Actuated	Check	Containment Isolation
	CKV-62-561[1]	8368B	2	Self Actuated	Check	Containment Isolation
	CKV-62-562[1]	8368C	2	Self Actuated	Check	Containment Isolation
	CKV-62-563[1]	8368D	2	Self Actuated	Check	Containment Isolation
	CKV-62-576	8367A	2	Self Actuated	Check	CCP Discharge Header Integrity
	CKV-62-577	8367B	2	Self Actuated	Check	CCP Discharge Header Integrity
	CKV-62-578	8367C	2	Self Actuated	Check	CCP Discharge Header Integrity
	CKV-62-579	8367D	2	Self Actuated	Check	CCP Discharge Header Integrity

TABLE 3.9-17 (Sheet 2 of 7)
UNIT 2

ACTIVE VALVES FOR PRIMARY FLUID SYSTEMS

System Name	TVA Valve No.	W Valve No.	Size Inches	Actuation	Type	Function/Description
	CKV-62-638	8557	3	Self Actuated	Check	Normal Charging Isolation
	CKV-62-639		:	Self Actuated	Check	Seal Water 1-FCV-62-61 Bypass
	CKV-62-640	8556	3	Self Actuated	Check	Alternate Charging Isolation
	RFV-62-649		2	Self Actuated	Relief	Seal Water Hx Relief Valve
	CKV-62-659	8378	3	Self Actuated	Check	Normal Charging Isolation
	CKV-62-660	8379	3	Self Actuated	Check	Alternate Charging Isolation
	CKV-62-661	8377	3	Self Actuated	Check	Auxiliary Spray Isolation
	CKV-62-525	8481A	4	Self Actuated	Check	Prevent Backflow thru Centrifugal Charging Pump
	CKV-62-532	8481B	4	Self Actuated	Check	Prevent Backflow thru Centrifugal Charging Pump
	FCV-62-1228	8870B	1	Air	Globe	Hydrogen vent header Isolation Valve
	FCV-62-1229	8870A	1	Air	Globe	Hydrogen vent header Isolation Valve
	RFV-62-662	8117	2	Self Actuated	Relief	Cntmt Isolation Thermal Relief
	RFV-62-1221		:	Self Actuated	Relief	CCP 1A-A Over Pressure
	RFV-62-1222		:	Self Actuated	Relief	CCP 1B-B Over Pressure
Safety Injection (63)	FCV-63-1	8812	14	Motor	Gate	Prevent Radioactive Release in Recirc Mode
	FCV-63-3	8813	2	Motor	Globe	Prevent Radioactive Release in Recirc Mode
	FCV-63-4	8814	2	Motor	Globe	Prevent Radioactive Release in Recirc Mode
	FCV-63-5	8806	8	Motor	Gate	Prevent Radioactive Release in Recirc Mode
	FCV-63-6	8807B	4	Motor	Gate	Sis Recirc Flowback Integrity
	FCV-63-7	8807A	4	Motor	Gate	Sis Recirc Flowback Integrity
	FCV-63-8	8804A	8	Motor	Gate	Sis Recirc Flowpath Integrity
	FCV-63-11	8804B	8	Motor	Gate	Sis Recirc Flowpath Integrity
	FCV-63-23	8888	1	Air	Globe	Containment Isolation
	FCV-63-25	8801B	4	Motor	Gate	ECCS Flowpath Integrity
	FCV-63-26	8801A	4	Motor	Gate	ECCS Flowpath Integrity
	FCV-63-47	8923A	6	Motor	Gate	ECCS Flowpath Integrity
	FCV-63-48	8923B	6	Motor	Gate	ECCS Flowpath Integrity

TABLE 3.9-17 (Sheet 3 of 7)
UNIT 2

ACTIVE VALVES FOR PRIMARY FLUID SYSTEMS

System Name	TVA Valve No.	W Valve No.	Size Inches	Actuation	Type	Function/Description
Safety Injection (63)	FCV-63-64	8880	1	Air	Globe	Containment Isolation
	FCV-63-71	8871	3/4	Air	Globe	Containment Isolation
	FCV-63-72	8811A	18	Motor	Gate	CNTMT Sump Isolation
	FCV-63-73	8811B	18	Motor	Gate	CNTMT Sump Isolation
	FCV-63-84	8964	3/4	Air	Globe	Containment Isolation
	FCV-63-93	8809A	8	Motor	Gate	RHR Cold Leg Injection Line Isolation
	FCV-63-94	8809B	8	Motor	Gate	RHR Cold Leg Injection Line Isolation
	FCV-63-152	8821A	4	Motor	Gate	ECCS Flowpath Integrity
	FCV-63-153	8821B	4	Motor	Gate	ECCS Flowpath Integrity
	FCV-63-156	8802A	4	Motor	Gate	ECCS Flowpath Integrity
	FCV-63-157	8802B	4	Motor	Gate	ECCS Flowpath Intgrity
	FCV-63-172	8840	12	Motor	Gate	RHR Hot Leg Recirc
	FCV-63-175	8920	:	Motor	Globe	Prevent Radioactive Release in Recirc Mode
	FCV-63-185	---	:	Air	Globe	Leak Test Line Isolation
	CKV-63-524	8922A	4	Self Actuated	Check	Prevent Backflow thru Nonoperating Train
	CKV-63-526	8922B	4	Self Actuated	Check	Prevent Backflow thru Nonoperating Train
	CKV-63-543	8905A	2	Self Actuated	Check	ECCS Flowpath Integrity/ RCS Press. Bound. Prot
	CKV-63-545	8905C	2	Self Actuated	Check	ECCS Flowpath Integrity/ RCS Press. Bound. Prot
	CKV-63-547	8905B	2	Self Actuated	Check	ECCS Flowpath Integrity/ RCS Press. Bound. Prot
	CKV-63-549	8905D	2	Self Actuated	Check	ECCS Flowpath Integrity/ RCS Press. Bound. Prot
	CKV-63-551	8819A	2	Self Actuated	Check	ECCS Flowpath Integrity/ RCS Press. Bound. Prot
	CKV-63-553	8819B	2	Self Actuated	Check	ECCS Flowpath Integrity/ RCS Press. Bound. Prot
	CKV-63-555	8819C	2	Self Actuated	Check	ECCS Flowpath Integrity/ RCS Press. Bound. Prot
	CKV-63-557	8819D	2	Self Actuated	Check	ECCS Flowpath Integrity/ RCS Press. Bound. Prot
	CKV-63-558	8949D	6	Self Actuated	Check	ECCS Flowpath Integrity/ RCS Press. Bound. Prot
	CKV-63-559	8949B	6	Self Actuated	Check	ECCS Flowpath Integrity/ RCS Press. Bound. Prot

TABLE 3.9-17 (Sheet 4 of 7)
UNIT 2

ACTIVE VALVES FOR PRIMARY FLUID SYSTEMS

System Name	TVA Valve No.	W Valve No.	Size Inches	Actuation	Type	Function/Description
Safety Injection (63)	CKV-63-560	8948A	10	Self Actuated	Check	ECCS Flowpath Integrity/RCS Press. Bound. Prot
	CKV-63-561	8948B	10	Self Actuated	Check	ECCS Flowpath Integrity/RCS Press. Bound. Prot
	CKV-63-562	8948C	10	Self Actuated	Check	ECCS Flowpath Integrity/RCS Press. Bound. Prot
	CKV-63-563	8948D	10	Self Actuated	Check	ECCS Flowpath Integrity/RCS Press. Bound. Prot
	CKV-63-581	8805	3	Self Actuated	Check	ECCS Flowpath Integrity/RCS Press. Bound. Prot
	CKV-63-586	8900A	1-1/2	Self Actuated	Check	ECCS Flowpath Integrity/RCS Press. Bound. Prot
	CKV-63-587	8900B	1-1/2	Self Actuated	Check	ECCS Flowpath Integrity/RCS Press. Bound. Prot
	CKV-63-588	8900C	1-1/2	Self Actuated	Check	ECCS Flowpath Integrity/RCS Press. Bound. Prot
	CKV-63-589	8900D	1-1/2	Self Actuated	Check	ECCS Flowpath Integrity/RCS Press. Bound. Prot
	CKV-63-622	8956A	10	Self Actuated	Check	ECCS Flowpath Integrity/RCS Press. Bound. Prot
	CKV-63-623	8956B	10	Self Actuated	Check	ECCS Flowpath Integrity/RCS Press. Bound. Prot
	CKV-63-624	8956C	10	Self Actuated	Check	ECCS Flowpath Integrity/RCS Press. Bound. Prot
	CKV-63-625	8956D	10	Self Actuated	Check	ECCS Flowpath Integrity/RCS Press. Bound. Prot
	CKV-63-632	8818B	6	Self Actuated	Check	ECCS Flowpath Integrity/RCS Press. Bound. Prot
	CKV-63-633	8818A	6	Self Actuated	Check	ECCS Flowpath Integrity/RCS Press. Bound. Prot
	CKV-63-634	8818C	6	Self Actuated	Check	ECCS Flowpath Integrity/RCS Press. Bound. Prot
	CKV-63-640	8841A	8	Self Actuated	Check	ECCS Flowpath Integrity/RCS Press. Bound. Prot
	CKV-63-635	8818D	6	Self Actuated	Check	ECCS Flowpath Integrity/RCS Press. Bound. Prot
	CKV-63-641	8949A	6	Self Actuated	Check	ECCS Flowpath Integrity/RCS Press. Bound. Prot
	CKV-63-643	8841B	8	Self Actuated	Check	ECCS Flowpath Integrity/RCS Press. Bound. Prot
	CKV-63-644	8949C	6	Self Actuated	Check	ECCS Flowpath Integrity/RCS Press. Bound. Prot
	CKV-63-5023	8958	12	Self Actuated	Check	ECCS Flowpath Integrity/RCS Press. Bound. Prot
	CKV-63-5103	8926	8	Self Actuated	Check	ECCS Flowpath Integrity/RCS Press. Bound. Prot

TABLE 3.9-17 (Sheet 5 of 7)
UNIT 2

ACTIVE VALVES FOR PRIMARY FLUID SYSTEMS

System Name	TVA Valve No.	W Valve No.	Size Inches	Actuation	Type	Function/Description
Safety Injection (63)	RFV-63-511[3]	8858	3/4	Self Actuated	Angle	SI Pressure Release
	RFV-63-534[3]	8853A	3/4	Self Actuated	Angle	SI Pressure Release
	RFV-63-535[3]	8851	3/4	Self Actuated	Angle	SI Pressure Release
	RFV-63-536[3]	8853B	3/4	Self Actuated	Angle	SI Pressure Release
	RFV-63-577[3,4]	8852	1	Self Actuated	Angle	SI Pressure Release
	RFV-63-602[3]	8855A	1	Self Actuated	Angle	SI Pressure Release
	RFV-63-603[3]	8855B	1	Self Actuated	Angle	SI Pressure Release
	RFV-63-604[3]	8855C	1	Self Actuated	Angle	SI Pressure Release
	RFV-63-605[3]	8855D	1	Self Actuated	Angle	SI Pressure Release
	RFV-63-626[3]	8856A	2	Self Actuated	Angle	SI Pressure Release
	RFV-63-627[3]	8856B	3	Self Actuated	Angle	SI Pressure Release
	RFV-63-637[3]	8842	3/4	Self Actuated	Angle	SI Pressure Release
	RFV-63-835	----	3/4	Self Actuated	Angle	SI Pressure Release
	CKV-63-868	---	1	Self Actuated	Check	Containment Isolation
	RFV-63-28	---	3/4	Self Actuated	Relief	Penetration X-30 pressure relief containment isolation
Reactor Coolant System (68)	FCV-68-305	8033	3/4	Air	Diaphragm	Containment Isolation
	FCV-68-307	8025	3/8	Air	Globe	Containment Isolation
	FCV-68-308	8026	3/8	Air	Globe	Containment Isolation
	FCV-68-332	8000A	3	Motor	Gate	PORV Isolation
	FCV-68-333	8000B	3	Motor	Gate	PORV Isolation
	*PCV-68-334	8097	3	Solenoid	Globe	PORV
	*PCV-68-340A	8010C	3	Solenoid	Globe	PORV
	CKV-68-559	8010B	4	Self Actuated	Check	Containment Isolation
	RFV-68-563	8010A	6	Self Actuated	Angle	RCS Pressure Release
	RFV-68-564	8012A	6	Self Actuated	Angle	RCS Pressure Release
	RFV-68-565	8012B	6	Self Actuated	Angle	RCS Pressure Release
	FSV-68-394	8014B	1	Solenoid	Globe	Head Vent
	FSV-68-395	8014A	1	Solenoid	Globe	Head Vent
	FSV-68-396	---	1	Solenoid	Globe	Head Vent
	FSV-68-397		1	Solenoid	Globe	Head Vent
	CKV-68-849		3/4	Self Actuated	Check	Containment Isolation

* Valves PCV-68-334 and PCV-68-340A were originally supplied by Westinghouse as valve numbers PCV-456 and PCV-455, respectively. Although these valves were in the original Westinghouse scope of supply, replacement valves have been supplied by TVA.

WBN

TABLE 3.9-17 (Sheet 6 of 7)
UNIT 2

ACTIVE VALVES FOR PRIMARY FLUID SYSTEMS

System Name	TVA Valve No.	W Valve No.	Size Inches	Actuation	Type	Function/Description
Containment Spray System (72)	FCV-72-2	9001B	10	Motor	Gate	Containment Isolation
	FCV-72-21	9017B	12	Motor	Gate	Containment Sump Recirculation
	FCV-72-22	9017A	12	Motor	Gate	Containment Sump Recirculation
	FCV-72-39	9001A	10	Motor	Gate	Containment Isolation
	FCV-72-40	9026A	8	Motor	Gate	Containment Isolation
	FCV-72-41	9026B	8	Motor	Gate	Containment Isolation
	FCV-72-44	9020A	12	Motor	Gate	Containment Sump Recirculation
	FCV-72-45	9020B	12	Motor	Gate	Containment Sump Recirculation
	CKV-72-506	9018A	12	Self Actuated	Check	Containment Sump Recirculation
	CKV-72-507	9018B	12	Self Actuated	Check	Containment Sump Recirculation
	RFV-72-508	9019A	0.75	Self Actuated	Relief	Containment Spray PMP A Suction Pressure Relief
	RFV-72-509	9019B	0.75	Self Actuated	Relief	Containment Spray PMP B Suction Pressure Relief
	CKV-72-548	9011A	10	Self Actuated	Check	Containment Isolation
	CKV-72-549	9011B	10	Self Actuated	Check	Containment Isolation
	CKV-72-562	9022A	8	Self Actuated	Check	RHR Isolation
	CKV-72-563	9022B	8	Self Actuated	Check	RHR Isolation
Heat Removal System (74)	FCV-74-1	8702	14	Motor	Gate	RCS Pressure Boundary Protection
	FCV-74-2	8701	14	Motor	Gate	RCS Pressure Boundary Protection
	FCV-74-3	8700A	14	Motor	Gate	ECCS Flowpath Integrity
	FCV-74-8	8703	10	Motor	Gate	RCS Pressure Boundary Protection
	FCV-74-9	8704	10	Motor	Gate	RCS Pressure Boundary Protection
	FCV-74-12	FCV-610	3	Motor	Globe	RHR Mini-Flow
	FCV-74-21	8700B	14	Motor	Gate	ECCS Flowpath Integrity
	FCV-74-24	FCV-611	3	Motor	Globe	RHR Mini-Flow
	FCV-74-33	8716A	8	Motor	Gate	ECCS Flowpath Integrity
	FCV-74-35	8716B	8	Motor	Gate	ECCS Flowpath Integrity
	RFV-74-505	8708	3	Self Actuated	Relief	RHR Pump Suction
	CKV-74-514	8730A	8	Self Actuated	Check	Prevent Backflow thru Nonoperating Train
	CKV-74-515	8730B	8	Self Actuated	Check	Prevent Backflow thru Nonoperating Train
	CKV-74-544		8	Self Actuated	Check	Prevents pump-to-pump Interaction
	CKV-74-545		8	Self Actuated	Check	Prevents pump-to-pump Interaction

TABLE 3.9-17 (Sheet 7 of 7)
UNIT 2

ACTIVE VALVES FOR PRIMARY FLUID SYSTEMS

System Name	TVA Valve No.	W Valve No.	Size Inches	Actuation	Type	Function/Description
Waste Disposal System (77)	FCV-77-9	9170	3	Air	Diaphragm	Containment Isolation
	FCV-77-10	FCV-1003	3	Air	Diaphragm	Containment Isolation
	FCV-77-16	9159A	3/4	Air	Globe	Containment Isolation
	FCV-77-17	9159B	3/4	Air	Globe	Containment Isolation
	FCV-77-18	9160A	1	Air	Globe	Containment Isolation
	FCV-77-19	9160B	1	Air	Globe	Containment Isolation
	FCV-77-20	9157	1	Air	Globe	Containment Isolation
	FCV-77-127		2	Air	Plug	Containment Isolation
	FCV-77-128		2	Air	Plug	Containment Isolation
	RFV-77-2875		1/2	Self Actuated	Relief	Thermal Relief Valve Penetration X41
Spent Fuel Pool Cooling (78)	CKV-78-509		8	Self Actuated	Check	Pump A-A Discharge Check Valve
	CKV-78-510		8	Self Actuated	Check	Pump B-B Discharge Check Valve
	ISV-78-581		10	Manual	Gate	Standby Pump Train A Suction Isolation Valve
	ISV-78-582		10	Manual	Gate	Standby Pump Train B Suction Isolation Valve
	CKV-78-586		8	Self Actuated	Check	Pump C-S Discharge Check Valve
	ISV-78-587		8	Manual	Gate	Standby Pump Train B Discharge Isolation Valve
	ISV-78-588		8	Manual	Gate	Standby Pump Train A Discharge Isolation Valve

[1] Testing not required to meet 10 CFR 50 Appendix J.

[2] Footnote 2 deleted by Amendment 113.

[3] These components were not committed to meet the requirements of RG 1.48 since these were procured under contracts issued prior to September 1, 1974.

[4] Valve 1-RFV-63-577 is not required to open to mitigate the consequences of an accident. However, the valve must be in the closed position to mitigate the consequences of an accident.

TABLE 3.9-18

STRESS LIMITS FOR ACTIVE CATEGORY I ASME CLASS 2 AND 3 PUMPS

Condition	Stress Limits[(1) (2)]
Design Normal and Upset	$P_m \leq 1.0\ S_h$ $(P_m \text{ or } P_L) + Pb \leq 1.5\ S_h$
Emergency	$P_m \leq 1.1\ S_h$ $(P_m \text{ or } P_L) + P_b \leq 1.65\ S_h$
Faulted	$P_m \leq 1.2\ S_h$ $(P_m \text{ or } P_L) + P_b \leq 1.8\ S_h$

S_h = Material allowable stress at maximum operating temperature from ASME Section III, 1971 Edition, through Summer 1973 Addenda or the applicable code edition specified at the time of procurement.

P_m = Primary general membrane stress, the average primary stress across the solid section under consideration. Excludes effects of discontinuities and concentrations. Produced by pressure, mechanical loads.

P_b = Primary bending stress. This stress is produced by pressure and mechanical loads including inertia earthquake effects but excluding effects of discontinuities and concentrations.

P_L = Primary local membrane stress, the average stress across any solid section under consideration. Considers effects of discontinuities but not concentrations. Produced by pressure and mechanical loads including inertia earthquake effects.

Notes:

1. The stress allowables given above were permitted for design, evaluation, and modification activities. As an alternative, a simplified approach was permitted for pumps procured prior to September 1, 1974. By this alternative approach, in addition to meeting applicable ASME Code design condition requirements, the pump was analyzed for the faulted condition and pump stresses were limited to 1.2 times the applicable ASME Code design/normal condition primary stress allowables.

2. Active pumps procured after September 1, 1974 also complied with operability tests and analysis requirements described in Section 3.9.3.2.2.2.

TABLE 3.9-19

STRESS LIMITS FOR ACTIVE CATEGORY I ASME CLASS 2 AND 3 VALVES

Condition	Stress Limits (Notes 1-6)
Design & Normal	$P_m \leq 1.0\ S_h$ $(P_m \text{ or } P_L) + P_b \leq 1.5\ S_h$
Upset	$P_m \leq 1.1\ S_h$ $(P_m \text{ or } P_L) + P_b \leq 1.65\ S_h$
Emergency	$P_m \leq 1.5\ S_h$ $(P_m \text{ or } P_L) + P_b \leq 1.8\ S_h$
Faulted	$P_m \leq 2.0\ S_h$ $(P_m \text{ or } P_L) + P_b \leq 2.4\ S_h$

Notes:

1. S_h, P_m, P_b, and P_L are defined in Table 3.9-18.
2. Valve nozzle (piping load) stress analysis is not required when section modulus and area of a plane, normal to the flow, through the region of valve body crotch is at least 10% greater than the piping connected (or joined) to the valve body inlet and outlet nozzles.
3. Stress in the valve nozzles resulting from connecting pipe does not exceed the limits listed in this table where S is based on the valve material. To ensure this, the attached pipe stress is limited in accordance with Table 3.9-10 unless justified on a case-by-case basis, or otherwise not part of the pressure boundary.
4. Design requirements listed in this table are not applicable to valve discs, stems, cast rings, or other parts of valves which are contained within the confines of the body and bonnet.
5. The stress allowables given above were permitted for design, evaluation, and modification activities. As an alternative, a simplified approach was permitted for valves procured prior to September 1, 1974. By this alternative approach, in addition to meeting the applicable ASME code design condition requirements, the valve was analyzed or tested on IEEE 344-1971 requirements for the faulted condition. When qualified by analysis using this alternative, the valve stresses were limited to 1.2 times the applicable ASME code design/normal condition primary stress allowables and the valve extended structure stresses were limited to 1.33 times the AISC Code normal stress allowable.
6. Active valves procured after September 1, 1974 also complied with operability test and analysis requirements of R.G. 1.48.

TABLE 3.9-20 (Sheet 1 of 2)
UNIT 1

RELIEF VALVES IN CLASS 2 AUXILIARY SYSTEMS

System	No.	Location	Fluid	Relieving Temperature	Valve Set Pressure	Max. Required Flow Rate	Discharge	Associated Relief Valve
SIS	1	Accumulator Tanks/ N_2 Supply	Nitrogen or Borated Water	120°F	700/750 psig	1500 cfm	Atmosphere	1-RFV-63-602, -603, -604, -605
SIS	2	S. I. Pump Suction	Borated Water	100°F	220 psig	25 gpm	to PRT	1-RFV-63-511; -835
SIS	3	S. I. Pump Discharge	Borated Water	100°F	1750 psig	20 gpm	to PRT	1-RFV-63-534, -535, -536
SIS	4	Boron Injection Tank	Borated Water	180°F	2735 psig	20 gpm	to HT	1-RFV-63-577
RHR	5	Residual Pump Suction	Borated Water	350°F ** 200°F	450 psig 450 psig	480 gpm 690 gpm	to PRT to PRT	1-RFV-74-505
RHR	6	Residual Pump Discharge	Borated Water	120°F	600 psig	20 gpm	to PRT	1-RFV-63-626, -627, -637
CVCS	7	Letdown Line Orifice	Borated Water	347°F **	600 psig	227 gpm	to PRT	1-RFV-62-662
CVCS	8	Seal Water Return Line	Borated Water	250°F **	150 psig	225 gpm	to PRT	1-RFV-62-636
CVCS	9	Letdown Line	Borated Water	200°F	200 psig	200 gpm	to VCT***	1-RFV-62-675
CVCS	10	Seal Water Return Line	Borated Water	150°F	200 psig	180 gpm	to VCT***	1-RFV-62-649
CVCS	11	Volume Control Tank	Hydrogen Nitrogen or Borated Water	130°F	70 psig	350 gpm	to HT***	1-RFV-62-688
CVCS	12	Charging Pump Suction	Borated Water	100°F	220 psig	25 gpm	to PRT	1-RFV-62-1221, -1222
WDS	14	Downstream of 1-FCV-77-127	Liquid Radwaste	140°F	50 psig	1 gpm	upstream of 1-FCV-77-127	1-RFV-77-2875
SIS	15	Penetration X-30	Borated Water	235°F	2480 psig	20 gpm	to PRT	1-RFV-63-28

**Water-steam Mixture Downstream of Valve
***Safety Class B Discharge Piping

PRT - Pressurizer Relief Tank
VCT - Volume Control Tank
HT - Holdup Tanks

Reference:
SIS = Figure 6.3-1, Sh 1 (TVA Dwg. 1-47W811-1)
RHR = Figure 2.4-107 and 5.5-4-1 (TVA Dwg. 1-47W810-1)
CVCS = Figure 9.3-15, Sh 1 (TVA Dwg. 1-47W809-1)
WDS = Figure 9.3-7 (TVA Dwg. 1-47W851-1)

TABLE 3.9-20 (Sheet 2 of 2)
UNIT 2

RELIEF VALVES IN CLASS 2 AUXILIARY SYSTEMS

System	No.	Location	Fluid	Relieving Temperature	Valve Set Pressure	Max. Required Flow Rate	Discharge	Associated Relief Valve
SIS	1	Accumulator Tanks/ N_2 Supply	Nitrogen or Borated Water	120°F	700/750 psig	1500 cfm	Atmosphere	1-RFV-63-602, -603, -604, -605
SIS	2	S. I. Pump Suction	Borated Water	100°F	220 psig	25 gpm	to PRT	1-RFV-63-511; -835
SIS	3	S. I. Pump Discharge	Borated Water	100°F	1750 psig	20 gpm	to PRT	1-RFV-63-534, -535, -536
SIS	4	Boron Injection Tank	Borated Water	180°F	2735 psig	20 gpm	to HT	1-RFV-63-577
RHR	5	Residual Pump Suction	Borated Water	350°F ** 200°F	450 psig 450 psig	480 gpm 690 gpm	to PRT to PRT	1-RFV-74-505
RHR	6	Residual Pump Discharge	Borated Water	120°F	600 psig	20 gpm	to PRT	1-RFV-63-626, -627, -637
CVCS	7	Letdown Line Orifice	Borated Water	347°F **	600 psig	227 gpm	to PRT	1-RFV-62-662
CVCS	8	Seal Water Return Line	Borated Water	250°F **	150 psig	225 gpm	to PRT	1-RFV-62-636
CVCS	9	Letdown Line	Borated Water	200°F	200 psig	200 gpm	to VCT***	1-RFV-62-675
CVCS	10	Seal Water Return Line	Borated Water	150°F	200 psig	180 gpm	to VCT***	1-RFV-62-649
CVCS	11	Volume Control Tank	Hydrogen Nitrogen or Borated Water	130°F	70 psig	350 gpm	to HT***	1-RFV-62-688
CVCS	12	Charging Pump Suction	Borated Water	100°F	220 psig	25 gpm	to PRT	1-RFV-62-1221, -1222
WDS	14	Downstream of 1-FCV-77-127	Liquid Radwaste	140°F	50 psig	1 gpm	upstream of 1-FCV-77-127	1-RFV-77-2875
SIS	15	Penetration X-30	Borated Water	235°F	2480 psig	20 gpm	to PRT	1-RFV-63-28

**Water-steam Mixture Downstream of Valve
***Safety Class B Discharge Piping

PRT - Pressurizer Relief Tank
VCT - Volume Control Tank
HT - Holdup Tanks

Reference:
SIS = Figure 6.3-1, Sh 1 (TVA Dwg. 1-47W811-1, 2-47W811-1)
RHR = Figure 2.4-107 and 5.5-4-1 (TVA Dwg. 1-47W810-1, 2-47W810-1))
CVCS = Figure 9.3-15, Sh 1 (TVA Dwg. 1-47W809-1, 2-47W809-1)
WDS = Figure 9.3-7 (TVA Dwg. 1-47W851-1, 2-47W851-1)

TABLE 3.9-21

SUPPORT DESIGN ALLOWABLE STRESSES FOR CATEGORY I PIPING SUPPORTS

Load Condition	Supplemental Structural Steel, Welds & Structural Bolts(2)	Component Standard Supports W/ LCDS' Except Unistrut Clamps	Component Standard Supports W/O LCDS' Except Unistrut Clamps(1)
Normal & Friction	Normal AISC Allowable	Manufacturer's LCDS for Level A	Manufacturer's Allowable Catalog Value
Upset	Normal AISC Allowable X 1.33	Manufacturer's LCDS for Level B	Manufacturer's Allowable Catalog Value X 1.2
Emergency	Normal AISC Allowable X 1.5	Manufacturer's LCDS for Level C	Manufacturer's Allowable Catalog Value X 1.5
Faulted	Normal AISC Allowable X 1.5	Manufacturer's LCDS for Level D	Manufacturer's Allowable Catalog Value X 1.5
Test	Normal AISC Allowable	Manufacturer's LCDS for Level A X 1.33	Manufacturer's Allowable Catalog Value X 1.33

Notes:

(1) The allowable loads for both U-bolts and unistrut clamps were developed based on the load testing per the requirements of ASME Section III 1974, Subsection NF including Winter 1974, Addenda.

(2) Tensile stresses do not exceed $0.9F_y$ and shear stresses do not exceed $0.9F_y / \sqrt{3}$. For compressive loads, the stress does not exceed 2/3 critical buckling.

TABLE 3.9-22
TABLE 3.9-23
TABLE 3.9-24

DELETED

TABLE 3.9-25 (Sheet 1 of 15)

UNIT 1

VALVES REQUIRED TO BE ACTIVE FOR DESIGN BASIS EVENTS

System Name	Valve No.	Size Inches	Actuation	Type	Function/Description
Main Steam (1)	FCV-1-4	32	Air2	Globe	Main steam and containment isolation
	PCV-1-5	6	Air	Globe	SG pressure control and relief
	FCV-1-7	4	Solenoid	Globe	Blowdown and containment isolation
	FCV-1-11	32	Air	Globe	Main steam and containment isolation
	PCV-1-12	6	Air	Globe	SG pressure control and relief
	FCV-1-14	4	Solenoid	Globe	Blowdown and containment isolation
	FCV-1-22	32	Air	Globe	Main steam and containment isolation
	PCV-1-23	6	Air	Globe	SG pressure control and relief
	FCV-1-25	4	Solenoid	Globe	Blowdown and containment isolation
	FCV-1-29	32	Air	Globe	Main steam and containment isolation
	PCV-1-30	6	Air	Globe	SG pressure control and relief
	FCV-1-32	4	Solenoid	Globe	Blowdown and containment isolation
	FCV-1-51	4	Motor	Globe	AFW pump turbine operation
	FCV-1-52	4	Hydraulic	Globe	AFW pump turbine operation
	FCV-1-147	2	Air	Globe	Containment isolation
	FCV-1-148	2	Air	Globe	Containment isolation
	FCV-1-149	2	Air	Globe	Containment isolation
	FCV-1-150	2	Air	Globe	Containment isolation
	FCV-1-181	4	Solenoid	Globe	SG blowdown isolation
	FCV-1-182	4	Solenoid	Globe	SG blowdown isolation
	FCV-1-183	4	Solenoid	Globe	SG blowdown isolation
	FCV-1-184	4	Solenoid	Globe	SG blowdown isolation
	SFV-1-512	6x10	Self-actuated	Angle relief	Steam generator safety relief
	SFV-1-513	6x10	Self-actuated	Angle relief	Steam generator safety relief
	SFV-1-514	6x10	Self-actuated	Angle relief	Steam generator safety relief
	SFV-1-515	6x10	Self-actuated	Angle relief	Steam generator safety relief
	SFV-1-516	6x10	Self-actuated	Angle relief	Steam generator safety relief
	SFV-1-517	6x10	Self-actuated	Angle relief	Steam generator safety relief
	SFV-1-518	6x10	Self-actuated	Angle relief	Steam generator safety relief
	SFV-1-519	6x10	Self-actuated	Angle relief	Steam generator safety relief
	SFV-1-520	6x10	Self-actuated	Angle relief	Steam generator safety relief
	SFV-1-521	6x10	Self-actuated	Angle relief	Steam generator safety relief
	SFV-1-522	6x10	Self-actuated	Angle relief	Steam generator safety relief
	SFV-1-523	6x10	Self-actuated	Angle relief	Steam generator safety relief
	SFV-1-524	6x10	Self-actuated	Angle relief	Steam generator safety relief
	SFV-1-525	6x10	Self-actuated	Angle relief	Steam generator safety relief

TABLE 3.9-25 (Sheet 2 of 15)

UNIT 1

VALVES REQUIRED TO BE ACTIVE FOR DESIGN BASIS EVENTS

System Name	Valve No.	Size Inches	Actuation	Type	Function/Description
	SFV-1-526	6x10	Self-actuated	Angle-relief	Steam generator safety relief
	SFV-1-527	6x10	Self-actuated	Angle-relief	Steam generator safety relief
	SFV-1-528	6x10	Self-actuated	Angle-relief	Steam generator safety relief
	SFV-1-529	6x10	Self-actuated	Angle-relief	Steam generator safety relief
	SFV-1-530	6x10	Self-actuated	Angle relief	Steam generator safety relief
	SFV-1-531	6x10	Self-actuated	Angle relief	Steam generator safety relief
	FCV-1-15	4	Motor	Gate	AFW pump turbine operation
	FCV-1-16	4	Motor	Gate	AFW pump turbine operation
	FCV-1-17	4	Motor	Gate	AFW pump turbine operation
	FCV-1-18	4	Motor	Gate	AFW pump turbine operation
	CKV-1-891	4	Self-actuated	Check	Prvnt bkflw btwn stm gen
	CKV-1-892	4	Self-actuated	Check	Prvnt bkflw btwn stm gen
Feedwater (3)	FCV-3-33	16	Motor	Gate	Main feedwater isolation
	FCV-3-47	16	Motor	Gate	Main feedwater isolation
	FCV-3-87	16	Motor	Gate	Main feedwater isolation
	FCV-3-100	16	Motor	Gate	Main feedwater isolation
	FCV-3-116A	4	Motor	Gate	AFW flow path integrity
	FCV-3-116B	4	Motor	Gate	AFW flow path integrity
	FCV-3-126A	4	Motor	Gate	AFW flow path integrity
	FCV-3-126B	4	Motor	Gate	AFW flow path integrity
	FCV-3-136A	6	Motor	Gate	AFW flow path integrity
	FCV-3-136B	6	Motor	Gate	AFW flow path integrity
	LCV-3-148	4	Air	Globe	Steam generator level control
	LCV-3-148A	2	Air	Globe	Steam generator level control
	LCV-3-156	4	Air	Globe	Steam generator level control
	LCV-3-156A	2	Air	Globe	Steam generator level control
	LCV-3-164	4	Air	Globe	Steam generator level control
	LCV-3-164A	2	Air	Globe	Steam generator level control
	LCV-3-171	4	Air	Globe	Steam generator level control
	LCV-3-171A	2	Air	Globe	Steam generator level control
	LCV-3-172	3	Air/Nitrogen	Globe	Steam generator level control
	LCV-3-173	3	Air/Nitrogen	Globe	Steam generator level control
	LCV-3-174	3	Air/Nitrogen	Globe	Steam generator level control
	LCV-3-175	3	Air/Nitrogen	Globe	Steam generator level control
	FCV-3-179A	6	Motor	Gate	AFW flow path integrity
	FCV-3-179B	6	Motor	Gate	AFW flow path integrity

TABLE 3.9-25 (Sheet 3 of 15)

UNIT 1

VALVES REQUIRED TO BE ACTIVE FOR DESIGN BASIS EVENTS

System Name	Valve No.	Size Inches	Actuation	Type	Function/Description
	FCV-3-236	6	Air	Globe	Main feedwater isolation
	FCV-3-239	6	Air	Globe	Main feedwater isolation
	FCV-3-242	6	Air	Globe	Main feedwater isolation
	FCV-3-245	6	Air	Globe	Main feedwater isolation
	FCV-3-355	2	Air	Globe	Recirc. Isolation
	FCV-3-359	2	Air	Globe	Recirc. Isolation
	CKV-3-508	16	Self-actuated	Check	Pipe break protection
	CKV-3-509	16	Self-actuated	Check	Pipe break protection
	CKV-3-510	16	Self-actuated	Check	Pipe break protection
	CKV-3-511	16	Self-actuated	Check	Pipe break protection
	CKV-3-638	6	Self-actuated	Check	Pipe break protection
	CKV-3-644	6	Self-actuated	Check	Pipe break protection
	CKV-3-645	6	Self-actuated	Check	Pipe break protection
	CKV-3-652	6	Self-actuated	Check	Pipe break protection
	CKV-3-655	6	Self-actuated	Check	Pipe break protection
	CKV-3-656	6	Self-actuated	Check	Pipe break protection
	CKV-3-669	6	Self-actuated	Check	Pipe break protection
	CKV-3-670	6	Self-actuated	Check	Pipe break protection
	CKV-3-678	6	Self-actuated	Check	Pipe break protection
	CKV-3-679	6	Self-actuated	Check	Pipe break protection
	CKV-3-805	6	Self-actuated	Check	ERCW flowpath integrity
	CKV-3-806	6	Self-actuated	Check	ERCW flowpath integrity
	CKV-3-810	10	Self-actuated	Check	ERCW flowpath integrity
	CKV-3-830	4	Self-actuated	Check	Maintain TDAFW pump flow path integrity
	CKV-3-831	4	Self-actuated	Check	Maintain TDAFW pump flow path integrity
	CKV-3-832	4	Self-actuated	Check	Maintain TDAFW pump flow path integrity
	CKV-3-833	4	Self-actuated	Check	Maintain TDAFW pump flow path integrity
	CKV-3-861	4	Self-actuated	Check	Containment Isolation
	CKV-3-862	4	Self-actuated	Check	Containment Isolation
	CKV-3-871	4	Self-actuated	Check	Maintain TDAFW pump flow path integrity
	CKV-3-872	4	Self-actuated	Check	Maintain TDAFW pump flow path integrity
	CKV-3-873	4	Self-actuated	Check	Maintain TDAFW pump flow path integrity
	CKV-3-874	4	Self-actuated	Check	Maintain TDAFW pump flow path integrity
	CKV-3-921	4	Self-actuated	Check	Containment Isolation
	CKV-3-922	4	Self-actuated	Check	Containment Isolation
Fuel Oil (18)	CKV-18-556A	1.500	Self-actuated	Check	7-DAY MDP #1 ISOL

TABLE 3.9-25 (Sheet 4 of 15)

UNIT 1

VALVES REQUIRED TO BE ACTIVE FOR DESIGN BASIS EVENTS

System Name	Valve No.	Size Inches	Actuation	Type	Function/Description
	CKV-18-556B	1.500	Self-actuated	Check	7-DAY MDP #1 ISOL
	CKV-18-557A	1.500	Self-actuated	Check	7-DAY MDP #2 ISOL
	CKV-18-557B	1.500	Self-actuated	Check	7-DAY MDP #2 ISOL
	CKV-18-558A	1.000	Self-actuated	Check	DAY TK #1 MDP ISOL
	CKV-18-558B	1.000	Self-actuated	Check	DAY TK #1 MDP ISOL
	CKV-18-559A	1.000	Self-actuated	Check	DAY TK #1 EDP ISOL
	CKV-18-559B	1.000	Self-actuated	Check	DAY TK #1 EDP ISOL
	RFV-18-560A	0.375	Self-actuated	Relief	DAY TK #1 MDP DISC
	RFV-18-560B	0.375	Self-actuated	Relief	DAY TK #1 MDP DISC
	CKV-18-563A	1.000	Self-actuated	Check	DAY TK #1 MDP DISC
	CKV-18-563B	1.000	Self-actuated	Check	DAY TK #1 MDP DISC
	CKV-18-565A	1.000	Self-actuated	Check	DAY TK #2 MDP ISOL
	CKV-18-565B	1.000	Self-actuated	Check	DAY TK #2 MDP ISOL
	CKV-18-566A	1.000	Self-actuated	Check	DAY TK #2 EDP ISOL
	CKV-18-566B	1.000	Self-actuated	Check	DAY TK #2 EDP ISOL
	RFV-18-567A	0.375	Self-actuated	Relief	DAY TK #2 MDP DISC
	RFV-18-567B	0.375	Self-actuated	Relief	DAY TK #2 MDP DISC
	CKV-18-570A	1.000	Self-actuated	Check	DAY TK #2 MDP DISC
	CKV-18-570B	1.000	Self-actuated	Check	DAY TK #2 MDP DISC
High-Pressure	FCV-26-240	4	Motor	Gate	Containment isolation
Fire Protection	FCV-26-243	4	Motor	Gate	Containment isolation
System (26)	CKV-26-1260	4	Self-actuated	Check	Containment isolation
	CKV-26-1296	4	Self-actuated	Check	Containment isolation
Ventilation (30)	FCV-30-2	24	Air	Butterfly	Isolation Valve
	FCV-30-5	24	Air	Butterfly	Isolation Valve
	FCV-30-7	24	Air	Butterfly	Containment Isolation
	FCV-30-8	24	Air	Butterfly	Containment isolation
	FCV-30-9	24	Air	Butterfly	Containment isolation
	FCV-30-10	24	Air	Butterfly	Containment isolation
	FCV-30-12	24	Air	Butterfly	Isolation Valve
	FCV-30-14	24	Air	Butterfly	Containment isolation
	FCV-30-15	24	Air	Butterfly	Containment isolation
	FCV-30-16	24	Air	Butterfly	Containment isolation
	FCV-30-17	24	Air	Butterfly	Containment isolation
	FCV-30-19	10	Air	Butterfly	Containment isolation
	FCV-30-20	10	Air	Butterfly	Containment isolation

TABLE 3.9-25 (Sheet 5 of 15)

UNIT 1

VALVES REQUIRED TO BE ACTIVE FOR DESIGN BASIS EVENTS

System Name	Valve No.	Size Inches	Actuation	Type	Function/Description
	FCV-30-37	8	Air	Butterfly	Containment isolation
	FCV-30-40	8	Air	Butterfly	Containment isolation
	FCV-30-50	24	Air	Butterfly	Containment isolation
	FCV-30-51	24	Air	Butterfly	Containment isolation
	FCV-30-52	24	Air	Butterfly	Containment isolation
	FCV-30-53	24	Air	Butterfly	Containment isolation
	FCV-30-54	24	Air	Butterfly	Isolation Valve
	FCV-30-56	24	Air	Butterfly	Containment isolation
	FCV-30-57	24	Air	Butterfly	Containment isolation
	FCV-30-58	10	Air	Butterfly	Containment isolation
	FCV-30-59	10	Air	Butterfly	Containment isolation
	FCV-30-61	24	Air	Butterfly	Isolation Valve
	FCV-30-62	24	Air	Butterfly	Isolation Valve
	FSV-30-134*	1	Solenoid	Solenoid	Containment isolation
	FSV-30-135*	1	Solenoid	Solenoid	Containment isolation
Air-Conditioning System (31)	FCV-31-305	2	Air	Gate	Containment Isolation
	FCV-31-306	2	Air	Gate	Containment Isolation
	FCV-31-308	2	Air	Gate	Containment Isolation
	FCV-31-309	2	Air	Gate	Containment Isolation
	FCV-31-326	2	Air	Gate	Containment Isolation
	FCV-31-327	2	Air	Gate	Containment Isolation
	FCV-31-329	2	Air	Gate	Containment Isolation
	FCV-31-330	2	Air	Gate	Containment Isolation
	CKV-31-3378	½	Self Actuated	Check	Containment Isolation
	CKV-31-3392	½	Self Actuated	Check	Containment Isolation
	CKV-31-3407	½	Self Actuated	Check	Containment Isolation
	CKV-31-3421	½	Self Actuated	Check	Containment Isolation
Control Air System (32)	0-FCV-32-70	1	Motor	Ball	Aux. Dryer Purge Control
	0-CKV-32-70A	1	Self Actuated	Check	Air Dryer Purge Check Valve
	0-CKV-32-70B	1	Self Actuated	Check	Air Dryer Purge Check Valve
	0-CKV-32-70C	1	Self Actuated	Check	Air Dryer Purge Check Valve
	0-CKV-32-70D	1	Self Actuated	Check	Air Dryer Purge Check Valve
	0-FCV-32-71	1	Motor	Ball	Aux. Dryer Purge Control
	0-FCV-32-72	1	Motor	Ball	Aux. Dryer Purge Control
	0-FCV-32-73	1	Motor	Ball	Aux. Dryer Purge Control

TABLE 3.9-25 (Sheet 6 of 15)

UNIT 1

VALVES REQUIRED TO BE ACTIVE FOR DESIGN BASIS EVENTS

System Name	Valve No.	Size Inches	Actuation	Type	Function/Description
	1-FCV-32-80	2	Air	Globe	Containment Isolation
	0-FCV-32-82	2	Air	Globe	Control Air Normal Flow Isol
	0-FCV-32-85	2	Air	Globe	Control Air Normal Flow Isol
	0-FCV-32-94	1	Motor	Ball	Aux. Dryer Purge Control
	0-CKV-32-94A	1	Self Actuated	Check	Air Dryer Purge Check Valve
	0-CKV-32-94B	1	Self Actuated	Check	Air Dryer Purge Check Valve
	0-CKV-32-94C	1	Self Actuated	Check	Air Dryer Purge Check Valve
	0-CKV-32-94D	1	Self Actuated	Check	Air Dryer Purge Check Valve
	0-FCV-32-95	1	Motor	Ball	Aux. Dryer Purge Control
	0-FCV-32-96	1	Motor	Ball	Aux. Dryer Purge Control
	0-FCV-32-97	1	Motor	Ball	Aux. Dryer Purge Control
	1-FCV-32-102	2	Air	Globe	Containment isolation
	1-FCV-32-110	2	Air	Globe	Containment isolation
	0-CKV-32-240	2	Self Actuated	Check	Air Dryer Purge Check Valve
	0-CKV-32-256	2	Self Actuated	Check	Air Dryer Purge Check Valve
	0-CKV-32-264	2	Self Actuated	Check	Air Dryer Purge Check Valve
	0-CKV-32-279	2	Self Actuated	Check	Air Dryer Purge Check Valve
	1-CKV-32-293	2	Self Actuated	Check	Containment isolation
	1-CKV-32-303	2	Self Actuated	Check	Containment isolation
	1-CKV-32-313	2	Self Actuated	Check	Containment isolation
Sampling and Water Quality (43)	FCV-43-2	3/8	Solenoid	Globe	Containment isolation
	FCV-43-3	3/8	Air	Globe	Containment isolation
	FCV-43-11	3/8	Solenoid	Globe	Containment isolation
	FCV-43-12	3/8	Air	Globe	Containment isolation
	FCV-43-22	3/8	Solenoid	Globe	Containment isolation
	FCV-43-23	1-1/3	Air	Gate	Containment isolation
	FCV-43-34	3/8	Solenoid	Globe	Containment isolation
	FCV-43-35	3/8	Air	Globe	Containment isolation
	FCV-43-54D	3/8	Air	Globe	Steam Gen 1 Drum/Bldn Sample Isol
	FCV-43-55	3/8	Air	Globe	Containment isolation
	FCV-43-56D	3/8	Air	Globe	Steam Gen 2 Drum/Bldn Sample Isol
	FCV-43-58	3/8	Air	Globe	Containment isolation
	FCV-43-59D	3/8	Air	Globe	Steam Gen 3 Drum/Bldn Sample Isol
	FCV-43-61	3/8	Air	Globe	Containment isolation
	FCV-43-63D	3/8	Air	Globe	Steam Gen 4 Drum/Bldn Sample Isol
	FCV-43-64	3/8	Air	Globe	Containment isolation

TABLE 3.9-25 (Sheet 7 of 15)

UNIT 1

VALVES REQUIRED TO BE ACTIVE FOR DESIGN BASIS EVENTS

System Name	Valve No.	Size Inches	Actuation	Type	Function/Description
	FCV-43-75	3/8	Solenoid	Globe	Containment isolation
	FCV-43-77	3/8	Air	Globe	Containment isolation
	1-PCV-43-200A	1/4	Self Actuated	Regulating	LOCA H2 Cntmt Monitor Press Reg
	1-PCV-43-200B	1/4	Self Actuated	Regulating	LOCA H2 Cntmt Monitor Press Reg
	FCV-43-201	3/8	Solenoid	Globe	Containment isolation
	FCV-43-202	3/8	Solenoid	Globe	Containment isolation
	FCV-43-207	3/8	Solenoid	Globe	Containment isolation
	FCV-43-208	3/8	Solenoid	Globe	Containment isolation
	1-PCV-43-210A	1/4	Self Actuated	Regulating	LOCA H2 Cntmt Monitor Press Reg
	1-PCV-43-210B	1/4	Self Actuated	Regulating	LOCA H2 Cntmt Monitor Press Reg
	FCV-43-433	3/8	Solenoid	Globe	Containment isolation
	FCV-43-434	3/8	Solenoid	Globe	Containment isolation
	FCV-43-435	3/8	Solenoid	Globe	Containment isolation
	FCV-43-436	3/8	Solenoid	Globe	Containment isolation
	1-CKV-43-834	1/2	Self Actuated	Check	Cntmt Isolation PASS Waste Holdup Tank
	1-CKV-43-841	1/2	Self Actuated	Check	Cntmt Isolation PASS Waste Holdup Tank
	1-CKV-43-883	1/2	Self Actuated	Check	Cntmt Isolation PASS Cntmt Air Return
	1-CKV-43-884	1/2	Self Actuated	Check	Cntmt Isolation PASS Cntmt Air Return
	1-PREG-43-1470A-A	1/4	Self Actuated	Regulating	O2 Reagent Gas for H2 Monitor Press Reg
	1-PREG-43-1470B-A	1/4	Self Actuated	Regulating	O2 Reagent Gas for H2 Monitor Press Reg
	1-PREG-43-1471A-B	1/4	Self Actuated	Regulating	O2 Reagent Gas for H2 Monitor Press Reg
	1-PREG-43-1471B-B	1/4	Self Actuated	Regulating	O2 Reagent Gas for H2 Monitor Press Reg
Ice Condenser (61)	CKV-61-533	3/8	Self Actuated	Check	Containment isolation
	CKV-61-680	3/8	Self Actuated	Check	Containment isolation
	CKV-61-692	3/8	Self Actuated	Check	Containment isolation
	CKV-61-745	3/8	Self Actuated	Check	Containment isolation
	FCV-61-96	2	Air	Diaphragm	Containment isolation
	FCV-61-97	2	Air	Diaphragm	Containment isolation
	FCV-61-110	2	Air	Diaphragm	Containment isolation
	FCV-61-122	2	Air	Diaphragm	Containment isolation
	FCV-61-191	4	Air	Diaphragm	Containment isolation
	FCV-61-192	4	Air	Diaphragm	Containment isolation
	FCV-61-193	4	Air	Diaphragm	Containment isolation
	FCV-61-194	4	Air	Diaphragm	Containment isolation
Safety Injection System (63)	1-RFV-63-28	3/4	Self Actuated	Relief	Penetration X-30 pressure relief containment isolation

TABLE 3.9-25 (Sheet 8 of 15)

UNIT 1

VALVES REQUIRED TO BE ACTIVE FOR DESIGN BASIS EVENTS

System Name	Valve No.	Size Inches	Actuation	Type	Function/Description
Emergency Gas Treatment System (65)	1-FCV-65-8	8	Air	Butterfly	EGTS Tr A Unit 1 Suction Damper
	1-FCV-65-10	24	Air	Butterfly	EGTS Tr A Unit 1 Suction Damper
	0-FCV-65-24	8	Air	Butterfly	EGTS Tr A Fan Isolation Damper
	0-FCV-65-28A	8	Air	Butterfly	EGTS Tr A Decay Cooling Damper
	0-FCV-65-28B	8	Air	Gate	EGTS Tr A Decay Cooling Damper
	1-FCV-65-30	24	Air	Butterfly	EGTS Tr B Unit 1 Suction Damper
	0-FCV-65-43	8	Air	Butterfly	EGTS Tr B Fan Isolation Damper
	0-FCV-65-47A	8	Air	Gate	EGTS Tr B Decay Cooling Damper
	0-FCV-65-47B	8	Air	Gate	EGTS Tr B Decay Cooling Damper
	1-FCV-65-51	8	Air	Butterfly	EGTS Tr B Unit 1 Suction Damper
	1-FCV-65-52	14	Air	Butterfly	Cntmt Annulus Vacuum Fan Isolation Damper
	1-FCV-65-53	14	Air	Butterfly	Cntmt Annulus Vacuum Fan Isolation Damper
	1-PCV-65-81	16	Air	Butterfly	Shield Bldg & Cntmt Annulus Isol Damper
	1-PCV-65-83	16	Air	Butterfly	Shield Bldg & Cntmt Annulus Isol Damper
	1-PCV-65-86	16	Air	Butterfly	EGTS Cntmt Annulus Isolation Damper
	1-PCV-65-87	16	Air	Butterfly	EGTS Cntmt Annulus Isolation Damper
Essential Raw Cooling Water (67) (See Note **)	FCV-67-9A	4	Motor	Ball	ERCW strainer
	FCV-67-9B	4	Motor	Ball	ERCW strainer
	FCV-67-10A	4	Motor	Ball	ERCW strainer
	FCV-67-10B	4	Motor	Ball	ERCW strainer
	FCV-67-66	8	Motor	Butterfly	Diesel Generator Cooling
	FCV-67-67	8	Motor	Butterfly	Diesel Generator Cooling
	1-FCV-67-83	6	Motor	Butterfly	Containment isolation
	1-FCV-67-87	6	Motor	Butterfly	Containment isolation
	1-FCV-67-88	6	Motor	Butterfly	Containment isolation
	1-FCV-67-89	6	Motor	Butterfly	Containment isolation
	1-FCV-67-91	6	Motor	Butterfly	Containment isolation
	1-FCV-67-95	6	Motor	Butterfly	Containment isolation
	1-FCV-67-96	6	Motor	Butterfly	Containment isolation
	1-FCV-67-97	6	Motor	Butterfly	Containment isolation
	1-FCV-67-99	6	Motor	Butterfly	Containment isolation

TABLE 3.9-25 (Sheet 9 of 15)

UNIT 1

VALVES REQUIRED TO BE ACTIVE FOR DESIGN BASIS EVENTS

System Name	Valve No.	Size Inches	Actuation	Type	Function/Description
	1-FCV-67-103	6	Motor	Butterfly	Containment isolation
	1-FCV-67-104	6	Motor	Butterfly	Containment isolation
	1-FCV-67-105	6	Motor	Butterfly	Containment isolation
	1-FCV-67-107	6	Motor	Butterfly	Containment isolation
	1-FCV-67-111	6	Motor	Butterfly	Containment isolation
	1-FCV-67-112	6	Motor	Butterfly	Containment isolation
	1-FCV-67-113	6	Motor	Butterfly	Containment isolation
	1-FCV-67-123	18	Motor	Butterfly	Containment spray cooling
	1-FCV-67-124	18	Motor	Butterfly	Containment spray cooling
	1-FCV-67-125	18	Motor	Butterfly	Containment spray cooling
	1-FCV-67-126	18	Motor	Butterfly	Containment spray cooling
	1-FCV-67-130	2	Motor	Plug	Containment isolation
	1-FCV-67-131	2	Motor	Plug	Containment isolation
	1-FCV-67-133	2	Motor	Plug	Containment isolation
	1-FCV-67-134	2	Motor	Plug	Containment isolation
	1-FCV-67-138	2	Motor	Plug	Containment isolation
	1-FCV-67-139	2	Motor	Plug	Containment isolation
	1-FCV-67-141	2	Motor	Plug	Containment isolation
	1-FCV-67-142	2	Motor	Plug	Containment isolation
	FCV-67-143	12	Motor	Globe	ERCW flow path integrity
	0-FCV-67-144	16	Motor	Globe	ERCW flow path integrity
	1-FCV-67-146	24	Motor	Butterfly	ERCW from CCS Heat Exchanger A
	2-FCV-67-146	24	Motor	Butterfly	ERCW from CCS Heat Exchanger B
	0-FCV-67-152	24	Motor	Butterfly	CCS flow path integrity
	TCV-67-158	4	Self-Actuated	Globe	SBR temperature control
	1-FCV-67-162	2	Air	Globe	ERCW to pump room coolers
	1-FCV-67-164	2	Air	Globe	ERCW to pump room coolers
	1-FCV-67-176	1-½	Air	Globe	ERCW to pump room coolers
	1-FCV-67-182	1-½	Air	Globe	ERCW to pump room coolers
	1-FCV-67-184	1-½	Air	Globe	ERCW to pump room coolers
	1-FCV-67-186	1-½	Air	Globe	ERCW to pump room coolers
	0-FCV-67-205	4	Motor	Butterfly	Nonessential equipment isolation
	0-FCV-67-208	4	Motor	Butterfly	Nonessential Equipment isolation
	1-FCV-67-213	1-½	Air	Globe	ERCW to pump room coolers
	1-FCV-67-215	1-½	Air	Globe	ERCW to pump room coolers
	2-FCV-67-217	2	Air	Globe	ERCW to pump room coolers

TABLE 3.9-25 (Sheet 10 of 15)

UNIT 1

VALVES REQUIRED TO BE ACTIVE FOR DESIGN BASIS EVENTS

System Name	Valve No.	Size Inches	Actuation	Type	Function/Description
	2-FCV-67-219	2	Air	Globe	ERCW to pump room coolers
	1-FCV-67-295	2	Motor	Plug	Containment isolation
	1-FCV-67-296	2	Motor	Plug	Containment isolation
	1-FCV-67-297	2	Motor	Plug	Containment isolation
	1-FCV-67-298	2	Motor	Plug	Containment isolation
	2-FCV-67-336	1	Air	Globe	ERCW to pump room coolers
	2-FCV-67-338	1	Air	Globe	ERCW to pump room coolers
	1-FCV-67-342	2	Air	Globe	ERCW to pump room coolers
	1-FCV-67-344	2	Air	Globe	ERCW to pump room coolers
	1-FCV-67-346	1-½	Air	Globe	ERCW to pump room coolers
	1-FCV-67-348	1-½	Air	Globe	ERCW to pump room coolers
	1-FCV-67-350	1-½	Air	Globe	ERCW to pump room coolers
	1-FCV-67-352	1-½	Air	Globe	ERCW to pump room coolers
	FCV-67-354	1-½	Air	Globe	ERCW to pump room coolers
	FCV-67-356	1-½	Air	Globe	ERCW to pump room coolers
	0-CKV-67-503A	20	Self-actuated	Check	ERCW flow path integrity
	0-CKV-67-503B	20	Self-actuated	Check	ERCW flow path integrity
	0-CKV-67-503C	20	Self-actuated	Check	ERCW flow path integrity
	0-TCV-67-1050-A	3	Self-actuated	Globe	EBR condenser temperature control
	0-TCV-67-1051-A	3	Self-actuated	Globe	MCR condenser temperature control
	0-TCV-67-1052-B	3	Self-actuated	Globe	EBR condenser temperature control
	0-TCV-67-1053-B	3	Self-actuated	Globe	MCR condenser temperature control
	CKV-67-508A	8	Self-actuated	Check	ERCW flow path integrity
	CKV-67-508B	8	Self-actuated	Check	ERCW flow path integrity
	0-CKV-67-512A	10	Self-Actuated	Check	ERCW flow path integrity
	0-CKV-67-517A	10	Self-Actuated	Check	ERCW flow path integrity
	1-CKV-67-940A	3	Self-Actuated	Check	ERCW flow path integrity
	2-CKV-67-935B	3	Self-Actuated	Check	ERCW flow path integrity
	0-CKV-67-503D	20	Self-actuated	Check	ERCW flow path integrity
	0-CKV-67-503E	20	Self-actuated	Check	ERCW flow path integrity
	0-CKV-67-503F	20	Self-actuated	Check	ERCW flow path integrity
	0-CKV-67-503G	20	Self-actuated	Check	ERCW flow path integrity
	0-CKV-67-503H	20	Self-actuated	Check	ERCW flow path integrity
	1-CKV-67-575A	1/2	Self-actuated	Check	Containment Isolation
	1-CKV-67-575B	1/2	Self-actuated	Check	Containment Isolation
	1-CKV-67-575C	1/2	Self-actuated	Check	Containment Isolation

TABLE 3.9-25 (Sheet 11 of 15)

UNIT 1

VALVES REQUIRED TO BE ACTIVE FOR DESIGN BASIS EVENTS

System Name	Valve No.	Size Inches	Actuation	Type	Function/Description
	1-CKV-67-575D	1/2	Self-actuated	Check	Containment Isolation
	1-CKV-67-580A	2	Self-actuated	Check	Containment Isolation
	1-CKV-67-580B	2	Self-actuated	Check	Containment Isolation
	1-CKV-67-580C	2	Self-actuated	Check	Containment Isolation
	1-CKV-67-580D	2	Self-actuated	Check	Containment Isolation
	1-CKV-67-585A	1/2	Self-actuated	Check	Containment Isolation
	1-CKV-67-585B	1/2	Self-actuated	Check	Containment Isolation
	1-CKV-67-585C	1/2	Self-actuated	Check	Containment Isolation
	1-CKV-67-585D	1/2	Self-actuated	Check	Containment Isolation
	1-RFV-67-1060A	3/4 x 1	Self-actuated	Relief	Containment Isolation
	1-RFV-67-1060B	3/4 x 1	Self-actuated	Relief	Containment Isolation
	1-RFV-67-1060C	3/4 x 1	Self-actuated	Relief	Containment Isolation
	1-RFV-67-1060D	3/4 x 1	Self-actuated	Relief	Containment Isolation
	0-CKV-67-502A	2	Self-actuated	Check	Air release
	0-CKV-67-502B	2	Self-actuated	Check	Air release
	0-CKV-67-502C	2	Self-actuated	Check	Air release
	0-CKV-67-502D	2	Self-actuated	Check	Air release
	0-CKV-67-502E	2	Self-actuated	Check	Air release
	0-CKV-67-502F	2	Self-actuated	Check	Air release
	0-CKV-67-502G	2	Self-actuated	Check	Air release
	0-CKV-67-502H	2	Self-actuated	Check	Air release
	0-FSV-67-1221-A	1	Solenoid	Globe	ERCW Supply
	0-PCV-67-1222	1	Self	Regulating	Press Cntr for ERCW to Aux Air Comp A
	0-TCV-67-1222A	1/2	Self	Regulating	Throttles ERCW to Aux Air Comp A cyl jacket
	0-TCV-67-1222B	3/4	Self	Regulating	Throttles ERCW to Aux Air Comp A cyl jacket
	0-FSV-67-1223-B	1	Solenoid	Globe	ERCW Supply
	0-PCV-67-1224	1	Self	Regulating	Press Cntr for ERCW to Aux Air Comp B
	0-TCV-67-1224A	1/2	Self	Regulating	Throttles ERCW to Aux Air Comp B cyl jacket
	0-TCV-67-1224B	3/4	Self	Regulating	Throttles ERCW to Aux Air Comp B cyl jacket
Component Cooling Water (70)	1-FCV-70-85	6	Air	Butterfly	Containment Isolation
	1-FCV-70-87	3	Motor	Gate	Containment Isolation
	1-FCV-70-89	6	Motor	Butterfly	Containment Isolation

TABLE 3.9-25 (Sheet 12 of 15)

UNIT 1

VALVES REQUIRED TO BE ACTIVE FOR DESIGN BASIS EVENTS

System Name	Valve No.	Size Inches	Actuation	Type	Function/Description
	1-FCV-70-90	3	Motor	Gate	Containment Isolation
	1-FCV-70-92	6	Motor	Butterfly	Containment Isolation
	1-FCV-70-100	6	Motor	Butterfly	Containment Isolation
	1-FCV-70-133	3	Motor	Gate	RCP Thermal Barrier Isolation
	1-FCV-70-134	3	Motor	Gate	Containment Isolation
	1-FCV-70-140	6	Motor	Butterfly	Containment Isolation
	1-FCV-70-143	6	Motor	Butterfly	Containment Isolation
	1, 2-FCV-70-153	18	Motor	Butterfly	RHR Hx Isolation
	1-FCV-70-156	18	Motor	Butterfly	RHR Hx Isolation
	0-FCV-70-194	20	Motor	Butterfly	Spent Fuel Pit Hx Isolation
	0-FCV-70-197	20	Motor	Butterfly	Spent fuel pit Hx isolation
	0-CKV-70-504	16	Self-actuated	Check	Prevent backflow through CCP
	1,2-CKV-70-504A	16	Self-actuated	Check	Prevent backflow through CCP
	1,2-CKV-70-504B	16	Self-actuated	Check	Prevent backflow through CCP
	1-CKV-70-679	3	Self-actuated	Check	Containment isolation CCP
	1-CKV-70-698	3/4 x 1	Self-actuated	Relief	Containment isolation CCP
	1-CKV-70-790	3/4 x 1	Self-actuated	Relief	Containment isolation
	1-FCV-70-183	3	Motor	Gate	Sample Hx Isolation
	1-FCV-70-215	3	Motor	Gate	Sample Hx Isolation
	1-FCV-70-66	2	Air	Angle	CCS surge tank isolation
	2-FCV-70-66	2	Air	Angle	CCS surge tank isolation
	1-RFV-70-538	3x4	Self-actuated	Relief	Surge tank 1A/1B relief
	1-CKV-70-681-A,B,C, D	1-1/2	Self -actuated	Check	Overpressurization protection
	1-CKV-70-682-A,B,C, D	1-1/2	Self -actuated	Check	Overpressurization protection
	1-CKV-70-687	3/4 x 1	Self -actuated	Relief	RCP thermal barrier isolation
	1-RFV-70-703	3x4	Self -actuated	Relief	Excess letdown HX relief
	1-RFV-70-835	3/4x1	Self -actuated	Relief	RCP thermal barrier supply relief
Containment Spray System (72)	1-FCV-72-13-B	2	Motor	Globe	Min-flow pump recirculation control valve
	1-FCV-72-34-A	2	Motor	Globe	Min-flow pump recirculation control valve
	1-RFV-72-40	3/4 x 1	Self-Actuated	Relief	Bonnet Overpressure Relief Valve for 1-FCV-72-40
	1-RFV-72-41	3/4 x 1	Self-Actuated	Relief	Bonnet Overpressure Relief Valve for 1-FCV-72-41

TABLE 3.9-25 (Sheet 13 of 15)

UNIT 1

VALVES REQUIRED TO BE ACTIVE FOR DESIGN BASIS EVENTS

System Name	Valve No.	Size Inches	Actuation	Type	Function/Description
Primary Water System (81)	1-FCV-81-12	3	Air	Gate	Primary water to RCS PRT
	1-CKV-81-502	3	Self-actuated	Gate	Primary water to RCS PRT
Standby Diesel Generators (82)	1-FCV-82-160	1.500	Air	Diaph	Flow Cont 1A1 TK A
	1-FSV-82-160-A	0.370	Elec	Sol V	Air ST SOL 1A1 (A)
	1-FCV-82-161	1.500	Air	Diaph	Flow Cont 1A2 TK A
	1-FSV-82-161-A	0.370	Elec	Sol V	Air ST SOL 1A2 (A)
	1-PCV-82-162A	2.000	Air	Diaph	PR RED V 1A1 TK A
	1-PREG-82-162B	0.250	Self	Diaph	PR REG V 1A1 TK A
	1-PCV-82-163A	2.000	Air	Diaph	PR RED V 1A2 TK A
	1-PREG-82-163B	0.250	Self	Diaph	PR REG V 1A2 TK A
	1-FCV-82-170	1.500	Air	Diaph	FLOW CONT 1A1 TK B
	1-FSV-82-170-A	0.370	Elec	Sol V	AIR ST SOL 1A1 (B)
	1-FCV-82-171	1.500	Air	Diaph	FLOW CONT 1A2 TK B
	1-FSV-82-171-A	0.370	Elec	Sol V	AIR ST SOL 1A2 (B)
	1-PCV-82-172A	2.000	Air	Diaph	PR RED V 1A1 TK B
	1-PREG-82-172B	0.250	Self	Diaph	PR REG V 1A1 TK B
	1-PCV-82-173A	2.000	Air	Diaph	PR RED V 1A2 TK B
	1-PREG-82-173B	0.250	Self	Diaph	PR REG V 1A2 TK B
	1-FCV-82-190	1.500	Air	Diaph	FLOW CONT 1B1 TK A
	1-FSV-82-190-A	0.370	Elec	Sol V	AIR ST SOL 1B1(A)
	1-FCV-82-191	1.500	Air	Diaph	FLOW CONT 1B2 TK A
	1-FSV-82-191-A	0.370	Elec	Sol V	AIR ST SOL 1B2 (A)
	1-PCV-82-192A	2.000	Air	Diaph	PR REG V 1B1 TK A
	1-PREG-82-192B	0.250	Self	Diaph	PR REG V 1B1 TK A
	1-PCV-82-193A	2.000	Air	Diaph	PR RED V 1B2 TK A
	1-PREG-82-193B	0.250	Self	Diaph	PR REG V 1B2 TK A
	1-FCV-82-200	1.500	Air	Diaph	FLOW CONT 1B1 TK B
	1-FSV-82-200-A	0.370	Elec	Sol V	AIR ST SOL 1B1 (B)
	1-FCV-82-201	1.500	Air	Diaph	FLOW CONT 1B2 TK B
	1-FSV-82-201-A	0.370	Elec	Sol V	AIR ST SOL 1B2 (B)
	1-PCV-82-202A	2.000	Air	Diaph	PR RED V 1B1 TK B
	1-PREG-82-202B	0.250	Self	Diaph	PR REG V 1B1 TK B
	1-PCV-82-203A	2.000	Air	Diaph	PR RED V 1B2 TK B
	1-PREG-82-203B	0.250	Self	Diaph	PR REG V 1B2 TK B

TABLE 3.9-25 (Sheet 14 of 15)

UNIT 1

VALVES REQUIRED TO BE ACTIVE FOR DESIGN BASIS EVENTS

System Name	Valve No.	Size Inches	Actuation	Type	Function/Description
	2-FCV-82-220	1.500	Air	Diaph	FLOW CONT 2A1 TK A
	2-FSV-82-220-A	0.370	Elec	Sol V	AIR ST SOL 2A1 (A)
	2-FCV-82-221	1.500	Air	Diaph	FLOW CONT 2A2 TK A
	2-FSV-82-221-A	0.370	Elec	Sol V	AIR ST SOL 2A2 (A)
	2-PCV-82-222A	2.000	Air	Diaph	PR RED V 2A1 TK A
	2-PREG-82-222B	0.250	Self	Diaph	PR REG V 2A1 TK A
	2-PCV-82-223A	2.000	Air	Diaph	PR RED V 2A2 TK A
	2-PREG-82-223B	0.250	Self	Diaph	PR REG V 2A2 TK A
	2-FCV-82-230	1.500	Air	Diaph	FLOW CONT 2A1 TK B
	2-FSV-82-230-A	0.370	Elec	Sol V	AIR ST SOL 2A1 (B)
	2-FCV-82-231	1.500	Air	Diaph	FLOW CONT 2A2 TK B
	2-FSV-82-231-A	0.370	Elec	Sol V	AIR ST SOL 2A2 (B)
	2-PCV-82-232A	2.000	Air	Diaph	PR RED V 2A1 TK B
	2-PREG-82-232B	0.250	Self	Diaph	PR REG V 2A1 TK B
	2-PCV-82-233A	2.000	Air	Diaph	PR RED V 2A2 TK B
	2-PREG-82-233B	0.250	Self	Diaph	PR REG V 2A2 TK B
	2-FCV-82-250	1.500	Air	Diaph	FLOW CONT 2B1 TK A
	2-FSV-82-250-A	0.370	Elec	Sol V	AIR ST SOL 2B1(A)
	2-FCV-82-251	1.500	Air	Diaph	FLOW CONT 2B2 TK A
	2-FSV-82-251-A	0.370	Elec	Sol V	AIR ST SOL 2B2 (A)
	2-PCV-82-252A	2.000	Air	Diaph	PR RED V 2B1 TK A
	2-PREG-82-252B	0.250	Self	Diaph	PR REG V 2B1 TK A
	2-PCV-82-253A	2.000	Air	Diaph	PR RED V 2B2 TK A
	2-PREG-82-253B	0.250	Self	Diaph	PR REG V 2B2 TK A
	2-FCV-82-260	1.500	Air	Diaph	FLOW CONT 2B1 TK B
	2-FSV-82-260-A	0.370	Elec	Sol V	AIR ST SOL 2B1 (B)
	2-FCV-82-261	1.500	Air	Diaph	FLOW CONT 2B2 TK B
	2-FSV-82-261-A	0.370	Elec	Sol V	AIR ST SOL 2B2 (B)
	2-PCV-82-262A	2.000	Air	Diaph	PR RED V 2B1 TK B
	2-PREG-82-262B	0.250	Self	Diaph	PR REG V 2B1 TK B
	2-PCV-82-263A	2.000	Air	Diaph	PR RED V 2B2 TK B
	2-PREG-82-263B	0.250	Self	Diaph	PR REG V 2B2 TK B
	1,2-CKV-82-502A1-A	0.750		Check	TK SUP A1 (A)
	1,2-CKV-82-502B1-B	0.750		Check	TK SUP B1 (A)
	1,2-CKV-82-505A1-A	0.750		Check	TK SUP A1 (B)
	1,2-CKV-82-505B1-B	0.750		Check	TK SUP B1 (B)

TABLE 3.9-25 (Sheet 15 of 15)

UNIT 1

VALVES REQUIRED TO BE ACTIVE FOR DESIGN BASIS EVENTS

System Name	Valve No.	Size Inches	Actuation	Type	Function/Description
	1,2-CKV-82-509A1-A	0.750		Check	CROSS CONN CK A1
	1,2-CKV-82-509B1-B	0.750		Check	CROSS CONN CK B1
	1,2-CKV-82-523A1-A	0.750		Check	RELAY CK A1 (A)
	1,2-CKV-82-523B1-B	0.750		Check	RELAY CK B1 (A)
	1,2-SPV-82-524A1-A	0.375		Check	SLIDE VLV A1
	1,2-SPV-82-524B1-B	0.375		Check	SLIDE VLV B1
	1,2-CKV-82-531A1-A	0.750		Check	RELAY CK A1 (B)
	1,2-CKV-82-531B1-B	0.750		Check	RELAY CK B1 (B)
	1,2-CKV-82-536A2-A	0.750		Check	TK SUP A2 (A)
	1,2-CKV-82-536B2-B	0.750		Check	TK SUP B2 (A)
	1,2-CKV-82-539A2-A	0.750		Check	TK SUP A2 (B)
	1,2-CKV-82-539B2-B	0.750		Check	TK SUP B2 (B)
	1,2-CKV-82-543A2-A	0.750		Check	CROSS CONN CK A2
	1,2-CKV-82-543B2-B	0.750		Check	CROSS CONN CK B2
	1,2-CKV-82-557A2-A	0.750		Check	RELAY CK A2 (A)
	1,2-CKV-82-557B2-B	0.750		Check	RELAY CK B2 (A)
	1,2-SPV-82-558A2-A	0.375		Check	SLIDE VLV A2
	1,2-SPV-82-558B2-B	0.375		Check	SLIDE VLV B2
	1,2-CKV-82-565A2-A	0.750		Check	RELAY CK A2 (B)
	1,2-CKV-82-565B2-B	0.750		Check	RELAY CK B2 (B)
Radiation Monitoring (90)	1-FCV-90-107	1-1/2	Air	Globe	Containment Isolation
	1-FCV-90-108	1-1/2	Air	Globe	Containment Isolation
	1-FCV-90-109	1-1/2	Air	Globe	Containment Isolation
	1-FCV-90-110	1-1/2	Air	Globe	Containment Isolation
	1-FCV-90-111	1-1/2	Air	Globe	Containment Isolation
	1-FCV-90-113	1-1/2	Air	Globe	Containment Isolation
	1-FCV-90-114	1-1/2	Air	Globe	Containment Isolation
	1-FCV-90-115	1-1/2	Air	Globe	Containment Isolation
	1-FCV-90-116	1-1/2	Air	Globe	Containment Isolation
	1-FCV-90-117	1-1/2	Air	Globe	Containment Isolation

*Unit 2 valves were deleted under ECN 5663

**Valves not prefixed by 1-, 2- or 0-are understood to be prefixed by 1- and 2

TABLE 3.9-25 (Sheet 1 of 14)
UNIT 2

VALVES REQUIRED TO BE ACTIVE FOR DESIGN BASIS EVENTS

System Name	Valve No.	Size Inches	Actuation	Type	Function/Description
Main Steam (1)	FCV-1-4	32	Air	Globe	Main steam and containment isolation
	PCV-1-5	6	Air	Globe	SG pressure control and relief
	FCV-1-7	4	Solenoid	Globe	Blowdown and containment isolation
	FCV-1-11	32	Air	Globe	Main steam and containment isolation
	PCV-1-12	6	Air	Globe	SG pressure control and relief
	FCV-1-14	4	Solenoid	Globe	Blowdown and containment isolation
	FCV-1-22	32	Air	Globe	Main steam and containment isolation
	PCV-1-23	6	Air	Globe	SG pressure control and relief
	FCV-1-25	4	Solenoid	Globe	Blowdown and containment isolation
	FCV-1-29	32	Air	Globe	Main steam and containment isolation
	PCV-1-30	6	Air	Globe	SG pressure control and relief
	FCV-1-32	4	Solenoid	Globe	Blowdown and containment isolation
	FCV-1-51	4	Motor	Globe	AFW pump turbine operation
	FCV-1-52	4	Hydraulic	Globe	AFW pump turbine operation
	FCV-1-147	2	Air	Globe	Containment isolation
	FCV-1-148	2	Air	Globe	Containment isolation
	FCV-1-149	2	Air	Globe	Containment isolation
	FCV-1-150	2	Air	Globe	Containment isolation
	FCV-1-181	4	Solenoid	Globe	Blowdown isolation
	FCV-1-182	4	Solenoid	Globe	Blowdown isolation
	FCV-1-183	4	Solenoid	Globe	Blowdown isolation
	FCV-1-184	4	Solenoid	Globe	Blowdown isolation
	SFV-1-512	6x10	Self-actuated	Angle relief	Steam generator safety relief
	SFV-1-513	6x10	Self-actuated	Angle relief	Steam generator safety relief
	SFV-1-514	6x10	Self-actuated	Angle relief	Steam generator safety relief
	SFV-1-515	6x10	Self-actuated	Angle relief	Steam generator safety relief
	SFV-1-516	6x10	Self-actuated	Angle relief	Steam generator safety relief
	SFV-1-517	6x10	Self-actuated	Angle relief	Steam generator safety relief
	SFV-1-518	6x10	Self-actuated	Angle relief	Steam generator safety relief
	SFV-1-519	6x10	Self-actuated	Angle relief	Steam generator safety relief
	SFV-1-520	6x10	Self-actuated	Angle relief	Steam generator safety relief
	SFV-1-521	6x10	Self-actuated	Angle relief	Steam generator safety relief
	SFV-1-522	6x10	Self-actuated	Angle relief	Steam generator safety relief
	SFV-1-523	6x10	Self-actuated	Angle relief	Steam generator safety relief
	SFV-1-524	6x10	Self-actuated	Angle relief	Steam generator safety relief
	SFV-1-525	6x10	Self-actuated	Angle relief	Steam generator safety relief
	SFV-1-526	6x10	Self-actuated	Angle-relief	Steam generator safety relief
	SFV-1-527	6x10	Self-actuated	Angle-relief	Steam generator safety relief
	SFV-1-528	6x10	Self-actuated	Angle-relief	Steam generator safety relief
	SFV-1-529	6x10	Self-actuated	Angle-relief	Steam generator safety relief

TABLE 3.9-25 (Sheet 2 of 14)
UNIT 2

VALVES REQUIRED TO BE ACTIVE FOR DESIGN BASIS EVENTS

System Name	Valve No.	Size Inches	Actuation	Type	Function/Description
Main Steam (1)	SFV-1-530	6x10	Self-actuated	Angle relief	Steam generator safety relief
	SFV-1-531	6x10	Self-actuated	Angle relief	Steam generator safety relief
	FCV-1-15	4	Motor	Gate	AFW pump turbine operation
	FCV-1-16	4	Motor	Gate	AFW pump turbine operation
	FCV-1-17	4	Motor	Gate	AFW pump turbine operation
	FCV-1-18	4	Motor	Gate	AFW pump turbine operation
	CKV-1-891	4	Self-actuated	Check	Prvnt bkflw btwn stm gen
	CKV-1-892	4	Self-actuated	Check	Prvnt bkflw btwn stm gen
Feedwater (3)	FCV-3-33	16	Motor	Gate	Main feedwater isolation
	FCV-3-47	16	Motor	Gate	Main feedwater isolation
	FCV-3-87	16	Motor	Gate	Main feedwater isolation
	FCV-3-100	16	Motor	Gate	Main feedwater isolation
	FCV-3-116A	4	Motor	Gate	AFW flow path integrity
	FCV-3-116B	4	Motor	Gate	AFW flow path integrity
	PCV-3-122 (Note)	4	Air/Nitrogen	Globe	Maintain head on pump
	FCV-3-126A	4	Motor	Gate	AFW flow path integrity
	FCV-3-126B	4	Motor	Gate	AFW flow path integrity
	PCV-3-132 (Note)	4	Air/Nitrogen	Globe	Maintain head on pump
	FCV-3-136A	6	Motor	Gate	AFW flow path integrity
	FCV-3-136B	6	Motor	Gate	AFW flow path integrity
	LCV-3-148 (Note)	4	Air/Nitrogen	Globe	Steam generator level control
	LCV-3-148A (Note)	2	Air/Nitrogen	Globe	Steam generator level control
	LCV-3-156 (Note)	4	Air/Nitrogen	Globe	Steam generator level control
	LCV-3-156A (Note)	2	Air/Nitrogen	Globe	Steam generator level control
	LCV-3-164 (Note)	4	Air/Nitrogen	Globe	Steam generator level control
	LCV-3-164A (Note)	2	Air/Nitrogen	Globe	Steam generator level control
	LCV-3-171 (Note)	4	Air/Nitrogen	Globe	Steam generator level control
	LCV-3-171A (Note)	2	Air/Nitrogen	Globe	Steam generator level control
	LCV-3-172	3	Air/Nitrogen	Globe	Steam generator level control
	LCV-3-173	3	Air/Nitrogen	Globe	Steam generator level control
	LCV-3-174	3	Air/Nitrogen	Globe	Steam generator level control
	LCV-3-175	3	Air/Nitrogen	Globe	Steam generator level control
	FCV-3-179A	6	Motor	Gate	AFW flow path integrity
	FCV-3-179B	6	Motor	Gate	AFW flow path integrity
	2-FCV-3-185	2	Air	Globe	FW pressure integrity
	2-FCV-3-186	2	Air	Globe	FW pressure integrity
	2-FCV-3-187	2	Air	Globe	FW pressure integrity

TABLE 3.9-25 (Sheet 3 of 14)
UNIT 2

VALVES REQUIRED TO BE ACTIVE FOR DESIGN BASIS EVENTS

System Name	Valve No.	Size Inches	Actuation	Type	Function/Description
Feedwater (3)	2-FCV-3-188	2	Air	Globe	FW pressure integrity
Note: Unit 2 provides Appendix R credited nitrogen gas backup control and signal air supply source to allow continued control of the Turbine Driven Auxiliary Feedwater (TDAFW) Level Control Valves (LCVs), Motor Driven Auxiliary Feedwater (MDAFW) Level Control Valves and Motor Driven Auxiliary Feedwater Pressure Control Valves (PCVs)					
	FCV-3-236	6	Air	Globe	Main feedwater isolation
	FCV-3-239	6	Air	Globe	Main feedwater isolation
	FCV-3-242	6	Air	Globe	Main feedwater isolation
	FCV-3-245	6	Air	Globe	Main feedwater isolation
	FCV-3-355	2	Air	Globe	Recirc. Isolation
	FCV-3-359	2	Air	Globe	Recirc. Isolation
	CKV-3-508	16	Self-actuated	Check	Pipe break protection
	CKV-3-509	16	Self-actuated	Check	Pipe break protection
	CKV-3-510	16	Self-actuated	Check	Pipe break protection
	CKV-3-511	16	Self-actuated	Check	Pipe break protection
	CKV-3-638	6	Self-actuated	Check	Pipe break protection
	CKV-3-644	6	Self-actuated	Check	Pipe break protection
	CKV-3-645	6	Self-actuated	Check	Pipe break protection
	CKV-3-652	6	Self-actuated	Check	Pipe break protection
	CKV-3-655	6	Self-actuated	Check	Pipe break protection
	CKV-3-656	6	Self-actuated	Check	Pipe break protection
	CKV-3-669	6	Self-actuated	Check	Pipe break protection
	CKV-3-670	6	Self-actuated	Check	Pipe break protection
	CKV-3-678	6	Self-actuated	Check	Pipe break protection
	CKV-3-679	6	Self-actuated	Check	Pipe break protection
	CKV-3-805	6	Self-actuated	Check	ERCW flowpath integrity
	CKV-3-806	6	Self-actuated	Check	ERCW flowpath integrity
	CKV-3-810	10	Self-actuated	Check	ERCW flowpath integrity
	CKV-3-830	4	Self-actuated	Check	Maintain TDAFW pump flow path integrity
	CKV-3-831	4	Self-actuated	Check	Maintain TDAFW pump flow path integrity
	CKV-3-832	4	Self-actuated	Check	Maintain TDAFW pump flow path integrity
	CKV-3-833	4	Self-actuated	Check	Maintain TDAFW pump flow path integrity
	CKV-3-861	4	Self-actuated	Check	Containment Isolation
	CKV-3-862	4	Self-actuated	Check	Containment Isolation
	CKV-3-871	4	Self-actuated	Check	Maintain TDAFW pump flow path integrity
	CKV-3-872	4	Self-actuated	Check	Maintain TDAFW pump flow path integrity
	CKV-3-873	4	Self-actuated	Check	Maintain TDAFW pump flow path integrity
	CKV-3-874	4	Self-actuated	Check	Maintain TDAFW pump flow path integrity
	CKV-3-921	4	Self-actuated	Check	Containment Isolation
	CKV-3-922	4	Self-actuated	Check	Containment Isolation

TABLE 3.9-25 (Sheet 4 of 14)
UNIT 2

VALVES REQUIRED TO BE ACTIVE FOR DESIGN BASIS EVENTS

System Name	Valve No.	Size Inches	Actuation	Type	Function/Description
Fuel Oil (18)	CKV-18-556A	1.500	Self-actuated	Check	7-DAY MDP #1 ISOL
	CKV-18-556B	1.500	Self-actuated	Check	7-DAY MDP #1 ISOL
	CKV-18-557A	1.500	Self-actuated	Check	7-DAY MDP #2 ISOL
	CKV-18-557B	1.500	Self-actuated	Check	7-DAY MDP #2 ISOL
	CKV-18-558A	1.000	Self-actuated	Check	DAY TK #1 MDP ISOL
	CKV-18-558B	1.000	Self-actuated	Check	DAY TK #1 MDP ISOL
	CKV-18-559A	1.000	Self-actuated	Check	DAY TK #1 EDP ISOL
	CKV-18-559B	1.000	Self-actuated	Check	DAY TK #1 EDP ISOL
	RFV-18-560A	0.375	Self-actuated	Relief	DAY TK #1 MDP DISC
	RFV-18-560B	0.375	Self-actuated	Relief	DAY TK #1 MDP DISC
	CKV-18-563A	1.000	Self-actuated	Check	DAY TK #1 MDP DISC
	CKV-18-563B	1.000	Self-actuated	Check	DAY TK #1 MDP DISC
	CKV-18-565A	1.000	Self-actuated	Check	DAY TK #2 MDP ISOL
	CKV-18-565B	1.000	Self-actuated	Check	DAY TK #2 MDP ISOL
	CKV-18-566A	1.000	Self-actuated	Check	DAY TK #2 EDP ISOL
	CKV-18-566B	1.000	Self-actuated	Check	DAY TK #2 EDP ISOL
	RFV-18-567A	0.375	Self-actuated	Relief	DAY TK #2 MDP DISC
	RFV-18-567B	0.375	Self-actuated	Relief	DAY TK #2 MDP DISC
	CKV-18-570A	1.000	Self-actuated	Check	DAY TK #2 MDP DISC
	CKV-18-570B	1.000	Self-actuated	Check	DAY TK #2 MDP DISC
High-Pressure	FCV-26-240	4	Motor	Gate	Containment isolation
Fire Protection	FCV-26-243	4	Motor	Gate	Containment isolation
System (26)	CKV-26-1260	4	Self-actuated	Check	Containment isolation
	CKV-26-1296	4	Self-actuated	Check	Containment isolation
Ventilation (30)	FCV-30-2	24	Air	Butterfly	Isolation Valve
	FCV-30-5	24	Air	Butterfly	Isolation Valve
	FCV-30-7	24	Air	Butterfly	Containment Isolation
	FCV-30-8	24	Air	Butterfly	Containment isolation
	FCV-30-9	24	Air	Butterfly	Containment isolation
	FCV-30-10	24	Air	Butterfly	Containment isolation
	FCV-30-12	24	Air	Butterfly	Isolation Valve
	FCV-30-14	24	Air	Butterfly	Containment isolation
	FCV-30-15	24	Air	Butterfly	Containment isolation
	FCV-30-16	24	Air	Butterfly	Containment isolation
	FCV-30-17	24	Air	Butterfly	Containment isolation
	FCV-30-19	10	Air	Butterfly	Containment isolation
	FCV-30-20	10	Air	Butterfly	Containment isolation
	FCV-30-37	88	Air	Butterfly	Containment isolation

TABLE 3.9-25 (Sheet 5 of 14)
UNIT 2

VALVES REQUIRED TO BE ACTIVE FOR DESIGN BASIS EVENTS

System Name	Valve No.	Size Inches	Actuation	Type	Function/Description
	FCV-30-40	24	Air	Butterfly	Containment isolation
	FCV-30-50	24	Air	Butterfly	Containment isolation
	FCV-30-51	24	Air	Butterfly	Containment isolation
	FCV-30-52	24	Air	Butterfly	Containment isolation
	FCV-30-53	24	Air	Butterfly	Containment isolation
	FCV-30-54	24	Air	Butterfly	Isolation Valve
	FCV-30-56	24	Air	Butterfly	Containment isolation
	FCV-30-57	10	Air	Butterfly	Containment isolation
	FCV-30-58	10	Air	Butterfly	Containment isolation
	FCV-30-59	24	Air	Butterfly	Containment isolation
	FCV-30-61	24	Air	Butterfly	Isolation Valve
	FCV-30-62	24	Air	Butterfly	Isolation Valve
Air-Conditioning System (31)	FCV-31-305	2	Air	Gate	Containment Isolation
	FCV-31-306	2	Air	Gate	Containment Isolation
	FCV-31-308	2	Air	Gate	Containment Isolation
	FCV-31-309	2	Air	Gate	Containment Isolation
	FCV-31-326	2	Air	Gate	Containment Isolation
	FCV-31-327	2	Air	Gate	Containment Isolation
	FCV-31-329	2	Air	Gate	Containment Isolation
	FCV-31-330	2	Air	Gate	Containment Isolation
	CKV-31-3378	½	Self Actuated	Check	Containment Isolation
	CKV-31-3392	½	Self Actuated	Check	Containment Isolation
	CKV-31-3407	½	Self Actuated	Check	Containment Isolation
	CKV-31-3421	½	Self Actuated	Check	Containment Isolation
Control Air System (32)	FCV-32-70	1	Motor	Ball	Aux. Dryer Purge Control
	CKV-32-70A	1	Self Actuated	Check	Air Dryer Purge Check Valve
	CKV-32-70B	1	Self Actuated	Check	Air Dryer Purge Check Valve
	CKV-32-70C	1	Self Actuated	Check	Air Dryer Purge Check Valve
	CKV-32-70D	1	Self Actuated	Check	Air Dryer Purge Check Valve
	FCV-32-71	1	Motor	Ball	Aux. Dryer Purge Control
	FCV-32-72	1	Motor	Ball	Aux. Dryer Purge Control
	FCV-32-73	1	Motor	Ball	Aux. Dryer Purge Control
	FCV-32-80	2	Air	Globe	Containment Isolation
	FCV-32-81	2	Air	Globe	Containment Isolation
	FCV-32-82	2	Air	Globe	Control Air Normal Flow Isol
	FCV-32-85	2	Air	Globe	Control Air Normal Flow Isol
	FCV-32-94	2	Motor	Ball	Aux. Dryer Purge Control
	CKV-32-94A	1	Self Actuated	Check	Air Dryer Purge Check Valve

TABLE 3.9-25 (Sheet 6 of 14)
UNIT 2

VALVES REQUIRED TO BE ACTIVE FOR DESIGN BASIS EVENTS

System Name	Valve No.	Size Inches	Actuation	Type	Function/Description
Control Air System (32)	CKV-32-94B	1	Self Actuated	Check	Air Dryer Purge Check Valve
	CKV-32-94C	1	Self Actuated	Check	Air Dryer Purge Check Valve
	CKV-32-94D	1	Self Actuated	Check	Air Dryer Purge Check Valve
	FCV-32-95	1	Motor	Ball	Aux. Dryer Purge Control
	FCV-32-96	1	Motor	Ball	Aux. Dryer Purge Control
	FCV-32-97	1	Motor	Ball	Aux. Dryer Purge Control
	1-FCV-32-102	2	Air	Globe	Containment isolation
	2-FCV-32-103	2	Air	Globe	Containment isolation
	1-FCV-32-110	2	Air	Globe	Containment isolation
	2-FCV-32-111	2	Air	Globe	Containment isolation
	0-CKV-32-240	2	Self Actuated	Check	Air Dryer Purge Check Valve
	0-CKV-32-256	2	Self Actuated	Check	Air Dryer Purge Check Valve
	0-CKV-32-264	2	Self Actuated	Check	Air Dryer Purge Check Valve
	0-CKV-32-279	2	Self Actuated	Check	Air Dryer Purge Check Valve
	1-CKV-32-293	2	Self Actuated	Check	Containment isolation
	1-CKV-32-303	2	Self Actuated	Check	Containment isolation
	1-CKV-32-313	2	Self Actuated	Check	Containment isolation
	2-CKV-32-323	2	Self Actuated	Check	Containment isolation
	2-CKV-32-333	2	Self Actuated	Check	Containment isolation
	2-CKV-32-343	2	Self Actuated	Check	Containment isolation
Sampling and Water Quality (43)	FCV-43-2	3/8	Air	Globe	Containment isolation
	FCV-43-3	3/8	Air	Globe	Containment isolation
	FCV-43-11	3/8	Air	Globe	Containment isolation
	FCV-43-12	3/8	Air	Globe	Containment isolation
	FCV-43-22	3/8	Air	Globe	Containment isolation
	FCV-43-23	3/8	Air	Globe	Containment isolation
	FCV-43-34	3/8	Air	Globe	Containment isolation
	FCV-43-35	3/8	Air	Globe	Containment isolation
	FCV-43-54D	3/8	Air	Globe	SGBD Sample Isolation
	FCV-43-56D	3/8	Air	Globe	SGBD Sample Isolation
	FCV-43-59D	3/8	Air	Globe	SGBD Sample Isolation
	FCV-43-63D	3/8	Air	Globe	SGBD Sample Isolation
	FCV-43-55	3/8	Air	Globe	Containment isolation
	FCV-43-58	3/8	Air	Globe	Containment isolation
	FCV-43-61	3/8	Air	Globe	Containment isolation
	FCV-43-64	3/8	Air	Globe	Containment isolation
	1-FCV-43-75	3/8	Solenoid	Globe	Containment isolation
	1-FCV-43-77	3/8	Air	Globe	Containment isolation
	1-PCV-43-200A	1/4	Self Actuated	Regulating	LOCA H2 Cntmt Monitor Press Reg

TABLE 3.9-25 (Sheet 7 of 14)
UNIT 2

VALVES REQUIRED TO BE ACTIVE FOR DESIGN BASIS EVENTS

System Name	Valve No.	Size Inches	Actuation	Type	Function/Description
Sampling and Water Quality (43)	1-PCV-43-200B	1/4	Self Actuated	Regulating	LOCA H2 Cntmt Monitor Press Reg
	FCV-43-201	3/8	Solenoid	Globe	Containment isolation
	FCV-43-202	3/8	Solenoid	Globe	Containment isolation
	1-FCV-43-207B	3/8	Solenoid	Globe	Containment isolation
	1-FCV-43-208B	3/8	Solenoid	Globe	Containment isolation
	1-PCV-43-210A	1/4	Self Actuated	Regulating	LOCA H2 Cntmt Monitor Press Reg
	1-PCV-43-210B	1/4	Self Actuated	Regulating	LOCA H2 Cntmt Monitor Press Reg
	FCV-43-433	3/8	Solenoid	Globe	Containment isolation
	FCV-43-434	3/8	Solenoid	Globe	Containment isolation
	1-FCV-43-435	3/8	Solenoid	Globe	Containment isolation
	1-FCV-43-436	3/8	Solenoid	Globe	Containment isolation
	1-CKV-43-834	1/2	Self Actuated	Check	Cntmt Isolation PASS Waste Holdup Tank
	1-CKV-43-841	1/2	Self Actuated	Check	Cntmt Isolation PASS Waste Holdup Tank
	1-CKV-43-883	1/2	Self Actuated	Check	Cntmt Isolation PASS Cntmt Air Return
	1-CKV-43-884	1/2	Self Actuated	Check	Cntmt Isolation PASS Cntmt Air Return
	1-PREG-43-1470A-A	1/4	Self Actuated	Regulating	O2 Reagent Gas for H2 Monitor Press Reg
	1-PREG-43-1470B-A	1/4	Self Actuated	Regulating	O2 Reagent Gas for H2 Monitor Press Reg
	1-PREG-43-1471A-B	1/4	Self Actuated	Regulating	O2 Reagent Gas for H2 Monitor Press Reg
	1-PREG-43-1471B-B	1/4	Self Actuated	Regulating	O2 Reagent Gas for H2 Monitor Press Reg
Ice Condenser (61)	CKV-61-533	3/8	Self Actuated	Check	Containment isolation
	CKV-61-680	3/8	Self Actuated	Check	Containment isolation
	CKV-61-692	3/8	Self Actuated	Check	Containment isolation
	CKV-61-745	3/8	Self Actuated	Check	Containment isolation
	FCV-61-96	2	Air	Diaphragm	Containment isolation
	FCV-61-97	2	Air	Diaphragm	Containment isolation
	FCV-61-110	2	Air	Diaphragm	Containment isolation
	FCV-61-122	2	Air	Diaphragm	Containment isolation
	FCV-61-191	4	Air	Diaphragm	Containment isolation
	FCV-61-192	4	Air	Diaphragm	Containment isolation
	FCV-61-193	4	Air	Diaphragm	Containment isolation
	FCV-61-194	4	Air	Diaphragm	Containment isolation
Emergency Gas Treatment System (65)	1-FCV-65-8	8	Air	Butterfly	EGTS Tr A Unit 1 Suction Damper
	1-FCV-65-10	24	Air	Butterfly	EGTS Tr A Unit 1 Suction Damper
	0-FCV-65-24	8	Air	Butterfly	EGTS Tr A Fan Isolation Damper
	0-FCV-65-28A	8	Air	Butterfly	EGTS Tr A Decay Cooling Damper
	0-FCV-65-28B	8	Air	Gate	EGTS Tr A Decay Cooling Damper
	1-FCV-65-30	24	Air	Butterfly	EGTS Tr B Unit 1 Suction Damper
	0-FCV-65-43	8	Air	Butterfly	EGTS Tr B Fan Isolation Damper
Emergency Gas	0-FCV-65-47A	8	Air	Gate	EGTS Tr B Decay Cooling Damper

TABLE 3.9-25 (Sheet 8 of 14)
UNIT 2

VALVES REQUIRED TO BE ACTIVE FOR DESIGN BASIS EVENTS

System Name	Valve No.	Size Inches	Actuation	Type	Function/Description
Treatment System (65)	0-FCV-65-47B	8	Air	Gate	EGTS Tr B Decay Cooling Damper
	1-FCV-65-51	8	Air	Butterfly	EGTS Tr B Unit 1 Suction Damper
	1-FCV-65-52	14	Air	Butterfly	Cntmt Annulus Vacuum Fan Isolation Damper
	1-FCV-65-53	14	Air	Butterfly	Cntmt Annulus Vacuum Fan Isolation Damper
	PCV-65-81	16	Air	Butterfly	Shield Bldg & Cntmt Annulus Isol Damper
	PCV-65-83	16	Air	Butterfly	Shield Bldg & Cntmt Annulus Isol Damper
	PCV-65-86	16	Air	Butterfly	EGTS Cntmt Annulus Isolation Damper
	PCV-65-87	16	Air	Butterfly	EGTS Cntmt Annulus Isolation Damper
	2-FCV-65-4	14	Air	Butterfly	Cntmt Annulus Vacuum Fan Isolation Damper
	2-FCV-65-5	14	Air	Butterfly	Cntmt Annulus Vacuum Fan Isolation Damper
	2-FCV-65-7	8	Air	Butterfly	EGTS Tr A Unit 2 Suction Damper
	2-FCV-65-9	24	Air	Butterfly	EGTS Tr A Unit 2 Suction Damper
	2-FCV-65-29	24	Air	Butterfly	EGTS Tr B Unit 2 Suction Damper
	2-FCV-65-50	8	Air	Butterfly	EGTS Tr B Unit 2 Suction Damper
Essential Raw Cooling Water (67) (See Note **)	FCV-67-9A	4	Motor	Ball	ERCW strainer
	FCV-67-9B	4	Motor	Ball	ERCW strainer
	FCV-67-10A	4	Motor	Ball	ERCW strainer
	FCV-67-10B	4	Motor	Ball	ERCW strainer
	FCV-67-66	8	Motor	Butterfly	Diesel Generator Cooling
	FCV-67-67	8	Motor	Butterfly	Diesel Generator Cooling
	FCV-67-83	6	Motor	Butterfly	Containment isolation
	FCV-67-87	6	Motor	Butterfly	Containment isolation
	FCV-67-88	6	Motor	Butterfly	Containment isolation
	FCV-67-89	6	Motor	Butterfly	Containment isolation
	FCV-67-91	6	Motor	Butterfly	Containment isolation
	FCV-67-95	6	Motor	Butterfly	Containment isolation
	FCV-67-96	6	Motor	Butterfly	Containment isolation
	FCV-67-97	6	Motor	Butterfly	Containment isolation
	FCV-67-99	6	Motor	Butterfly	Containment isolation
	FCV-67-103	6	Motor	Butterfly	Containment isolation
	FCV-67-104	6	Motor	Butterfly	Containment isolation
	FCV-67-105	6	Motor	Butterfly	Containment isolation
	FCV-67-107	6	Motor	Butterfly	Containment isolation
	FCV-67-111	6	Motor	Butterfly	Containment isolation
	FCV-67-112	6	Motor	Butterfly	Containment isolation
	FCV-67-113	6	Motor	Butterfly	Containment isolation
	FCV-67-123	18	Motor	Butterfly	Containment spray cooling
	FCV-67-124	18	Motor	Butterfly	Containment spray cooling
	FCV-67-125	18	Motor	Butterfly	Containment spray cooling

TABLE 3.9-25 (Sheet 9 of 14)
UNIT 2

VALVES REQUIRED TO BE ACTIVE FOR DESIGN BASIS EVENTS

System Name	Valve No.	Size Inches	Actuation	Type	Function/Description
Essential Raw Cooling Water (67) (See Note **)	FCV-67-126	18	Motor	Butterfly	Containment spray cooling
	FCV-67-130	2	Motor	Plug	Containment isolation
	FCV-67-131	2	Motor	Plug	Containment isolation
	FCV-67-133	2	Motor	Plug	Containment isolation
	FCV-67-134	2	Motor	Plug	Containment isolation
	FCV-67-138	2	Motor	Plug	Containment isolation
	FCV-67-139	2	Motor	Plug	Containment isolation
	FCV-67-141	2	Motor	Plug	Containment isolation
	FCV-67-142	2	Motor	Plug	Containment isolation
	FCV-67-143	12	Motor	Globe	ERCW flow path integrity
	O-FCV-67-144	16	Motor	Globe	ERCW flow path integrity
	1-FCV-67-146	24	Motor	Butterfly	ERCW from CCS Heat Exchanger A
	2-FCV-67-146	24	Motor	Butterfly	ERCW from CCS Heat Exchanger B
	O-FCV-67-152	24	Motor	Butterfly	CCS flow path integrity
	1-TCV-67-158	4	Self -Actuated	Globe	SBR temperature control
	2-TCV-67-158	4	Self-Actuated	Globe	SBR temperature control
	1-FCV-67-162	2	Air	Globe	ERCW to pump room coolers
	1-FCV-67-164	2	Air	Globe	ERCW to pump room coolers
	FCV-67-176	1-1/2	Air	Globe	ERCW to pump room coolers
	FCV-67-182	1-1/2	Air	Globe	ERCW to pump room coolers
	FCV-67-184	1-1/2	Air	Globe	ERCW to pump room coolers
	FCV-67-186	1-1/2	Air	Globe	ERCW to pump room coolers
	0-FCV-67-205	4	Motor	Butterfly	Nonessential equipment isolation
	0-FCV-67-208	4	Motor	Butterfly	Nonessential Equipment isolation
	1-FCV-67-213	1-1/2	Air	Globe	ERCW to pump room coolers
	1-FCV-67-215	1-1/2	Air	Globe	ERCW to pump room coolers
	2-FCV-67-217	2	Air	Globe	ERCW to pump room coolers
	2-FCV-67-219	2	Air	Globe	ERCW to pump room coolers
	FCV-67-295	2	Motor	Plug	Containment isolation
	FCV-67-296	2	Motor	Plug	Containment isolation
	FCV-67-297	2	Motor	Plug	Containment isolation
	FCV-67-298	2	Motor	Plug	Containment isolation
	2-FCV-67-336	1	Air	Globe	ERCW to pump room coolers
	2-FCV-67-338	1	Air	Globe	ERCW to pump room coolers
	FCV-67-342	2	Air	Globe	ERCW to pump room coolers
	FCV-67-344	2	Air	Globe	ERCW to pump room coolers
	FCV-67-346	1-1/2	Air	Globe	ERCW to pump room coolers
	FCV-67-348	1-1/2	Air	Globe	ERCW to pump room coolers
	FCV-67-350	1-1/2	Air	Globe	ERCW to pump room coolers
	FCV-67-352	1-1/2	Air	Globe	ERCW to pump room coolers

TABLE 3.9-25 (Sheet 10 of 14)
UNIT 2

VALVES REQUIRED TO BE ACTIVE FOR DESIGN BASIS EVENTS

System Name	Valve No.	Size Inches	Actuation	Type	Function/Description
Essential Raw	FCV-67-354	1-1/2	Air	Globe	ERCW to pump room coolers
Cooling Water (67)	FCV-67-356	1-1/2	Air	Globe	ERCW to pump room coolers
(See Note **)	0-CKV-67-503A	20	Self-actuated	Check	ERCW flow path integrity
	0-CKV-67-503B	20	Self-actuated	Check	ERCW flow path integrity
	0-CKV-67-503C	20	Self-actuated	Check	ERCW flow path integrity
	0-TCV-67-1050-A	3	Self-actuated	Globe	EBR condenser temperature control
	0-TCV-67-1051-A	3	Self-actuated	Globe	MCR condenser temperature control
	0-TCV-67-1052-B	3	Self-actuated	Globe	EBR condenser temperature control
	0-TCV-67-1053-B	3	Self-Actuated	Globe	MRC condenser temperature control
	CKV-67-508A	8	Self-Actuated	Check	ERCW flow path integrity
	CKV-67-508B	8	Self-Actuated	Check	ERCW flow path integrity
	0-CKV-67-517A	10	Self-Actuated	Check	ERCW flow path integrity
	0-CKV-67-512A	10	Self-Actuated	Check	ERCW flow path integrity
	1-CKV-67-940A	3	Self-actuated	Check	ERCW flowpath integrity
	2-CKV-67-935B	3	Self-actuated	Check	ERCW flowpath integrity
	0-CKV-67-503D	20	Self-actuated	Check	ERCW flowpath integrity
	0-CKV-67-503E	20	Self-actuated	Check	ERCW flowpath integrity
	0-CKV-67-503F	20	Self-actuated	Check	ERCW flowpath integrity
	0-CKV-67-503G	20	Self-actuated	Check	ERCW flowpath integrity
	0-CKV-67-503H	20	Self-actuated	Check	ERCW flowpath integrity
	CKV-67-575A	1/2	Self-actuated	Check	Containment Isolation
	CKV-67-575B	1/2	Self-actuated	Check	Containment Isolation
	CKV-67-575C	1/2	Self-actuated	Check	Containment Isolation
	CKV-67-575D	1/2	Self-actuated	Check	Containment Isolation
	CKV-67-580A	2	Self-actuated	Check	Containment Isolation
	CKV-67-580B	2	Self-actuated	Check	Containment Isolation
	CKV-67-580C	2	Self-actuated	Check	Containment Isolation
	CKV-67-580D	2	Self-actuated	Check	Containment Isolation
	CKV-67-585A	1/2	Self-actuated	Check	Containment Isolation
	CKV-67-585B	1/2	Self-actuated	Check	Containment Isolation
	CKV-67-585C	1/2	Self-actuated	Check	Containment Isolation
	CKV-67-585D	1/2	Self-actuated	Check	Containment Isolation
	CKV-67-1054A	1/2	Self-actuated	Check	Containment Isolation
	CKV-67-1054B	1/2	Self-actuated	Check	Containment Isolation
	CKV-67-1054C	1/2	Self-actuated	Check	Containment Isolation
	CKV-67-1054D	1/2	Self-actuated	Check	Containment Isolation
	0-CKV-67-502A	2	Self-actuated	Check	Air release
	0-CKV-67-502B	2	Self-actuated	Check	Air release
	0-CKV-67-502C	2	Self-actuated	Check	Air release
	0-CKV-67-502D	2	Self-actuated	Check	Air release

TABLE 3.9-25 (Sheet 11 of 14)
UNIT 2

VALVES REQUIRED TO BE ACTIVE FOR DESIGN BASIS EVENTS

System Name	Valve No.	Size Inches	Actuation	Type	Function/Description
Essential Raw Cooling Water (67) (See Note **)	0-CKV-67-502E	2	Self-actuated	Check	Air release
	0-CKV-67-502F	2	Self-actuated	Check	Air release
	0-CKV-67-502G	2	Self-actuated	Check	Air release
	0-CKV-67-502H	2	Self-actuated	Check	Air release
	0-FSV-67-1221-A	1	Solenoid	Globe	ERCW Supply
	0-PCV-67-1222	1	Self-actuated	Regulating	Press Cntr for ERCW to Aux Air Comp A
	0-TCV-67-1222A	1/2	Self-actuated	Regulating	Throttles ERCW to Aux Air Comp A cyl jacket
	0-TCV-67-1222B	3/4	Self-actuated	Regulating	Throttles ERCW to Aux Air Comp A cyl jacket
	0-FSV-67-1223-B	1	Solenoid	Globe	ERCW Supply
	0-PCV-67-1224	1	Self-actuated	Regulating	Press Cntr for ERCW to Aux Air Comp B
	0-TCV-67-1224A	1/2	Self-actuated	Regulating	Throttles ERCW to Aux Air Comp B cyl jacket
	0-TCV-67-1224B	3/4	Self-actuated	Regulating	Throttles ERCW to Aux Air Comp B cyl jacket
Component Cooling Water (70)	FCV-70-85	6	Air	Butterfly	Containment Isolation
	FCV-70-87	3	Motor	Gate	Containment Isolation
	FCV-70-89	6	Motor	Butterfly	Containment Isolation
	FCV-70-90	3	Motor	Gate	Containment Isolation
	FCV-70-92	6	Motor	Butterfly	Containment Isolation
	FCV-70-100	6	Motor	Butterfly	Containment Isolation
	FCV-70-133	3	Motor	Gate	RCP Thermal Barrier Isolation
	FCV-70-134	3	Motor	Gate	Containment Isolation
	FCV-70-140	6	Motor	Butterfly	Containment Isolation
	FCV-70-143	6	Motor	Butterfly	Containment Isolation
	FCV-70-156	18	Motor	Butterfly	RHR Hx Isolation
	FCV-70-194	20	Motor	Butterfly	Spent Fuel Pit Hx Isolation
	FCV-70-197	20	Motor	Butterfly	Spent fuel pit Hx isolation
	0-CKV-70-504	16	Self-actuated	Check	Prevent backflow through CCP
	CKV-70-504A	16	Self-actuated	Check	Prevent backflow through CCP
	CKV-70-504B	16	Self-actuated	Check	Prevent backflow through CCP
	CKV-70-679	3	Self-actuated	Check	Containment isolation CCP
	CKV-70-698	3/4	Self-actuated	Check	Containment isolation CCP
	CKV-70-790	3/4	Self-actuated	Check	Containment isolation
	FCV-70-183	3	Motor	Gate	Sample Hx Isolation
	FCV-70-215	3	Motor	Gate	Sample Hx Isolation
	1-FCV-70-66	2	Air	Angle	CCS surge tank isolation
	2-FCV-70-66	2	Air	Angle	CCS surge tank isolation
	RFV-70-538	3X4	Self actuated	Relief	Surge tank 1A/1B relief
	CKV-70-681-A,B, C, D	1-1/2	Self actuated	Check	Overpressurization protection
	CKV-70-682-A,B, C, D	1-1/2	Self actuated	Check	Overpressurization protection
	CKV-70-687	3/4	Self actuated	Check	RCP thermal barrier isolation

TABLE 3.9-25 (Sheet 12 of 14)
UNIT 2

VALVES REQUIRED TO BE ACTIVE FOR DESIGN BASIS EVENTS

System Name	Valve No.	Size Inches	Actuation	Type	Function/Description
Component Cooling Water (70)	1-RFV-70-703	3X4	Self actuated	Relief	Excess letdown HX relief
	2-RFV-70-703	3X4	Self actuated	Relief	Excess letdown HX relief
	RFV-70-835	3/4 X 1	Self actuated	Relief	RCP thermal barrier supply relief
Containment Spray System (72)	2-FCV-72-13-B	2	Motor	Globe	Min-flow pump recirculation control valve
	2-FCV-72-34-A	2	Motor	Globe	Min-flow pump recirculation control valve
	2-RFV-72-40	3/4 x 1	Self-Actuated	Relief	Bonnet Overpressure Relief Valve for 2-FCV-72-40
	2-RFV-72-41	3/4 x 1	Self-Actuated	Relief	Bonnet Overpressure Relief Valve for 2-FCV-72-41
Primary Water System (81)	FCV-81-12	3	Air	Gate	Primary water to RCS PRT
	CKV-81-502	3	Self-actuated	Gate	Primary water to RCS PRT
Standby Diesel Generators (82)	1-FCV-82-160	1.500	Air	Diaph	Flow Cont 1A1 TK A
	1-FSV-82-160-A	0.370	Elec	Sol V	Air ST SOL 1A1 (A)
	1-FCV-82-161	1.500	Air	Diaph	Flow Cont 1A2 TK A
	1-FSV-82-161-A	0.370	Elec	Sol V	Air ST SOL 1A2 (A)
	1-PCV-82-162A	2.000	Air	Diaph	PR RED V 1A1 TK A
	1-PREG-82-162B	0.250	Self	Diaph	PR REG V 1A1 TK A
	1-PCV-82-163A	2.000	Air	Diaph	PR RED V 1A2 TK A
	1-PREG-82-163B	0.250	Self	Diaph	PR REG V 1A2 TK A
	1-FCV-82-170	1.500	Air	Diaph	FLOW CONT 1A1 TK B
	1-FSV-82-170-A	0.370	Elec	Sol V	AIR ST SOL 1A1 (B)
	1-FCV-82-171	1.500	Air	Diaph	FLOW CONT 1A2 TK B
	1-FSV-82-171-A	0.370	Elec	Sol V	AIR ST SOL 1A2 (B)
	1-PCV-82-172A	2.000	Air	Diaph	PR RED V 1A1 TK B
	1-PREG-82-172B	0.250	Self	Diaph	PR REG V 1A1 TK B
	1-PCV-82-173A	2.000	Air	Diaph	PR RED V 1A2 TK B
	1-PREG-82-173B	0.250	Self	Diaph	PR REG V 1A2 TK B
	1-FCV-82-190	1.500	Air	Diaph	FLOW CONT 1B1 TK A
	1-FSV-82-190-A	0.370	Elec	Sol V	AIR ST SOL 1B1(A)
	1-FCV-82-191	1.500	Air	Diaph	FLOW CONT 1B2 TK A
	1-FSV-82-191-A	0.370	Elec	Sol V	AIR ST SOL 1B2 (A)
	1-PCV-82-192A	2.000	Air	Diaph	PR RED V 1B1 TK A
	1-PREG-82-192B	0.250	Self	Diaph	PR REG V 1B1 TK A
	1-PCV-82-193A	2.000	Air	Diaph	PR RED V 1B2 TK A
	1-PREG-82-193B	0.250	Self	Diaph	PR REG V 1B2 TK A
	1-FCV-82-200	1.500	Air	Diaph	FLOW CONT 1B1 TK B
	1-FSV-82-200-A	0.370	Elec	Sol V	AIR ST SOL 1B1 (B)

TABLE 3.9-25 (Sheet 13 of 14)
UNIT 2

VALVES REQUIRED TO BE ACTIVE FOR DESIGN BASIS EVENTS

System Name	Valve No.	Size Inches	Actuation	Type	Function/Description
Standby Diesel Generators (82)	1-FCV-82-201	1.500	Air	Diaph	FLOW CONT 1B2 TK B
	1-FSV-82-201-A	0.370	Elec	Sol V	AIR ST SOL 1B2 (B)
	1-PCV-82-202A	2.000	Air	Diaph	PR RED V 1B1 TK B
	1-PREG-82-202B	0.250	Self	Diaph	PR REG V 1B1 TK B
	1-PCV-82-203A	2.000	Air	Diaph	PR RED V 1B2 TK B
	1-PREG-82-203B	0.250	Self	Diaph	PR REG V 1B2 TK B
	2-FCV-82-220	1.500	Air	Diaph	FLOW CONT 2A1 TK A
	2-FSV-82-220-A	0.370	Elec	Sol V	AIR ST SOL 2A1 (A)
	2-FCV-82-221	1.500	Air	Diaph	FLOW CONT 2A2 TK A
	2-FSV-82-221-A	0.370	Elec	Sol V	AIR ST SOL 2A2 (A)
	2-PCV-82-222A	2.000	Air	Diaph	PR RED V 2A1 TK A
	2-PREG-82-222B	0.250	Self	Diaph	PR REG V 2A1 TK A
	2-PCV-82-223A	2.000	Air	Diaph	PR RED V 2A2 TK A
	2-PREG-82-223B	0.250	Self	Diaph	PR REG V 2A2 TK A
	2-FCV-82-230	1.500	Air	Diaph	FLOW CONT 2A1 TK B
	2-FSV-82-230-A	0.370	Elec	Sol V	AIR ST SOL 2A1 (B)
	2-FCV-82-231	1.500	Air	Diaph	FLOW CONT 2A2 TK B
	2-FSV-82-231-A	0.370	Elec	Sol V	AIR ST SOL 2A2 (B)
	2-PCV-82-232A	2.000	Air	Diaph	PR RED V 2A1 TK B
	2-PREG-82-232B	0.250	Self	Diaph	PR REG V 2A1 TK B
	2-PCV-82-233A	2.000	Air	Diaph	PR RED V 2A2 TK B
	2-PREG-82-233B	0.250	Self	Diaph	PR REG V 2A2 TK B
	2-FCV-82-250	1.500	Air	Diaph	FLOW CONT 2B1 TK A
	2-FSV-82-250-A	0.370	Elec	Sol V	AIR ST SOL 2B1(A)
	2-FCV-82-251	1.500	Air	Diaph	FLOW CONT 2B2 TK A
	2-FSV-82-251-A	0.370	Elec	Sol V	AIR ST SOL 2B2 (A)
	2-PCV-82-252A	2.000	Air	Diaph	PR RED V 2B1 TK A
	2-PREG-82-252B	0.250	Self	Diaph	PR REG V 2B1 TK A
	2-PCV-82-253A	2.000	Air	Diaph	PR RED V 2B2 TK A
	2-PREG-82-253B	0.250	Self	Diaph	PR REG V 2B2 TK A
	2-FCV-82-260	1.500	Air	Diaph	FLOW CONT 2B1 TK B
	2-FSV-82-260-A	0.370	Elec	Sol V	AIR ST SOL 2B1 (B)
	2-FCV-82-261	1.500	Air	Diaph	FLOW CONT 2B2 TK B
	2-FSV-82-261-A	0.370	Elec	Sol V	AIR ST SOL 2B2 (B)
	2-PCV-82-262A	2.000	Air	Diaph	PR RED V 2B1 TK B
	2-PREG-82-262B	0.250	Self	Diaph	PR REG V 2B1 TK B
	2-PCV-82-263A	2.000	Air	Diaph	PR RED V 2B2 TK B
	2-PREG-82-263B	0.250	Self	Diaph	PR REG V 2B2 TK B
	1,2-CKV-82-502A1-A	0.750	Self	Check	TK SUP A1 (A)
	1,2-CKV-82-502B1-B	0.750	Self	Check	TK SUP B1 (A)

TABLE 3.9-25 (Sheet 14 of 14)
UNIT 2

VALVES REQUIRED TO BE ACTIVE FOR DESIGN BASIS EVENTS

System Name	Valve No.	Size Inches	Actuation	Type	Function/Description
Standby Diesel Generators (82)	1,2-CKV-82-505A1-A	0.750	Self	Check	TK SUP A1 (B)
	1,2-CKV-82-505B1-B	0.750	Self	Check	TK SUP B1 (B)
	1,2-CKV-82-509A1-A	0.750	Self	Check	CROSS CONN CK A1
	1,2-CKV-82-509B1-B	0.750	Self	Check	CROSS CONN CK B1
	1,2-CKV-82-523A1-A	0.750	Self	Check	RELAY CK A1 (A)
	1,2-CKV-82-523B1-B	0.750	Self	Check	RELAY CK B1 (A)
	1,2-SPV-82-524A1-A	0.375	Self	Check	SLIDE VLV A1
	1,2-SPV-82-524B1-B	0.375	Self	Check	SLIDE VLV B1
	1,2-CKV-82-531A1-A	0.750	Self	Check	RELAY CK A1 (B)
	1,2-CKV-82-531B1-B	0.750	Self	Check	RELAY CK B1 (B)
	1,2-CKV-82-536-A2-A	0.750	Self	Check	TK SUP A2 (A)
	1,2-CKV-82-536B2-B	0.750	Self	Check	TK SUP B2 (A)
	1,2-CKV-82-539-A2-A	0.750	Self	Check	TK SUP A2 (B)
	1,2-CKV-82-539B2-B	0.750	Self	Check	TK SUP B2 (B)
	1,2-CKV-82-543-A2-A	0.750	Self	Check	CROSS CONN CK A2
	1,2-CKV-82-543B2-B	0.750	Self	Check	CROSS CONN CK B2
	1,2-CKV-82-557-A2-A	0.750	Self	Check	RELAY CK A2 (A)
	1,2-CKV-82-557B2-B	0.750	Self	Check	RELAY CK B2 (A)
	1,2-SPV-82-558-A2-A	0.375	Self	Check	SLIDE VLV A2
	1,2-SPV-82-558B2-B	0.375	Self	Check	SLIDE VLV B2
	1,2-CKV-82-565-A2-A	0.750	Self	Check	RELAY CK A2 (B)
	1,2-CKV-82-565B2-B	0.750	Self	Check	RELAY CK B2 (B)
Radiation Monitoring (90)	1,2-FCV-90-107	1-1/2	Air	Globe	Containment Isolation
	1,2-FCV-90-108	1-1/2	Air	Globe	Containment Isolation
	1,2-FCV-90-109	1-1/2	Air	Globe	Containment Isolation
	1,2-FCV-90-110	1-1/2	Air	Globe	Containment Isolation
	1,2-FCV-90-111	1-1/2	Air	Globe	Containment Isolation
	1,2-FCV-90-113	1-1/2	Air	Globe	Containment Isolation
	1,2-FCV-90-114	1-1/2	Air	Globe	Containment Isolation
	1,2-FCV-90-115	1-1/2	Air	Globe	Containment Isolation
	1,2-FCV-90-116	1-1/2	Air	Globe	Containment Isolation
	1,2-FCV-90-117	1-1/2	Air	Globe	Containment Isolation

**Valves not prefixed by 1-, 2- or 0-are understood to be prefixed by 1- and 2

TABLE 3.9-26 (Sheet 1 of 4)
UNIT 1

INSERVICE INSPECTION CATEGORY VALVES (Note 2)

SYSTEM	CATEGORY	CLASS	VALVES
MAIN STEAM 47W801-1	B	B	FCV-1-4, FCV-1-11, FCV-1-22, FCV-1-29, FCV-1-147, FCV-1-148, FCV-1-149, FCV-1-150
	B	B	PCV-1-5, PCV-1-12, PCV-1-23, PCV-1-30, 1-ISV-1-619, 1-ISV-1-620, 1-ISV-1-621, 1-ISV-1-622
	C	B	1-512, 1-513, 1-514, 1-515, 1-516, 1-517, 1-518, 1-519, 1-520, 1-521, 1,522, 1-523, 1-524, 1-525, 1-526, 1-527, 1-528, 1-529, 1-530, 1-531
STEAM GENERATOR BLOWDOWN SYSTEM 47W801-2	B	B	FCV-1-7, FCV-1-14, FCV-1-25, FCV-1-32, FCV-1-181, FCV-1-182, FCV-1-183, FCV-1-184
CONDENSATE 47W804-1	C	Note 1	2-667
FEEDWATER 47W803-1	B	B	FCV-3-33, FCV-3-47, FCV-3-87, FCV-3-100 FCV-3-236, FCV-3-239, FCV-3-242, FCV-3-245
	B	Note 1 & C	FCV-3-35, FCV-3-35A, FCV-3-48, FCV-3-48A, FCV-3-90, FCV-3-90A, FCV-3-103, FCV-3-103A
	C	B	3-508, 3-509, 3-510, 3-511, 3-644, 3-645, 3-655, 3-656, 3-670, 3-679
	AC	B	3-638, 3-652, 3-669, 3-678
AUXILIARY FEEDWATER 47W803-2	B	B	FCV-1-15, FCV-1-16, FCV-1-18
	B	C	LCV-3-148, LCV-3-148A, LCV-3-156, LCV-3-156A, LCV-3-164, LCV-3-164A, LCV-3-171, LCV-3-171A, LCV-3-172, LCV-3-173, LCV-3-174, FCV-3-175, FCV-1-17, FCV-3-116A, FCV-3-116B, FCV-3-126A, FCV-3-126B, FCV-3-136A, FCV-3-136B, FCV-3-179A, FCV-3-179B, FCV-1-51, FCV-3-355, FCV-3-359
	C	B	3-830, 3-831, 3-832, 3-833, 3-861, 3-862, 3-864, 3-871, 3-872, 3-873, 3-874, 1-891, 1-892, 3-921, 3-922
	C	C	3-805, 3-806, 3-810, 3-814, 3-815, 3-818
CHEMICAL & VOLUME CONTROL 47W809-1, -2, -3,-5	A	B	FCV-62-61, FCV-62-63, FCV-62-72, FCV-62-73 FCV-62-74, FCV-62-77, FCV-62-76
	AC	B	62-639, 62-662, 62-523, 62-525, 62-530, 62-532
	B	B	LCV-62-132, LCV-62-133, LCV-62-135, LCV-62-136, FCV-62-1228, FCV-62-1229, FCV-62-90, FCV-62-91, PCV-62-81
	C	B	62-504, 62-505, 62-518 (Note 3) 62-636, 62-649, 62-675, 62-1220 (Note 3), 62-1221, 62-1222
	B	C	FCV-62-138
	C	C	CKV-62-930, CKV-62-1052-A, CKV-62-1052-B
	C	B	RFV-62-955, RFV-62-1079
RESIDUAL HEAT REMOVAL 47W810-1	A	A	FCV-74-1, FCV-74-2, FCV-74-8, FCV-74-9

TABLE 3.9-26 (Sheet 2 of 4)
UNIT 1

INSERVICE INSPECTION CATEGORY VALVES (Note 2)

SYSTEM	CATEGORY	CLASS	VALVES
RESIDUAL HEAT REMOVAL 47W810-1 (cont.)	B	B	FCV-74-3, FCV-74-12, FCV-74-21,FCV-74-24, FCV-74-33, FCV-74-35
	C	B	74-505, 74-514, 74-515, 74-544, 74-545
SAFETY INJECTION 47W811-1	A	B	FCV-63-23, FCV-63-64, FCV-63-71, FCV-63-84
	AC	A	63-543, 63-545, 63-547, 63-549, 63-551, 63-553, 63-555, 63-557, 63-558, 63-559, 63-560, 63-561, 63-562, 63-563, 63-622, 63-623, 63-624, 63-625, 63-632, 63-633, 63-634, 63-635, 63-640, 63-641, 63-643, 63-644, 63-581, 63-586, 63-587, 63-588, 63-589
	AC	B	CKV-63-524,CKV-63-526, CKV-63-528, CKV-63-530, CKV-63-868, 1-RFV-63-28
	B	B	FCV-63-1, FCV-63-3, FCV-63-4, FCV-63-5, FCV-63-6, FCV-63-7, FCV-63-8, FCV-63-11, FCV-63-22, FCV-63-25, FCV-63-26, FCV-63-47, FCV-63-48, FCV-63-72, FCV-63-73, FCV-63-93, FCV-63-94, FCV-63-152, FCV-63-153, FCV-63-156, FCV-63-157, FCV-63-172, FCV-63-175, FCV-63-185
	C	B	63-502, 63-510, 63-511, 63-534, 63-535, 63-536, 63-577, 63-602, 63-603, 63-604, 63-605, 63-626, 63-627, 63-637, 63-725, 63-835
CONTAINMENT SPRAY 47W812-1	A	B	FCV-72-2, FCV-72-39, FCV-72-40, FCV-72-41, RFV-72-40, RFV-72-41
	B	B	FCV-72-13, FCV-72-21, FCV-72-22, FCV-72-34, FCV-72-44, FCV-72-45
	C	B	72-506, 72-507, 72-508, 72-509, 72-524, 72-525, 72-548, 72-549, 72-562, 72-563
REACTOR COOLANT 47W813-1	A	B	FCV-68-305, FCV-68-307, FCV-68-308
	B	A	FCV-68-332, FCV-68-333, PCV-68-334, PCV-68-340A
	B	B	FSV-68-394, FSV-68-395, FSV-68-396, FSV-68-397
	C	A	68-563, 68-564, 68-565
	C	B	68-559, 68-849
ESSENTIAL RAW COOLING WATER 47W845-1,2,3,4,5,7	A	B	FCV-67-83, FCV-67-87, FCV-67-88, 1-FCV-67-89,FCV-67-91, FCV-67-95, FCV-67-96, 1-FCV-67-97, FCV-67-99, FCV-67-103, FCV-67-104, 1-FCV-67-105, FCV-67-107, FCV-67-111, FCV-67-112, 1-FCV-67-113, FCV-67-130, FCV-67-131, FCV-67-133, FCV-67-134, FCV-67-138, FCV-67-139, FCV-67-141, FCV-67-142, FCV-67-295, FCV-67-296, FCV-67-297, FCV-67-298
	AC	B	67-575A, 67-575B, 67-575C, 67-575D, 67-580A, 67-580B, 67-580C, 67-580D, 67-585A, 67-585B, 67-585C, 67-585D, 1-67-1060A, 1-67-1060B, 1-67-1060C, 1-67-1060D
	B	C	FCV-67-65, FCV-67-66, FCV-67-67, FCV-67-68, FCV-67-123, FCV-67-124, FCV-67-125, FCV-67-126, FCV-67-143, FCV-67-144, FCV-67-146, FCV-67-152, FCV-67-162, FCV-67-164, FCV-67-176, FCV-67-182, FCV-67-184, FCV-67-186, FCV-67-205, FCV-67-208, FCV-67-213, FCV-67-215, FCV-67-342, FCV-67-344, FCV-67-346, FCV-67-348, FCV-67-350, FCV-67-352, FCV-67-354, FCV-67-356, 2-FCV-67-217, 2-FCV-67-219, 2-FCV-67-336, 2-FCV-67-338, FCV-67-9A, FCV-67-9B, FCV-67-10A, FCV-67-10B, 2-FCV-67-354, 2-FCV-67-356

TABLE 3.9-26 (Sheet 3 of 4)
UNIT 1

INSERVICE INSPECTION CATEGORY VALVES (Note 2)

SYSTEM	CATEGORY	CLASS	VALVES
	C	C	67-503A, 67-503B, 67-503C, 67-503D, 67-503E, 67-503F, 67-503G, 67-503H, 1-67-508A, 2-67-508A, 1-67-508B, 2-67-508B, 1-67-513A, 2-67-513A, 1-67-513B, 2-67-513B, 67-502A thru H, 1-67-940A, 2-67-935B, 0-RFV-67-671, 0-RFV-67-672, RFV-67-539A, RFV-67-539B
COMPONENT COOLING WATER 47W859-1, -2, -4	A	B	FCV-70-85, FCV-70-87, FCV-70-89, FCV-70-90, FCV-70-92, 1-FCV-70-100, FCV-70-134, FCV-70-140, FCV-70-143
COMPONENT COOLING WATER 47W859-1, -2, -4 (continued)	AC	B	70-679, 70-687, 70-698, 70-703, 1-70-790
	B	C	FCV-70-66, FCV-70-133, 1, 2-FCV-70-153, FCV-70-156, FCV-70-183, FCV-70-197, FCV-70-215
	C	C	70-504, 70-504A, 70-504B, 70-538, 70-753, 70-539, 70-681A, 70-681B, 70-681C, 70-681D, 70-682A, 70-682B, 70-682C, 70-682D, RFV-70-551A, RFV-70-551B, RFV-70-556A, RFV-70-556B, RFV-70-565A, RFV-70-565B, RFV-70-578, RFV-70-835
PRIMARY WATER 47W819-1	A	B	FCV-81-12
	AC	B	81-502
WASTE DISPOSAL 47W830-1 47W851-1	A	B	FCV-77-9, FCV-77-10, FCV-77-16, FCV-70-17, FCV-77-18, FCV-77-19, FCV-77-20, FCV-77-127, FCV-77-128
	AC	B	77-2875
FIRE PROTECTION 47W850-9	A	B	FCV-26-240, FCV-26-243
	AC	B	26-1260, 26-1296
HEATING AND VENTILATION 47W866-1	A	B	FCV-30-7, FCV-30-8, FCV-30-9, FCV-30-10, FCV-30-14, FCV-30-15, FCV-30-16, FCV-30-17, FCV-30-19, FCV-30-20, FCV-30-37, FCV-30-40, FCV-30-50, FCV-30-51, FCV-30-52, FCV-30-53, FCV-30-56, FCV-30-57, FCV-30-58, FCV-30-59, FSV-30-134, FSV-30-135
AIR CONDITIONING 47W865-5, -3, -7, -8	A	B	FCV-31-305, FCV-31-306, FCV-31-308, FCV-31-309, FCV-31-326, FCV-31-327, FCV-31-329, FCV-31-330
	AC	B	31-3378, 31-3392, 31-3407, 31-3421
	C	Note 1	0-31-2210, 0-31-2252, 0-31-2326, 0-31-2383, 0-31-2623, 0-31-2665
CONTROL AIR 47W848-1	A	B	FCV-32-80, FCV-32-102, FCV-32-110, BYV-32-288, BYV-32-298, BYV-32-308
	AC	B	32-293, 32-303, 32-313
SERVICE AIR 47W846-2	A	B	33-713, 33-714

TABLE 3.9-26 (Sheet 4 of 4)
UNIT 1

INSERVICE INSPECTION CATEGORY VALVES (Note 2)

SYSTEM	CATEGORY	CLASS	VALVES
RADIATION SAMPLING 47W625-1, -2, -7, -11, -15	A	B	FCV-43-2, FCV-43-3, FCV-43-11, FCV-43-12, FCV-43-22, FCV-43-23, FCV-43-34, FCV-43-35, FCV-43-75, FCV-43-77, FCV-43-201, FCV-43-202, FCV-43-207, FCV-43-208,FSV-43-250, FSV-43-251, FSV-43-287, FSV-43-288, FSV-43-307, FSV-43-309, FSV-43-310, FSV-43-318,FSV-43-319, FSV-43-325, FSV-43-341, FSV-43-342
	B	B	FCV-43-54D, FCV-43-55, FCV-43-56D, FCV-43-58, FCV-43-59D, FCV-43-61, FCV-43-63D, FCV-43-64
	AC	B	43-834, 43-841, 43-883, 43-884
SYSTEM TEST FACILITY 47W331-3	A	B	52-500, 52-501, 52-502, 52-503, 52-504, 52-505, 52-506, 52-507
DEMINERALIZED WATER AND CASK DECONTAMINATION 47W856-1	A	B	59-522, 59-698
ICE CONDENSER 47W814-2	A	B	FCV-61-96, FCV-61-97, FCV-61-110, FCV-61-122, FCV-61-191, FCV-61-192, FCV-61-193, FCV-61-194
	AC	B	61-533, 61-680, 61-692, 61-745
	C	Note 1	61-658, 61-659, 61-660, 61-661, 61-662, 61-663, 61-664, 61-665, 61-666, 61-667, 61-668, 61-669, 61-670, 61-671, 61-672, 61-673, 61-674, 61-675, 61-676, 61-677
BORATION MAKEUP 47W809-7	A	B	84-530
RADIATION MONITORING 47W610-90-3	A	B	FCV-90-107, FCV-90-108, FCV-90-109, FCV-90-110, FCV-90-111, FCV-90-113, FCV-90-114, FCV-90-115, FCV-90-116, FCV-90-117
FUEL POOL COOLING AND CLEANING 47W855-1	A	B	78-557, 78-558, 78-560, 78-561

Note 1: Not Constructed to an ASME Code Class.

Note 2: Valves listed in Table 3.9-26 are not necessarily Reg Guide 1.48 active and/or event active. Non-active valves may be added for convenience of plant operations to improve a valve's reliability, etc. All active valves are reflected in Tables 3.9-17 and 3.9-25.

Note 3: Valve is abandoned in place.

TABLE 3.9-26 (Sheet 1 of 4)
UNIT 2

INSERVICE INSPECTION CATEGORY VALVES (Note 2)

SYSTEM	CATEGORY	CLASS	VALVES
MAIN STEAM 47W801-1	B	B	FCV-1-4, FCV-1-11, FCV-1-22, FCV-1-29, FCV-1-147, FCV-1-148, FCV-1-149, FCV-1-150
	B	B	PCV-1-5, PCV-1-12, PCV-1-23, PCV-1-30, 1-ISV-1-619, 1-ISV-1-620, 1-ISV-1-621, 1-ISV-1-622
	C	B	1-512, 1-513, 1-514, 1-515, 1-516, 1-517, 1-518, 1-519, 1-520, 1-521, 1,522, 1-523, 1-524, 1-525, 1-526, 1-527, 1-528, 1-529, 1-530, 1-531
STEAM GENERATOR BLOWDOWN SYSTEM 47W801-2	B	B	FCV-1-7, FCV-1-14, FCV-1-25, FCV-1-32, FCV-1-181, FCV-1-182, FCV-1-183, FCV-1-184
CONDENSATE 47W804-1	C	Note 1	2-667
FEEDWATER 47W803-1	B	B	FCV-3-33, FCV-3-47, FCV-3-87, FCV-3-100, 2-FCV-3-185, 2-FCV-3-186, 2-FCV-3-187, 2-FCV-3-188, FCV-3-236, FCV-3-239, FCV-3-242, FCV-3-245
	B	Note 1 & C	FCV-3-35, FCV-3-35A, FCV-3-48, FCV-3-48A, FCV-3-90, FCV-3-90A, FCV-3-103, FCV-3-103A
	C	B	3-508, 3-509, 3-510, 3-511, 3-644, 3-645, 3-655, 3-656, 3-670, 3-679
	AC	B	3-638, 3-652, 3-669, 3-678
AUXILIARY FEEDWATER 47W803-2	B	B	FCV-1-15, FCV-1-16, FCV-1-18
	B	C	LCV-3-148, LCV-3-148A, LCV-3-156, LCV-3-156A, LCV-3-164, LCV-3-164A, LCV-3-171, LCV-3-171A, LCV-3-172, LCV-3-173, LCV-3-174, FCV-3-175, FCV-1-17, FCV-3-116A, FCV-3-116B, FCV-3-126A, FCV-3-126B, FCV-3-136A, FCV-3-136B, FCV-3-179A, FCV-3-179B,FCV-1-51, PCV-3-122, PCV-3-132, FCV-3-355, FCV-3-359
	C	B	3-830, 3-831, 3-832, 3-833, 3-861, 3-862, 3-864, 3-871, 3-872, 3-873, 3-874, 1-891, 1-892, 3-921, 3-922
	C	C	3-805, 3-806, 3-810, 3-814, 3-815, 3-818
CHEMICAL & VOLUME CONTROL 47W809-1, -2, -3,-5	A	B	FCV-62-61, FCV-62-63, FCV-62-72, FCV-62-73 FCV-62-74, FCV-62-77, FCV-62-76
	AC	B	62-639, 62-662, 62-523, 62-525, 62-530, 62-532
	B	B	LCV-62-132, LCV-62-133, LCV-62-135, LCV-62-136, ,FCV-62-1228, FCV-62-1229, FCV-62-90, FCV-62-91, PCV-62-81
	C	B	62-504, 62-505, 62-636, 62-649, 62-675, 62-1221, 62-1222, CKV-62-543
	B	C	FCV-62-138
	C	C	CKV-62-930, CKV-62-1052-A, CKV-62-1052-B
	C	B	RFV-62-955, RFV-62-1079
RESIDUAL HEAT REMOVAL 47W810-1	A	A	FCV-74-1, FCV-74-2, FCV-74-8, FCV-74-9

TABLE 3.9-26 (Sheet 2 of 4)
UNIT 2

INSERVICE INSPECTION CATEGORY VALVES (Note 2)

SYSTEM	CATEGORY	CLASS	VALVES
RESIDUAL HEAT REMOVAL 47W810-1 (cont.)	B	B	FCV-74-3, FCV-74-12, FCV-74-21,FCV-74-24, FCV-74-33, FCV-74-35
	C	B	74-505, 74-514, 74-515, 74-544, 74-545
SAFETY INJECTION 47W811-1	A	B	FCV-63-23, FCV-63-64, FCV-63-71, FCV-63-84
	AC	A	63-543, 63-545, 63-547, 63-549, 63-551, 63-553, 63-555, 63-557, 63-558, 63-559, 63-560, 63-561, 63-562, 63-563, 63-622, 63-623, 63-624, 63-625, 63-632, 63-633, 63-634, 63-635, 63-640, 63-641, 63-643, 63-644, 63-581, 63-586, 63-587, 63-588, 63-589
	AC	B	CKV-63-524,CKV-63-526, CKV-63-528, CKV-63-530, CKV-63-868, RFV-63-28
	B	B	FCV-63-1, FCV-63-3, FCV-63-4, FCV-63-5, FCV-63-6, FCV-63-7, FCV-63-8, FCV-63-11, FCV-63-22, FCV-63-25, FCV-63-26, FCV-63-47, FCV-63-48, FCV-63-72, FCV-63-73, FCV-63-93, FCV-63-94, FCV-63-152, FCV-63-153, FCV-63-156, FCV-63-157, FCV-63-172, FCV-63-175, FCV-63-185
	C	B	63-502, 63-510, 63-511, 63-534, 63-535, 63-536, 63-577, 63-602, 63-603, 63-604, 63-605, 63-626, 63-627, 63-637, 63-725, 63-835
CONTAINMENT SPRAY 47W812-1	A	B	FCV-72-2, FCV-72-39, FCV-72-40, FCV-72-41, RFV-72-40, RFV-72-41
	B	B	FCV-72-13, FCV-72-21, FCV-72-22, FCV-72-34, FCV-72-44, FCV-72-45
	C	B	72-506, 72-507, 72-508, 72-509, 72-524, 72-525, 72-548, 72-549, 72-562, 72-563
REACTOR COOLANT 47W813-1	A	B	FCV-68-305, FCV-68-307, FCV-68-308
	B	A	FCV-68-332, FCV-68-333, PCV-68-334, PCV-68-340A
	B	B	FSV-68-394, FSV-68-395, FSV-68-396, FSV-68-397
	C	A	68-563, 68-564, 68-565
	C	B	68-559, 68-849
ESSENTIAL RAW COOLING WATER 47W845-1,2,3,4,5,7	A	B	FCV-67-83, FCV-67-87, FCV-67-88, 1-FCV-67-89, FCV-67-91, FCV-67-95, FCV-67-96, 1-FCV-67-97, FCV-67-99, FCV-67-103, FCV-67-104, 1-FCV-67-105, FCV-67-107, FCV-67-111, FCV-67-112, 1-FCV-67-113, FCV-67-130, FCV-67-131, FCV-67-133, FCV-67-134, FCV-67-138, FCV-67-139, FCV-67-141, FCV-67-142, FCV-67-295, FCV-67-296, FCV-67-297, FCV-67-298
	AC	B	67-575A, 67-575B, 67-575C, 67-575D, 67-580A, 67-580B, 67-580C, 67-580D, 67-585A, 67-585B, 67-585C, 67-585D, 1-67-1054A, 1-67-1054B, 1-67-1054C, 1-67-1054D

TABLE 3.9-26 (Sheet 3 of 4)
UNIT 2

INSERVICE INSPECTION CATEGORY VALVES (Note 2)

SYSTEM	CATEGORY	CLASS	VALVES
ESSENTIAL RAW COOLING WATER 47W845-1,2,3,4,5,7 (Continued)	B	C	FCV-67-65, FCV-67-66, FCV-67-67, FCV-67-68, FCV-67-123, FCV-67-124, FCV-67-125, FCV-67-126, FCV-67-143, FCV-67-144, 1-FCV-67-146, FCV-67-152, FCV-67-162, FCV-67-164, FCV-67-176, FCV-67-182, FCV-67-184, FCV-67-186, FCV-67-205, FCV-67-208, FCV-67-213, FCV-67-215, FCV-67-342, FCV-67-344, FCV-67-346, FCV-67-348, FCV-67-350, FCV-67-352, FCV-67-354, FCV-67-356, 2-FCV-67-217, 2-FCV-67-219, 2-FCV-67-336, 2-FCV-67-338, FCV-67-9A, FCV-67-9B, FCV-67-10A, FCV-67-10B, 2-FCV-67-354, 2-FCV-67-356
	C	C	67-503A, 67-503B, 67-503C, 67-503D, 67-503E, 67-503F, 67-503G, 67-503H, 1-67-508A, 2-67-508A, 1-67-508B, 2-67-508B, 1-67-513A, 2-67-513A, 1-67-513B, 2-67-513B, 67-502A thru H, 1-67-940A, 2-67-935B, 0-RFV-67-671, 0-RFV-67-672, RFV-67-539A, RFV-67-539B
COMPONENT COOLING WATER 47W859-1, -2, -3, -4	A	B	FCV-70-85, FCV-70-87, FCV-70-89, FCV-70-90, FCV-70-92, 1-FCV-70-100, FCV-70-134, FCV-70-140, FCV-70-143
	AC	B	70-679, 70-687, 70-698, 70-703, 1-70-790
	B	C	FCV-70-66, FCV-70-133, FCV-70-156, FCV-70-183, FCV-70-197, FCV-70-215
	C	C	70-504, 70-504A, 70-504B, 70-538, 70-753, 70-539, 70-681A, 70-681B, 70-681C, 70-681D, 70-682A, 70-682B, 70-682C, 70-682D, RFV-70-551A, RFV-70-551B, RFV-70-556A, RFV-70-556B, RFV-70-565A, RFV-70-565B, RFV-70-578, RFV-70-835
PRIMARY WATER 47W819-1	A	B	FCV-81-12
	AC	B	81-502
WASTE DISPOSAL 47W830-1, 47W851-1	A	B	FCV-77-9, FCV-77-10, FCV-77-16, FCV-70-17, FCV-77-18, FCV-77-19, FCV-77-20, FCV-77-127, FCV-77-128
	AC	B	77-2875
FIRE PROTECTION 47W850-9	A	B	FCV-26-240, FCV-26-243
	AC	B	26-1260, 26-1296
HEATING AND VENTILATION 47W866-1	A	B	FCV-30-7, FCV-30-8, FCV-30-9, FCV-30-10, FCV-30-14, FCV-30-15, FCV-30-16, FCV-30-17, FCV-30-19, FCV-30-20, FCV-30-37, FCV-30-40, FCV-30-50, FCV-30-51, FCV-30-52, FCV-30-53, FCV-30-56, FCV-30-57, FCV-30-58, FCV-30-59, FSV-30-134, FSV-30-135
AIR CONDITIONING 47W865-5, -3, -7, -8	A	B	FCV-31-305, FCV-31-306, FCV-31-308, FCV-31-309, FCV-31-326, FCV-31-327, FCV-31-329, FCV-31-330
	AC	B	31-3378, 31-3392, 31-3407, 31-3421
	C	Note 1	0-31-2193, 0-31-2235, 0-31-2210, 0-31-2252, 0-31-2307, 0-31-2364, 0-31-2326, 0-31-2383, 0-31-2607, 0-31-2649, 0-31-2623, 0-31-2665
CONTROL AIR 47W848-1	A	B	FCV-32-80, FCV-32-102, FCV-32-110, BYV-32-288, BYV-32-298, BYV-32-308
	AC	B	32-293, 32-303, 32-313

TABLE 3.9-26 (Sheet 4 of 4)
UNIT 2

INSERVICE INSPECTION CATEGORY VALVES (Note 2)

SYSTEM	CATEGORY	CLASS	VALVES
SERVICE AIR 47W846-2	A	B	33-713, 33-714
RADIATION SAMPLING 47W625-1, -2, -7, -11, -15	A	B	FCV-43-2, FCV-43-3, FCV-43-11, FCV-43-12, FCV-43-22, FCV-43-23, FCV-43-34, FCV-43-35, 1-FCV-43-75, 1-FCV-43-77, FCV-43-201, FCV-43-202, 1-FCV-43-207, 1-FCV-43-208, 1-FSV-43-250, 1-FSV-43-251, 1-FSV-43-287, 1-FSV-43-288, 1-FSV-43-307, 1-FSV-43-309, 1-FSV-43-310, 1-FSV-43-318, 1-FSV-43-319, 1-FSV-43-325, 1-FSV-43-341, 1-FSV-43-342 FCV-43-433, FCV-43-434, 1-FCV-43-435, 1-FCV-43-436
	B	B	FCV-43-54D, FCV-43-55, FCV-43-56D, FCV-43-58, FCV-43-59D, FCV-43-61, FCV-43-63D, FCV-43-64
	AC	B	1-43-834, 1-43-841, 1-43-883, 1-43-884
SYSTEM TEST FACILITY 47W331-3	A	B	52-500, 52-501, 52-502, 52-503, 52-504, 52-505, 52-506, 52-507
DEMINERALIZED WATER AND CASK DECONTAMINATION 47W856-1	A	B	59-522, 59-698
ICE CONDENSER 47W814-2	A	B	FCV-61-96, FCV-61-97, FCV-61-110, FCV-61-122, FCV-61-191, FCV-61-192, FCV-61-193, FCV-61-194
	AC	B	61-533, 61-680, 61-692, 61-745
	C	Note 1	61-658, 61-659, 61-660, 61-661, 61-662, 61-663, 61-664, 61-665, 61-666, 61-667, 61-668, 61-669, 61-670, 61-671, 61-672, 61-673, 61-674, 61-675, 61-676, 61-677
BORATION MAKEUP 47W809-7	A	B	84-530
RADIATION MONITORING 47W610-90-3	A	B	FCV-90-107, FCV-90-108, FCV-90-109, FCV-90-110, FCV-90-111, FCV-90-113, FCV-90-114, FCV-90-115, FCV-90-116, FCV-90-117
FUEL POOL COOLING AND CLEANING 47W855-1	A	B	78-557, 78-558, 78-560, 78-561

Note 1: Not Constructed to an ASME Code Class.

Note 2: Valves listed in Table 3.9-26 are not necessarily Reg Guide 1.48 active and/or event active. Non-active valves may be added for convenience of plant operations to improve a valve's reliability, etc. All active valves are reflected in Tables 3.9-17 and 3.9-25.

TABLE 3.9-27 (Sheet 1 of 2)

ACTIVE SECTION III ASME-CODED COMPONENTS (EXCEPT VALVES) IN TVA SCOPE OF SUPPLY[1]

SYSTEM NAME	COMPONENT	ANS SAFETY CLASS	NORMAL MODE	POST LOCA MODE	REASON
Feedwater (3)	Auxiliary feedwater pumps:				
	Motor driven				
	1A-A	2B	OFF	ON	Provide heat removal for chapter 15 events.
	1B-B	2B	OFF	ON	
	2A-A	2B	OFF	ON	
	2B-B	2B	OFF	ON	
	Steam driven				
	1A-S	2B	OFF	ON	Provide heat removal for chapter 15 events.
	2A-S	2B	OFF	ON	
Control Air (32)	Auxiliary air compressors A & B	2B	OFF	ON	Provide control air for safety-related equipment.
Essential Raw Cooling Water (67)	ERCW pump A-A	2B	ON	ON	Provide cooling water flow for component cooling system and other heat removal systems.
	B-A	2B	ON	ON	
	C-A	2B	ON	ON	
	D-A	2B	ON	ON	
	E-B	2B	ON	ON	
	F-B	2B	ON	ON	
	G-B	2B	ON	ON	
	H-B	2B	ON	ON	
	Screen Wash Pump				
	1AA	2B	ON	ON	Prevents fouling of ERCW pump station.
	2AA	2B	ON	ON	
	1BB	2B	ON	ON	
	2BB	2B	ON	ON	

TABLE 3.9-27 (Sheet 2 of 2)

ACTIVE SECTION III ASME-CODED COMPONENTS (EXCEPT VALVES) IN TVA SCOPE OF SUPPLY[1]

SYSTEM NAME	COMPONENT	ANS SAFETY CLASS	NORMAL MODE	POST LOCA MODE	REASON
Component Cooling (70)	Component cooling pumps1A	2B	ON	ON	Provide cooling water flow for required equipment served by the CCS.
	1B	2B	ON	ON	
	2A	2B	ON	ON	
	2B	2B	ON	ON	
	C-S	2B	ON	ON	
	1A TB Booster	2B	ON	OFF	Provides flow RCP thermal barriers
	1B TB Booster	2B	ON	OFF	
	2A TB Booster	2B	ON	OFF	
	2B TB Booster	2B	ON	OFF	

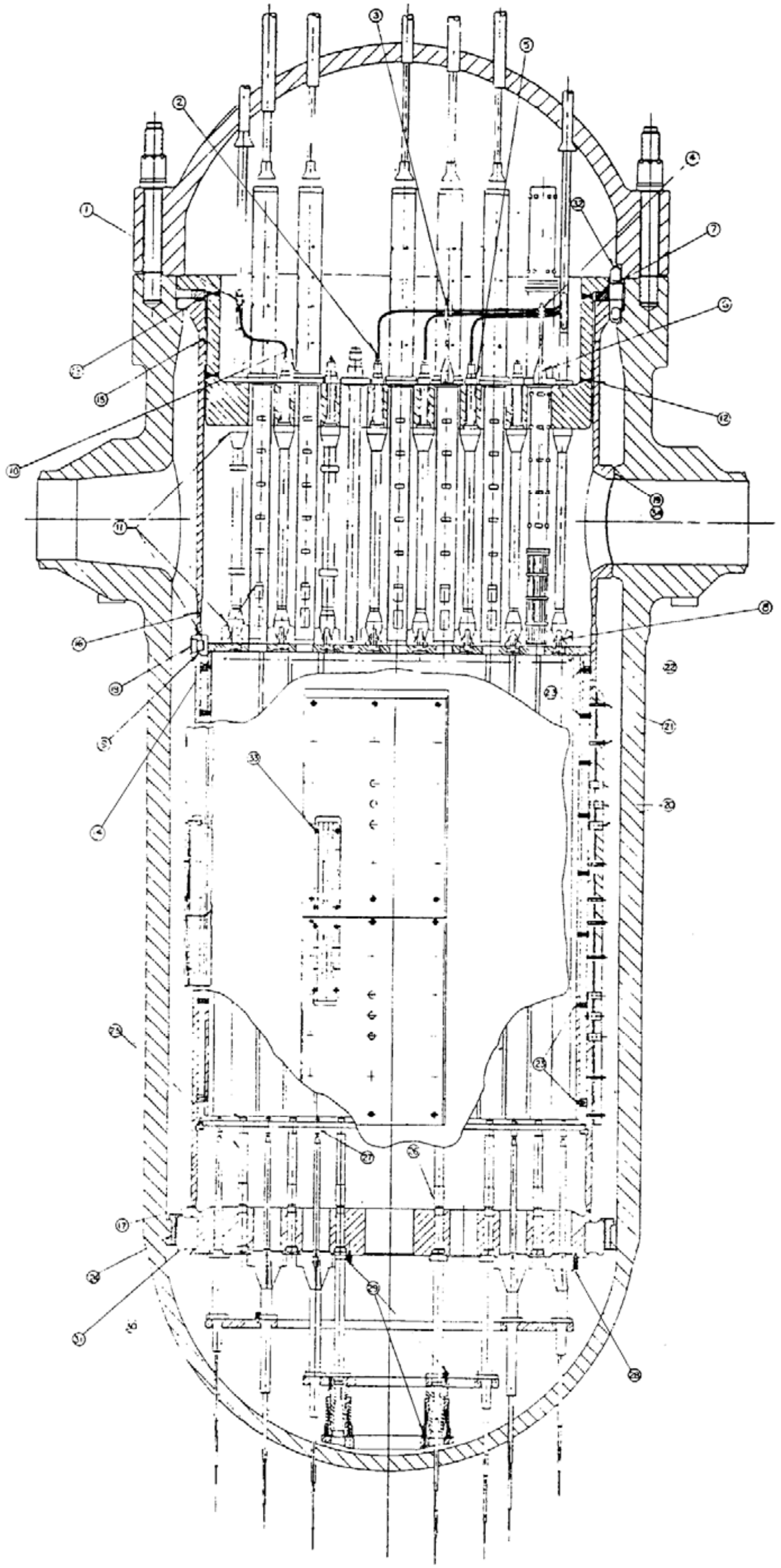
Note:
(1) As defined in Regulatory Guide 1.48

WBN

TABLE 3.9-28

ACTIVE PUMPS FOR PRIMARY FLUID SYSTEMS IN WESTINGHOUSE SCOPE OF SUPPLY AS APPLIED TO WATTS BAR NUCLEAR PLANT

SYSTEM NAME	COMPONENT	ANS SAFETY CLASS	NORMAL MODE	POST LOCA MODE	REASON
CVCS (62)	Centrifugal Charging Pumps				
	1A-A	2A	ON	ON	To provide emergency
	2A-A	2A	ON	ON	core cooling, reactivity
	1B-B	2A	ON	ON	control and RCP seal
	2B-2B	2A	ON	ON	injection flow.
Safety Injection	SIS Pump				
Systems (63)	1A-A	2A	OFF	ON	To provide emergency
	1B-B	2A	OFF	ON	core cooling and reactivity
	2A-A	2A	OFF	ON	control.
	2B-B	2A	OFF	ON	
Containment	Pump				
Spray (72)	1A-A	2A	OFF	ON	Provide cooling water flow
	2A-A	2A	OFF	ON	to control containment
	1B-B	2A	OFF	ON	temperature and pressure.
	2B-B	2A	OFF	ON	
Residual Heat	Pump				
Removal (74)	1A-A	2A	OFF	ON	To provide emergency
	1B-B	2A	OFF	ON	core cooling and reactivity
	2A-A	2A	OFF	ON	control and containment
	2B-B	2A	OFF	ON	temperature and pressure
					control.
Spent Fuel Pool	Pump				
Cooling (78)	A-A	2B	ON	ON	Provide adequate spent
	B-B	2B	ON	ON	fuel cooling.
	C-S	2B	OFF	OFF	



SEE NOTES	STEP	FEATURES TO BE EXAMINED	COMMENTS AND OBSERVATIONS BEFORE FUNCTIONAL TEST	COMMENTS AND OBSERVATIONS AFTER FUNCTIONAL TEST
1	1.	THERMOCOUPLE CONDUIT CLAMPS INSIDE THE THERMOCOUPLE COLUMN	NO APPARENT DEFECTS	NO APPARENT DEFECTS
1, 5	2.	CONDUIT SWAGLOCK FITTINGS, THEIR BANDINGS, AND THE TAB TYPE LOCKS.	NO APPARENT DEFECTS	NO APPARENT DEFECTS
1	3.	CLAMP ARRANGEMENTS AT THE MOUNTING BRACKET LOCATIONS.	ACCEPTED	NO APPARENT DEFECTS
1	4.	CONDUIT FITTING TO SUPPORT BRACKET WELDS ADJACENT TO T/C COLUMNS.	NO APPARENT DEFECTS	NO APPARENT DEFECTS
1	5.	UPPER SUPPORT COLUMN NUT TO EXTENSION WELDS.	NO APPARENT DEFECTS	NO APPARENT DEFECTS
1	6.	ACCESSIBLE CONDUIT SUPPORT BRACKET WELDS	ACCEPTED	NO APPARENT DEFECTS
6	7.	HOLD DOWN SPRING INTERFACE SURFACE CONDITION.	NO DEFECTS	NO APPARENT DEFECTS
1	8.	ACCESSIBLE WELDS ON SUPPORT COLUMN LOWER NOZZLES.	NO APPARENT DEFECTS	NO APPARENT DEFECTS
3, 6	9.	UPPER CORE PLATE INSERTS.	NO APPARENT DEFECTS	NO APPARENT DEFECTS
2	10.	THERMOCOUPLE COLUMN, FLOW COLUMN, AND GUIDE TUBE SCREW LOCKING DEVICES.	NO APPARENT DEFECTS	NO APPARENT DEFECTS
2	11.	ACCESSIBLE SUPPORT COLUMN, AND CORE PLATE INSERT SCREW LOCKING DEVICES.	ACCEPTED	NO APPARENT DEFECTS
1	12.	UPPER SUPPORT SKIRT TO PLATE GIRTH WELD.	NO APPARENT DEFECTS	NO APPARENT DEFECTS
1	13.	UPPER SUPPORT SKIT TO FLANGE GIRTH WELD.	NO APPARENT DEFECTS	NO APPARENT DEFECTS
1	14.	ACCESSIBLE GUIDE TUBE WELDS.	NO APPARENT DEFECTS	NO APPARENT DEFECTS
1	15.	UPPER BARREL TO FLANGE GIRTH WELD.	NO APPARENT DEFECTS	NO APPARENT DEFECTS
1	16.	UPPER BARREL TO LOWER BARREL GIRTH WELD.	NO APPARENT DEFECTS	NO APPARENT DEFECTS
1	17.	LOWER BARREL TO CORE SUPPORT GIRTH WELD.	NO APPARENT DEFECTS	NO APPARENT DEFECTS
1, 4	18.	UPPER CORE PLATE ALIGNING PIN WELDS AND BEARING SURFACES.	ACCEPTED	NO APPARENT DEFECTS
6	19.	OUTLET NOZZLE INTERFACE SURFACE CONDITION.	ACCEPTED	NO APPARENT DEFECTS
1	20.	NEUTRON SHIELD PANEL DOWEL PIN COVER PLATE WELDS.	ACCEPTED	NO APPARENT DEFECTS
1, 2	21.	NEUTRON SHIELD PANEL SCREW LOCKING DEVICES	ACCEPTED	NO APPARENT DEFECTS
10	22.	INTERFACE SURFACES AT THE SPACER PADS ALONG THE TOP AND BOTTOM ENDS OF THE NEUTRON PANELS.	NO APPARENT DEFECTS	NO APPARENT DEFECTS
1	23.	BAFFLE ASSEMBLY SCREW LOCKING ARRANGEMENTS AT THE TWO TOP AND THE TWO BOTTOM FORMER ELEVATIONS.	ACCEPTED	NO APPARENT DEFECTS
1, 3, 4	24.	VESSEL CLEVIS LOCKING ARRANGEMENTS AND BEARING SURFACES.	NO APPARENT DEFECTS	NO APPARENT DEFECTS
1, 2, 7	25.	CORE SUPPORT COLUMNS AND THEIR SCREW LOCKING DEVICES.	ACCEPTED	NO APPARENT DEFECTS
8	26.	CORE SUPPORT COLUMN ADJUSTING SLEEVES.	ACCEPTED	NO APPARENT DEFECTS
9	27.	ACCESSIBLE (2) INTRUMENTATION GUIDE COLUMN LOCKING COLLARS NEAREST THE MANWAY.	NO APPARENT DEFECTS	NO APPARENT DEFECTS
1, 2, 10	28.	LOCKING DEVICES AND CONTACT OF THE CURCIFORM SHAPED BOTTOM INSTRUMENTATION GUIDE COLUMNS WHERE ATTACHED TO THE CORE SUPPORT AND TIE PLATES.	NO DEFECTS	NO APPARENT DEFECTS
1, 2	29.	LOCKING DEVICES OF THE SECONDARY CORE SUPPORT BUTT COLUMNS AT THE CORE SUPPORT, TIE PLATE AND BASE PLATE.	ACCEPTED	NO APPARENT DEFECTS
1	30.	RADIAL SUPPORT KEY WELDS	ACCEPTED	NO APPARENT DEFECTS
1, 4	31.	RADIAL SUPPORT KEY LOCKING ARRANGEMENTS AND BEARING SURFACES.	NO DEFECTS	NO APPARENT DEFECTS
1, 4	32.	HEAD AND VESSEL ALIGNING PIN SCREW LOCKING DEVICES AND BEARING SURFACES.	NO DEFECTS	NO APPARENT DEFECTS
1, 2	33.	IRRADIATION SPECIMEN GUIDE SCREW LOCKING DEVICES AND DOWEL PINS	NO DEFECTS	NO APPARENT DEFECTS
6	34.	VESSEL NOZZLE INTERFACE SURFACE CONDITION.	NO DEFECTS	NO APPARENT DEFECTS

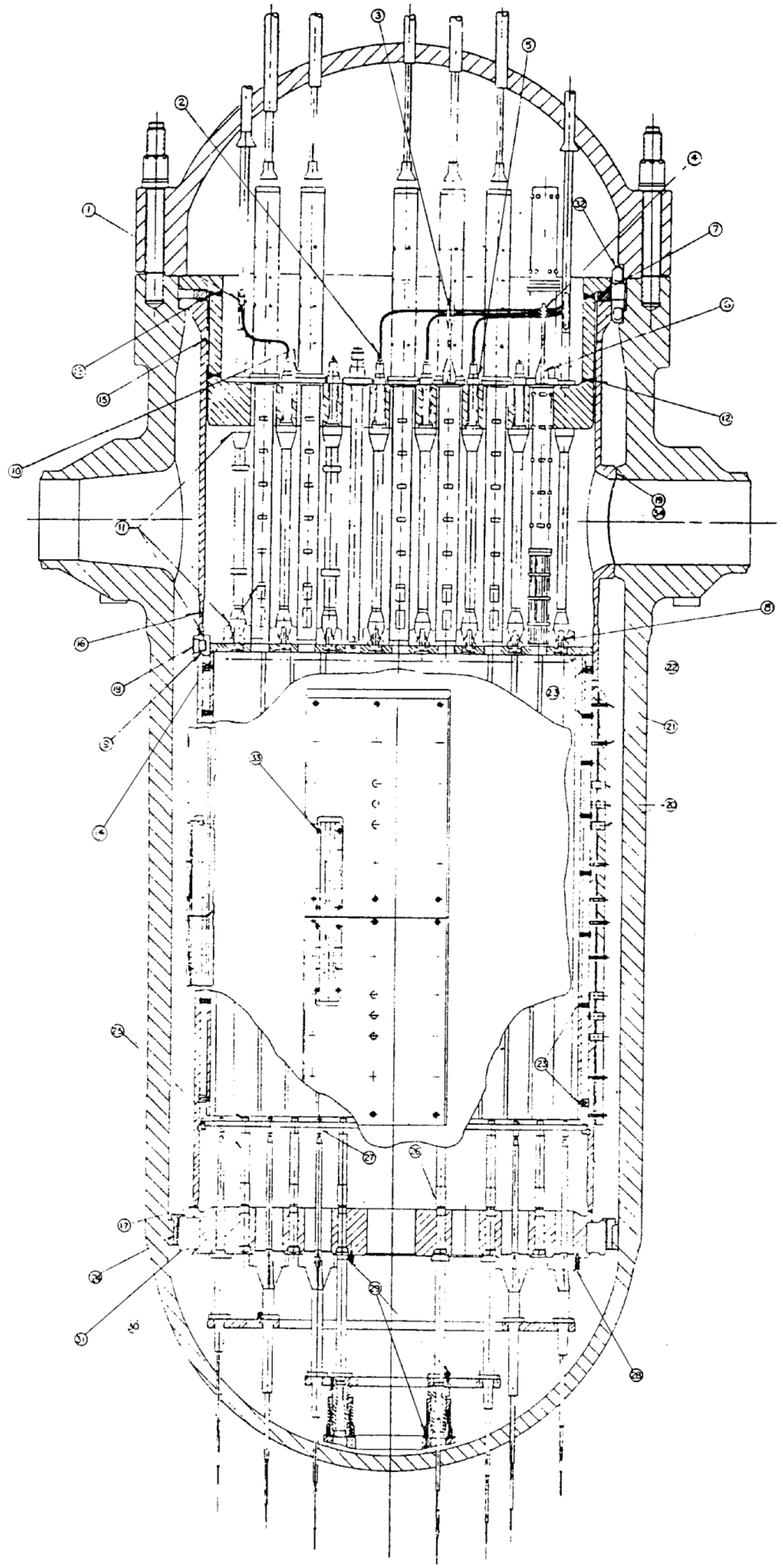
NOTES

1. VISUALLY EXAMINE WELDS USING 5-10X MAGNIFICATION. NOT CRACKS ALLOWED.
2. VERIFY THAT LOCKING DEVICES ARE CRIMPED AND UNDAMAGED.
3. VERIFY THAT INSERTS ARE SEATED (.0015 FEELER MUST NOT PASS THRU INTERFACE).
4. VISUALLY EXAMINE FACES FOR DAMAGE USING 5-10X MAGNIFICATION.
5. VERIFY THAT FITTINGS AER TIGHT.
6. VISUALLY EXAMINE INTERFACE SURFACES FOR ANY EVIDENCE OF DAMAGE.
7. VERIFY THAT ACCESSIBLE COLUMNS ARE SEATED ON LOWER CORE PLATE. A .0015 FEELER MUST NOT PASS THRU 90°.
8. VERIFY THAT ACCESSIBLE SLEEVES ARE SEATED ON COLUMNS. A .0015 FEELER MUST NOT PASS THRU 90°.
9. VERIFY THAT LOCKING COLLARS ARE TIGHT. NO MOVEMENT ALLOWED.
10. VERIFY SEATING USING A .0015 FEELER GAGE. FEELER MUST NOT PASS THRU 90°.

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Unit 1
Vibration Check-out
Functional Test Inspection Data

FIGURE 3.9-1 (U1)



SEE NOTES	STEP	FEATURES TO BE EXAMINED	COMMENTS AND OBSERVATIONS BEFORE FUNCTIONAL TEST	COMMENTS AND OBSERVATIONS AFTER FUNCTIONAL TEST
1	5.	UPPER SUPPORT COLUMN NUT TO EXTENSION WELDS.	NO APPARENT DEFECTS	NO APPARENT DEFECTS
6	7.	HOLD DOWN SPRING INTERFACE SURFACE CONDITION.	NO DEFECTS	NO APPARENT DEFECTS
1	8.	ACCESSIBLE WELDS ON SUPPORT COLUMN LOWER NOZZLES.	NO APPARENT DEFECTS	NO APPARENT DEFECTS
3, 6	9.	UPPER CORE PLATE INSERTS.	NO APPARENT DEFECTS	NO APPARENT DEFECTS
2	10.	SUPPORT COLUMN, FLOW COLUMN, AND GUIDE TUBE SCREW LOCKING DEVICES.	NO APPARENT DEFECTS	NO APPARENT DEFECTS
2	11.	ACCESSIBLE SUPPORT COLUMN, AND CORE PLATE INSERT SCREW LOCKING DEVICES.	ACCEPTED	NO APPARENT DEFECTS
1	12.	UPPER SUPPORT SKIRT TO PLATE GIRTH WELD.	NO APPARENT DEFECTS	NO APPARENT DEFECTS
1	13.	UPPER SUPPORT SKIT TO FLANGE GIRTH WELD.	NO APPARENT DEFECTS	NO APPARENT DEFECTS
1	14.	ACCESSIBLE GUIDE TUBE WELDS.	NO APPARENT DEFECTS	NO APPARENT DEFECTS
1	15.	UPPER BARREL TO FLANGE GIRTH WELD.	NO APPARENT DEFECTS	NO APPARENT DEFECTS
1	16.	UPPER BARREL TO LOWER BARREL GIRTH WELD.	NO APPARENT DEFECTS	NO APPARENT DEFECTS
1	17.	LOWER BARREL TO CORE SUPPORT GIRTH WELD.	NO APPARENT DEFECTS	NO APPARENT DEFECTS
1, 4	18.	UPPER CORE PLATE ALIGNING PIN WELDS AND BEARING SURFACES.	ACCEPTED	NO APPARENT DEFECTS
6	19.	OUTLET NOZZLE INTERFACE SURFACE CONDITION.	ACCEPTED	NO APPARENT DEFECTS
1	20.	NEUTRON SHIELD PANEL DOWEL PIN COVER PLATE WELDS.	ACCEPTED	NO APPARENT DEFECTS
1, 2	21.	NEUTRON SHIELD PANEL SCREW LOCKING DEVICES	ACCEPTED	NO APPARENT DEFECTS
10	22.	INTERFACE SURFACES AT THE SPACER PADS ALONG THE TOP AND BOTTOM ENDS OF THE NEUTRON PANELS.	NO APPARENT DEFECTS	NO APPARENT DEFECTS
1	23.	BAFFLE ASSEMBLY SCREW LOCKING ARRANGEMENTS AT THE TWO TOP AND THE TWO BOTTOM FORMER ELEVATIONS.	ACCEPTED	NO APPARENT DEFECTS
1, 3, 4	24.	VESSEL CLEVIS LOCKING ARRANGEMENTS AND BEARING SURFACES.	NO APPARENT DEFECTS	NO APPARENT DEFECTS
1, 2, 7	25.	CORE SUPPORT COLUMNS AND THEIR SCREW LOCKING DEVICES.	ACCEPTED	NO APPARENT DEFECTS
8	26.	CORE SUPPORT COLUMN ADJUSTING SLEEVES.	ACCEPTED	NO APPARENT DEFECTS
9	27.	ACCESSIBLE (2) INTRUMENTATION GUIDE COLUMN LOCKING COLLARS NEAREST THE MANWAY.	NO APPARENT DEFECTS	NO APPARENT DEFECTS
1, 2, 10	28.	LOCKING DEVICES AND CONTACT OF THE CURCIFORM SHAPED BOTTOM INSTRUMENTATION GUIDE COLUMNS WHERE ATTACHED TO THE CORE SUPPORT AND TIE PLATES.	NO DEFECTS	NO APPARENT DEFECTS
1, 2	29.	LOCKING DEVICES OF THE SECONDARY CORE SUPPORT BUTT COLUMNS AT THE CORE SUPPORT, TIE PLATE AND BASE PLATE.	ACCEPTED	NO APPARENT DEFECTS
1	30.	RADIAL SUPPORT KEY WELDS	ACCEPTED	NO APPARENT DEFECTS
1, 4	31.	RADIAL SUPPORT KEY LOCKING ARRANGEMENTS AND BEARING SURFACES.	NO DEFECTS	NO APPARENT DEFECTS
1, 4	32.	HEAD AND VESSEL ALIGNING PIN SCREW LOCKING DEVICES AND BEARING SURFACES.	NO DEFECTS	NO APPARENT DEFECTS
1, 2	33.	IRRADIATION SPECIMEN GUIDE SCREW LOCKING DEVICES AND DOWEL PINS	NO DEFECTS	NO APPARENT DEFECTS
6	34.	VESSEL NOZZLE INTERFACE SURFACE CONDITION.	NO DEFECTS	NO APPARENT DEFECTS

NOTES

1. VISUALLY EXAMINE WELDS USING 5-10X MAGNIFICATION. NOT CRACKS ALLOWED.
2. VERIFY THAT LOCKING DEVICES ARE CRIMPED AND UNDAMAGED.
3. VERIFY THAT INSERTS ARE SEATED (.0015 FEELER MUST NOT PASS THRU INTERFACE).
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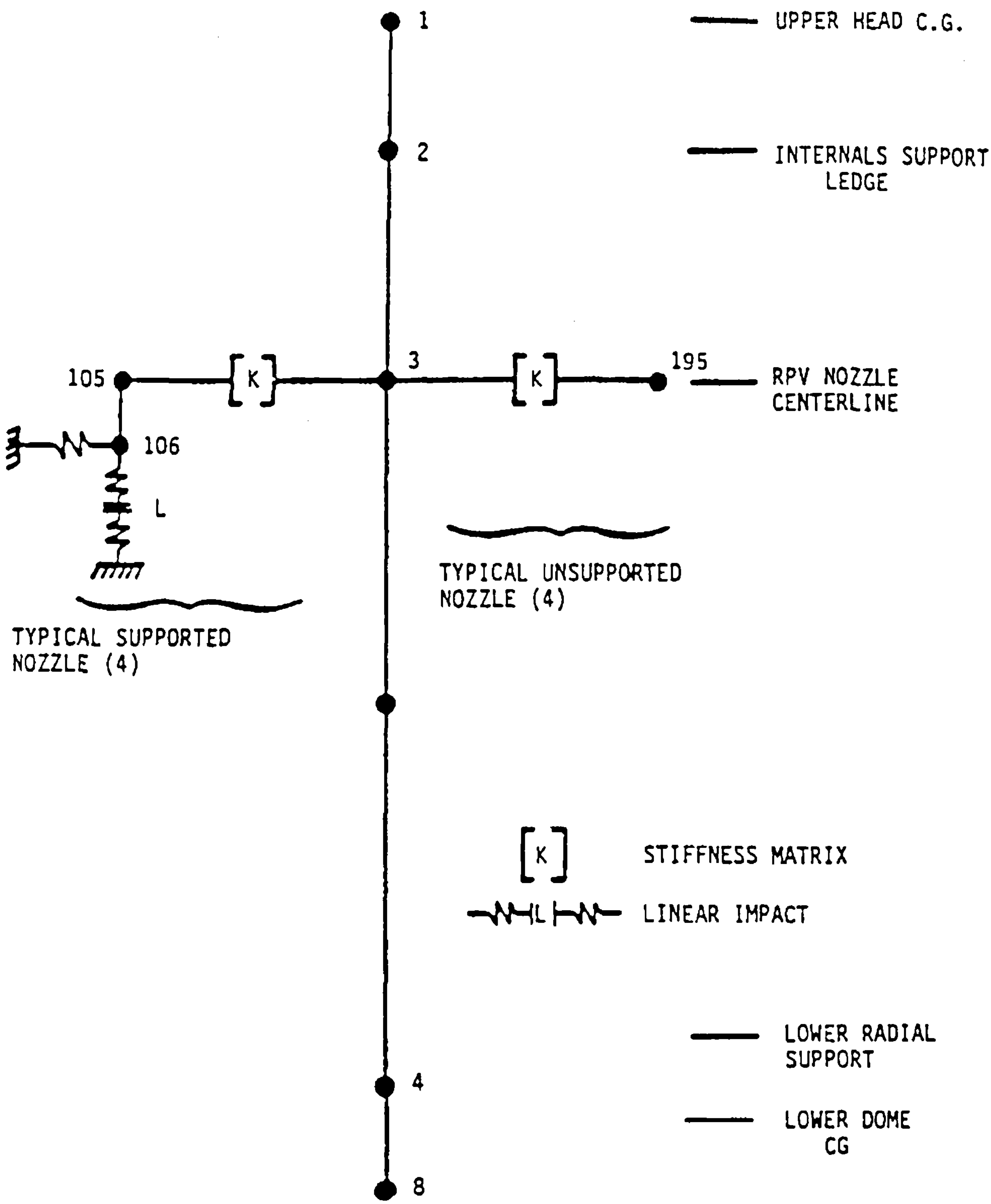
5. VERIFY THAT FITTINGS AER TIGHT.
6. VISUALLY EXAMINE INTERFACE SURFACES FOR ANY EVIDENCE OF DAMAGE.
7. VERIFY THAT ACCESSIBLE COLUMNS ARE SEATED ON LOWER CORE PLATE. A .0015 FEELER MUST NOT PASS THRU 90°.
8. VERIFY THAT ACCESSIBLE SLEEVES ARE SEATED ON COLUMNS. A .0015 FEELER MUST NOT PASS THRU 90°.
9. VERIFY THAT LOCKING COLLARS ARE TIGHT. NO MOVEMENT ALLOWED.
10. VERIFY SEATING USING A .0015 FEELER GAGE. FEELER MUST NOT PASS THRU 90°.

WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Unit 2
Vibration Check-out
Functional Test Inspection Data

FIGURE 3.9-1 (U2)



WATTS BAR NUCLEAR PLANT
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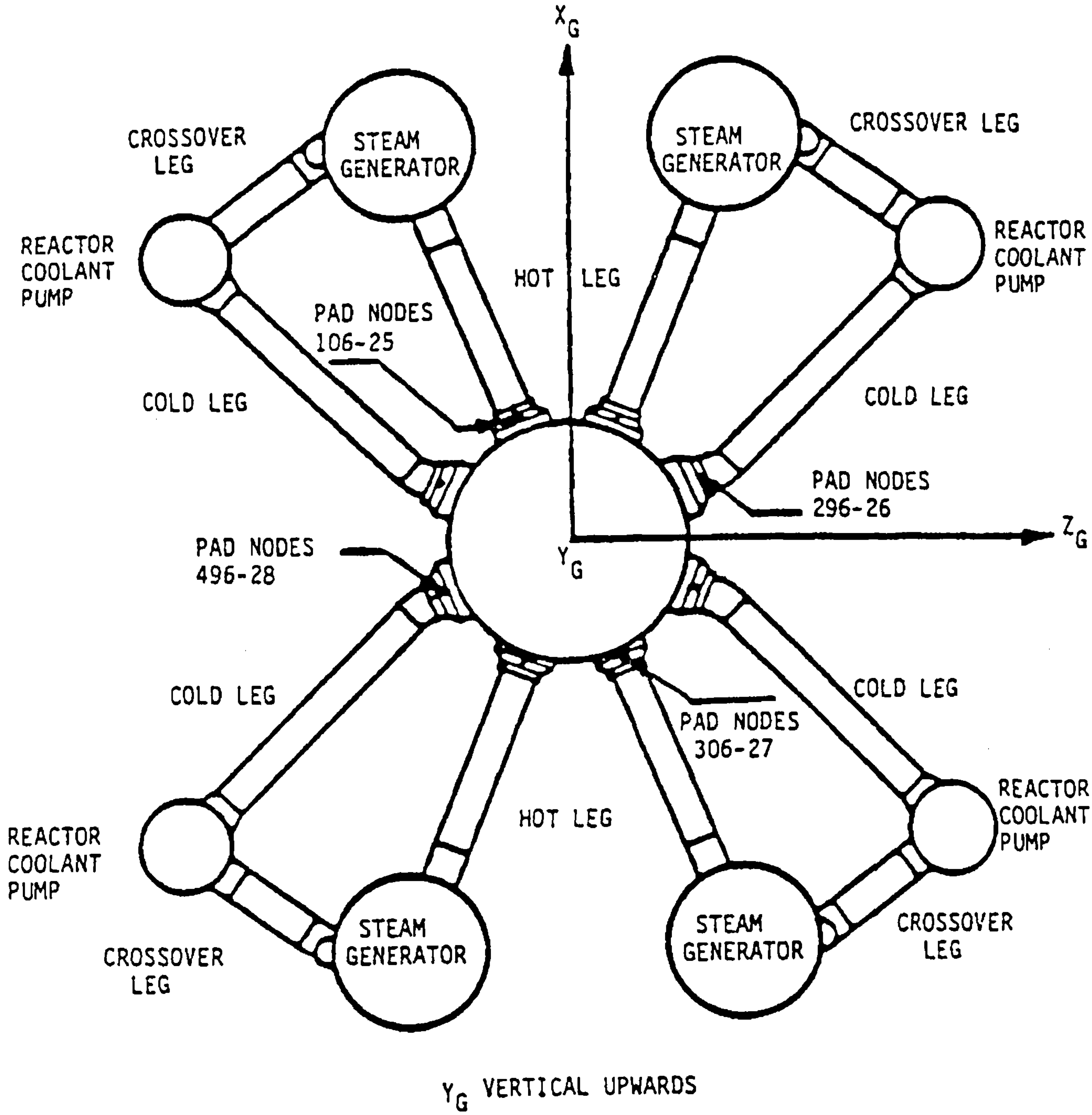
ANALYSIS REPORT

RPV Shell Submodel

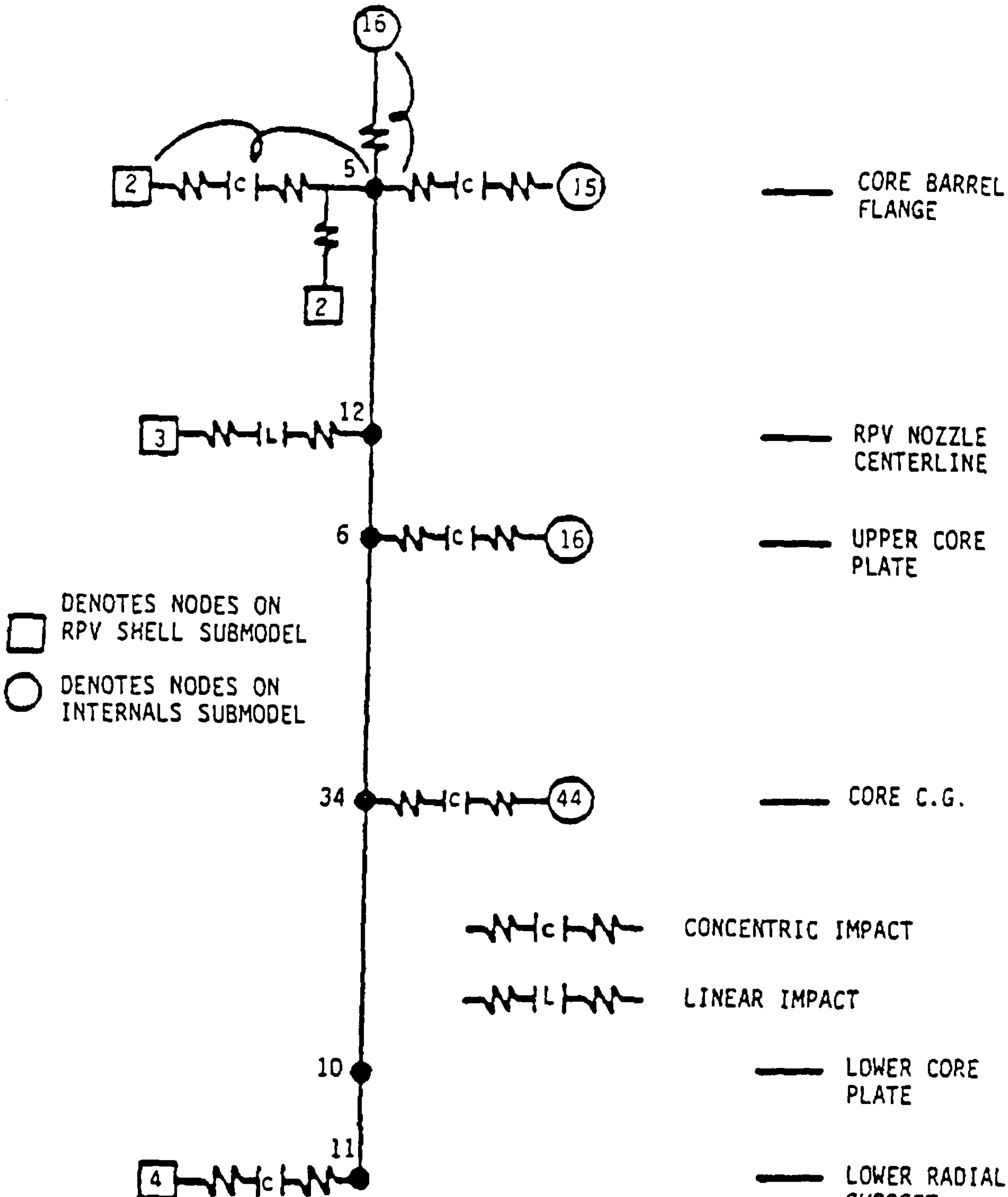
FIGURE 3.9.2A



WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

RPB Support Pads and
WECAN Global Coordinates

FIGURE 3.9-2B



WATTS BAR NUCLEAR PLANT
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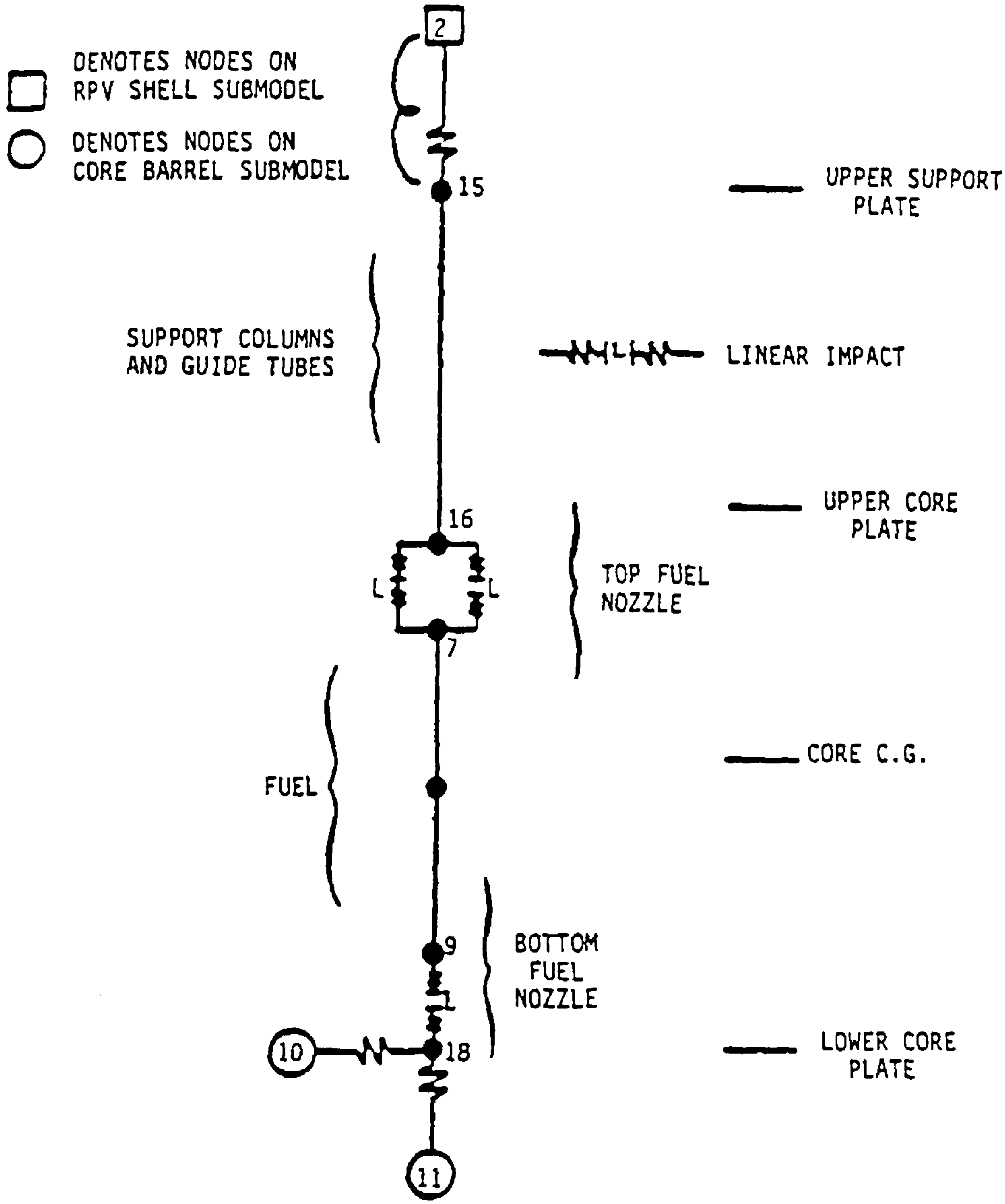
ANALYSIS REPORT

Core Barrel Submodel

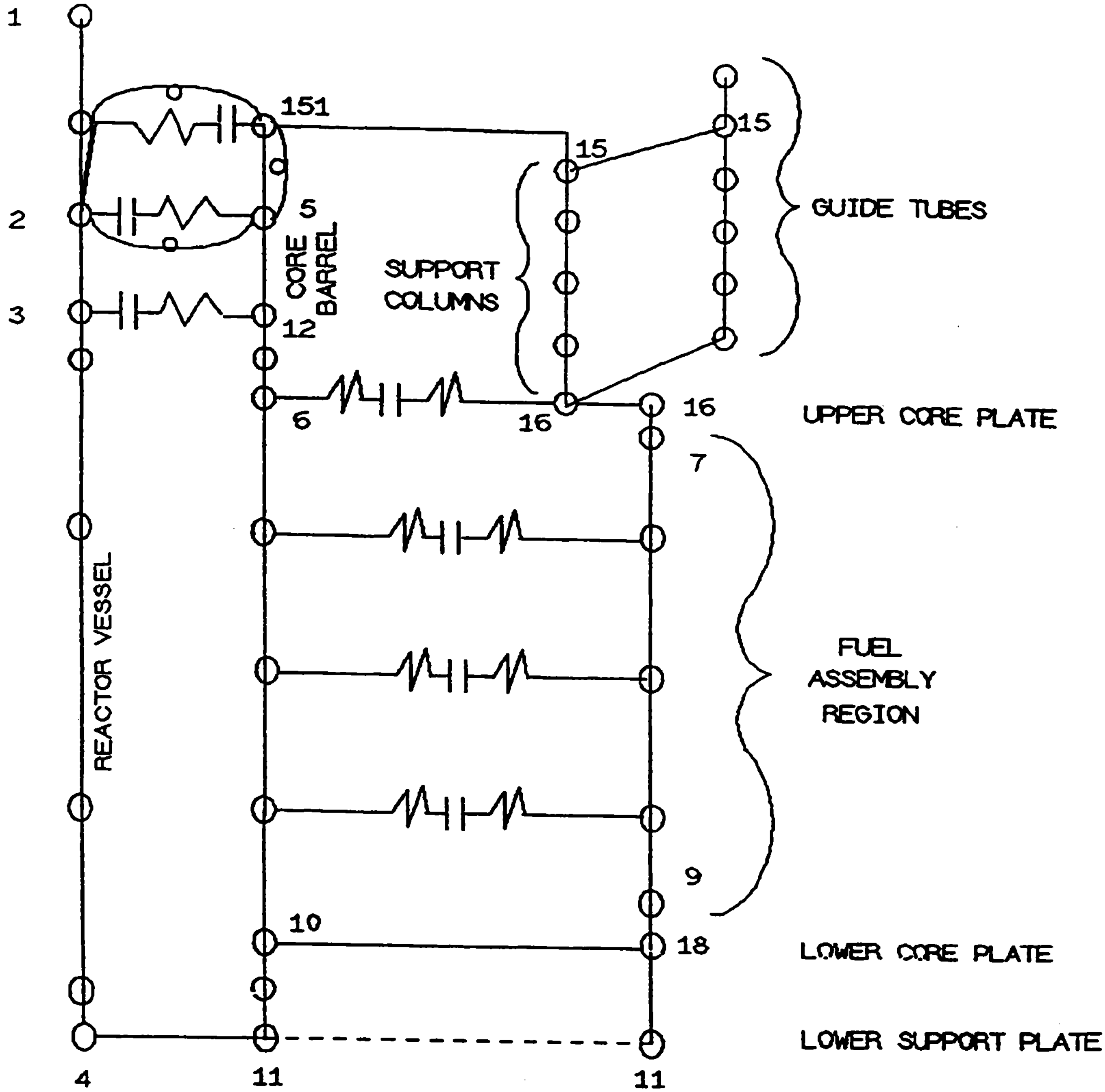
FIGURE 3.9-3A



WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Internals Submodel

FIGURE 3.9-3B



WATTS BAR NUCLEAR PLANT
FINAL SAFETY
ANALYSIS REPORT

Reactor Pressure Vessel
System Model

FIGURE 3.9-3C

3.10 SEISMIC DESIGN OF CATEGORY 1 INSTRUMENTATION AND ELECTRICAL EQUIPMENT

Seismic Category I instrumentation and electrical equipment for the Watts Bar Nuclear Plant was either furnished by Westinghouse or purchased by TVA. TVA's seismic qualification program for instrumentation and electrical equipment at Watts Bar is based on the requirements of IEEE 344-1971 and the NRC Standard Review Plan, Section 3.10 (specifically, acceptance criteria for plants with Construction Permit application docketed before October 27, 1972) as discussed in Section 3.7.3.16.

Instrumentation and electrical equipment was purchased in assemblies except for local panel instrumentation as described in Section 3.10.1. TVA provided the vendor with a required response spectrum as a part of the equipment specification in order that the vendor could qualify the equipment. The derivation of the response spectrum is described in Section 3.7.

3.10.1 Seismic Qualification Criteria

TVA Supplied

Class 1E Power Equipment

Table 3.10-1 lists the procurement packages for Class 1E power equipment. TVA's seismic qualification criteria is based on IEEE 344-1971 or IEEE 344-1975 as discussed above.

The capability of ESF circuits and the Class 1E system to withstand seismic disturbances is established by seismic analysis and/or testing of each system component. The qualification criteria used in the design of Seismic Category I electrical equipment are given below.

1. Safety-related equipment designated as Seismic Category I, when subjected to the vertical and horizontal acceleration of the safe shutdown earthquake (SSE), shall perform as follows:

    a. Equipment shall retain its structural integrity during and after the seismic event.

    b. Equipment shall be capable of performing its design function during and after the seismic event.

    c. Maximum displacement of the equipment during the earthquake shall not cause loss of function of any externally connected parts, such as conduit, cable, or bus connections.

Equipment anchorage/support design is discussed in Section 3.10.3.1. Other considerations for the seismic qualification of Category I electrical equipment are described in Section 3.7.3.

Local Instrumentation

TVA supplied instruments were classified as Seismic Category I in accordance with the system served and instrument function. Seismic Category I systems are qualified in accordance with IEEE-344-1971 or 1975, as applicable, and are listed in Table 3.10-1.

Type testing for seismic qualification has been performed on the Seismic Category I instruments. The active instruments are capable of performing their function during and following a SSE. They are qualified to the response acceleration which exceeds the response of the support structure. Tests and/or analyses were conducted on critical rack-instrumentation configurations to confirm the conservatism of the seismic test level for the instruments.

Westinghouse Supplied (Unit 1 Only)

The reactor trip system, and engineered safety features actuation system are designed so that they are capable of providing the necessary protective actions during and after a SSE; therefore, the reactor protection system is capable of tripping the reactor during and after a SSE. The engineered safety features actuation system and the safety features systems are designed to initiate their protective functions during and after an SSE.

The following list identifies the instrumentation and electrical equipment requiring seismic qualification by the supplier of the Nuclear Steam Supply System (NSSS).

1. Foxboro Model E-11 pressure transmitter and Model E-13 differential pressure transmitter.

2. Foxboro Process Control Equipment cabinets.

3. Westinghouse Solid-State Protection System cabinets.

4. Nuclear Instrumentation System cabinets.[1]

5. Safeguards Test Racks.

6. Resistance Temperature Detectors.

7. Power range Neutron Detectors.

8. Reactor trip breakers.

9. Barton Models 332 and 386 differential pressure transmitters.

10. Eagle-21 Process Protection System

[1] NOTE: Unit 1 Source Intermediate Range Electronics and Detectors were replaced with Gamma Metrics Equipment (DCN 03206). The equipment was placed into the Nuclear Instrumentation System Cabinets and subsequently qualified by TVA calculation WCG-ACQ-0104.

Seismic qualification testing of Items 1 through 9 is documented in References [1] through [10]. Reference [10] presents the theory and practice, as well as justification, for the use of single axis sine beat test inputs used in the seismic qualification of electrical equipment. In addition, it is noted that Westinghouse has conducted a seismic qualification "Demonstration Test Program" (reference Letter NS-CE-692, C. Eicheldinger (W), to D. B. Vassallo (NRC), 7/10/75) to confirm equipment operability during a seismic event. This program is documented in References [12] through [15] (Proprietary) and References [16] through [20] (Non-Proprietary). Seismic qualification testing of Item 10 to IEEE 344-1975 is documented in References [21], [22], and [23].

The Watts Bar Nuclear Plant complies with paragraph IV, "Conclusions and Regulatory Positions" of the "Mechanical Engineering Branch Report on Seismic Audit of Westinghouse Electrical Equipment." All topical reports have been completed and are included in the reference list. The non-proprietary topical reports have been referenced as a group above. The structural capability of the NIS rack is discussed in References [14], [19], and [24].

The demonstration test program, in conjunction with the justification for the use of single axis sine beat tests, presented in WCAP-8373, and the original tests, documented in References [2] through [10], meet the requirements of IEEE Standard 344-1975 "IEEE Recommended Practices for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations" for the seismic qualification of Westinghouse electrical equipment outside of containment. Environmental qualification for equipment inside of containment is described in Section 3.11.

The peak accelerations used in the type testing are conservative values that are checked against those derived by structural analyses of SSE loadings of the Watts Bar Nuclear Plant. For the SSE there may be permanent deformation of the equipment provided that the capability to perform its function is maintained.

Resistance temperature detectors used to sense the temperature in the main coolant loops are rigid, ruggedly built devices designed to withstand the high temperature, high pressure, and flow vibration induced acceleration forces which they are subjected to when installed in the coolant loops. The natural frequency of this device is designed to be higher than the frequencies associated with the seismic disturbance. Seismic qualification of these resistance temperature detectors is presented in Reference [9].

The nuclear instrumentation system power range neutron detector has been vibration tested in both the transverse (horizontal) direction and longitudinal (vertical) direction at acceleration levels greater than those expected during a seismic disturbance at the Watts Bar Nuclear Plant site. Detector current measurements were made during the tests and neutron sensitivity, resistance, and capacitance checks were made after the test. No significant changes were seen. There was no mechanical damage to the detector.

Typical switches and indicators which could defeat automatic operation of a required safety function have been tested to determine their ability to withstand seismic excitation without malfunction. The control boards are stiff and past experience indicates that the amplification due to the board structure is sufficiently low so that the acceleration seen by the device is considerably less than that used in testing.

All safety-related instruments of the reactor protection system and the engineered safety feature circuits are mounted on Seismic Category I supporting structures. They are designed to withstand horizontal and vertical accelerations at each floor level for the SSE. The instrument supporting structures located throughout the plant (local panels) have been standardized in design and have been seismically qualified by testing. The local panels were tested using response spectra for the highest elevation on which any of these panels are mounted. The test criteria were in accordance with IEEE 344-1971 or IEEE 344-1975, as discussed above.

Where space requirements preclude the use of the standard local panels, a small wall-mounted panel is used. This panel is qualified, to the same criteria as the local panels, by analysis and/or test.

Reactor Protection System (Unit 2 only)

The reactor trip system, and engineered safety features actuation system are designed so that they are capable of providing the necessary protective actions during and after a SSE; therefore, the reactor protection system is capable of tripping the reactor during and after a SSE. The engineered safety features actuation system and the safety features systems are designed to initiate their protective functions during and after an SSE.

The following list identifies the instrumentation and electrical equipment requiring seismic qualification.

1. Foxboro Process Control Equipment cabinets.
2. Westinghouse Solid-State Protection System and cabinets.
3. Nuclear Instrumentation System cabinets.
4. Nuclear Instrumentation System Power Range Electronics.
5. Safeguards Test Racks.
6. esistance Temperature Detectors.
7. Power range Neutron Detectors.
8. Reactor trip breakers.
9. Cameron Model 764 differential pressure transmitters and Model 763A pressure transmitters.
10. Eagle-21 Process Protection System
11. Nuclear Instrumentation Source and Intermediate Range Electronics
12. Combined Source and Intermediate Range Neutron Detectors
13. Process Transmitters (not supplied by Westinghouse)

Seismic qualification testing/analysis of Items 1 through 9 is documented in References [1] through [10] and [26]. Reference [10] presents the theory and practice, as well as justification, for the use of single axis sine beat test inputs used in the seismic qualification of electrical equipment. In addition, it is noted that Westinghouse has conducted a seismic qualification "Demonstration Test Program" (reference Letter NS-CE-692, C. Eicheldinger (W), to D. B. Vassallo (NRC), 7/10/75) to confirm equipment operability during a seismic event. This program is documented in References [12] through [14] (Proprietary) and References [16] through [19] (Non-Proprietary). Seismic qualification testing of Item 10 to IEEE 344-1975 is documented in References [21], [22], [23], [31], and [32]. Reference [26] documents the Westinghouse qualification by analysis of the Nuclear Instrumentation System cabinet 2-M-13 with Gamma Metrics Source and Intermediate Range hardware installed.

The Watts Bar Nuclear Plant complies with paragraph IV, "Conclusions and Regulatory Positions" of the "Mechanical Engineering Branch Report on Seismic Audit of Westinghouse Electrical Equipment." All topical reports have been completed and are included in the reference list. The non-proprietary topical reports have been referenced as a group above. The structural capability of the NIS cabinets and power range electronics is discussed in References[14], [19], [24], and [26].

The demonstration test program, in conjunction with the justification for the use of single axis sine beat tests, presented in WCAP-8373, and the original tests, documented in References [2] through [10], meet the requirements of IEEE Standard 344-1975 "IEEE Recommended Practices for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations" for the seismic qualification of Westinghouse electrical equipment outside of containment. Environmental qualification for equipment inside of containment is described in Section 3.11.

The peak accelerations used in the type testing are conservative values that are checked against those derived by structural analyses of SSE loadings of the Watts Bar Nuclear Plant. For the SSE there may be permanent deformation of the equipment provided that the capability to perform its function is maintained.

Resistance temperature detectors used to sense the temperature in the main coolant loops are rigid, ruggedly built devices designed to withstand the high temperature, high pressure, and flow vibration induced acceleration forces which they are subjected to when installed in the coolant loops. The natural frequency of this device is designed to be higher than the frequencies associated with the seismic disturbance. Seismic qualification of these resistance temperature detectors is presented in Reference [9].

The nuclear instrumentation system power range neutron detector has been vibration tested in both the transverse (horizontal) direction and longitudinal (vertical) direction at acceleration levels greater than those expected during a seismic disturbance at the Watts Bar Nuclear Plant site. Detector current measurements were made during the tests and neutron sensitivity, resistance, and capacitance checks were made after the test. No significant changes were seen. There was no mechanical damage to the detector.

Typical switches and indicators which could defeat automatic operation of a required safety function have been tested to determine their ability to withstand seismic excitation without malfunction. The control boards are stiff and past experience indicates that the amplification due to the board structure is sufficiently low so that the acceleration seen by the device is considerably less than that used in testing.

All safety-related instruments of the reactor protection system and the engineered safety feature circuits are mounted on Seismic Category I supporting structures. They are designed to withstand horizontal and vertical accelerations at each floor level for the SSE. The instrument supporting structures located throughout the plant (local panels) have been standardized in design and have been seismically qualified by testing. The local panels were tested using response spectra for the highest elevation on which any of these panels are mounted. The test criteria were in accordance with IEEE 344-1971 or IEEE 344-1975, as discussed above.

Where space requirements preclude the use of the standard local panels, a small wall-mounted panel is used. This panel is qualified, to the same criteria as the local panels, by analysis and/or test.

Seismic qualification testing of the Gamma-Metrics supplied source and intermediate range neutron detection system (Items 11 and 12 including all interconnections) is documented in Reference [25].

Seismic qualification testing of the protection system process transmitters not supplied by Westinghouse (Item 13) is documented in References [27] through [30].

Seismic qualification on testing of safety related radiation monitors is documented in References [33] through [39].

3.10.2 Methods And Procedures For Qualifying Electrical Equipment And Instrumentation

For the seismic qualification methods of selected Category I electrical equipment and instrumentation, see Tables 3.10-1 and 3.10-2.

Instrumentation

The seismic type testing performed by the NSSS supplier (Westinghouse) is described in References [1] through [10], and [21]. For References [1] through [10], the test method used was the sine beat procedure described in IEEE 344-1971 and Reference [11]. In addition, as noted in Section 3.10.1, Westinghouse conducted a "Demonstration Test Program" which, when considered in conjunction with the tests presented in References [11] through [13], results in meeting the requirements of IEEE 344-1975.

Supporting Structures (Panels, Racks, Cabinets, and Boards)

The qualification of the supporting structures for Seismic Category I instruments has been accomplished by either analysis or testing. The method commonly used is testing under simulated conditions. All tests by TVA before September 1, 1974 on these supporting structures were similar. The support structure was mounted on a vibration generator in a manner that simulated the intended service mounting. The vibratory forces were applied to each of the three major perpendicular axes independently. Maximum service dead loads were simulated. Selected points were monitored to establish amplification of loads. Testing was done at the structure's resonant frequencies. The resonant frequencies were determined by an exploratory test using a sinusoidal steady-state input of low amplitude, (two continuous sweeps from 1 to 33 Hz at a rate of 1 octave per minute). The qualification test was conducted using the sine beat method at the resonant frequencies using the appropriate acceleration input as determined from the building response acceleration spectra. Also, reference Section 3.7.3.16 for additional details.

Later qualification tests typically used multi-frequency time history input motion for which the test response spectra enveloped the required response spectra in accordance with IEEE 344-1975 guidelines.

3.10.3 Methods of Qualifying TVA-Designed Supports for Electrical Equipment Instrumentation and Cables

The methods and procedures of design and analysis or testing of electrical equipment and instrumentation supports, cable trays, cable tray supports, conduit, conduit supports, and conduit banks are provided in the following sections.

3.10.3.1 Electrical Equipment and Instrumentation Assemblies

TVA-designed supports and anchorage for Category I electrical equipment assemblies ensure compatibility with the equipment seismic qualifications test or analysis as described in Section 3.7.3.16.5. Design of these supports is in accordance with Section 3.8.4.5.2.

All floor/wall mounted Category I electrical equipment assemblies such as battery racks, instrument racks, and control consoles are attached by TVA to the building structure. The attachments are made by bolting or welding to structural members. Anchorages to concrete are made by welding to embedded plates cast in the concrete with stud anchors, or by bolting to anchors set in the hardened concrete (self-drilling bolts, wedge bolts, undercut expansion anchors, or grouted anchors).

3.10.3.2 Cable Trays and Supports

3.10.3.2.1 Cable Trays

Cable trays containing Class 1E cables located in Category I structures are considered safety-related and are designed to resist gravity and SSE forces.

Cable tray acceptance criteria are derived from testing. A factor of safety of 1.25 against the tested capacity, is maintained for the vertical moment. A ductility factor of 3 is used to establish tray capacity in the transverse direction. These limits are used in an interaction equation to evaluate tray sections for the SSE loading condition. Seismic loadings are developed based on the applicable response spectra. In addition, all trays are evaluated to ensure a minimum factor of safety of 3 against test capacity for dead load only.

Figure 3.10-1 defines the orientation of the transverse and vertical moments.

Cable tray X and T fittings are evaluated for vertical loading to ensure a minimum factor of safety of 1.25 against the formation of a first hinge.

All other cable tray components are evaluated using AISI or AISC allowables (as applicable) with increase factors as allowed by Standard Review Plan Section 3.8.4. Where test data is used to establish capacities of bolted parts, a factor of safety of 1.5 is maintained against the ultimate test load for the SSE loading condition.

3.10.3.2.2 Supports

All cable tray supports located in Category I structures are designated Seismic Category I and designed to resist seismic forces applied to the weight of trays and cables. Each support in Category I structures is designed independently to support its appropriate length of tray. Seismic load inputs are based on the methods described in Section 3.7 and the damping requirements described in Table 3.7-2.

Trays are designed to carry a load of 30 pounds per square foot (which is equivalent to 45 pounds per linear foot for an 18 inch wide tray) and an additional construction load of 30 pounds per linear foot on the top tray. Actual tray loading may be used on a case by case basis.

For load combinations and allowables applicable for cable tray supports, see Table 3.10-5.

Welding was in accordance with the American Welding Society (AWS), "Structural Welding Code," AWS D1.1 with revision 1-73 and 1-74, except later editions may be used for prequalified joint details, base materials, and qualification of welding procedures and welders. Nuclear Construction Issues Group documents NCIG-01 and NCIG-02 may be used after June 26, 1985, for weldments that were designed and fabricated to the requirements of AISC/AWS. Visual inspection of structural welds will meet the minimum requirements of NCIG-01 and NCIG-02 as specified on the design drawings or other design output. Inspectors performing visual examination to the criteria of NCIG-01 are trained in the subject criteria.

3.10.3.3 Conduit and Supports

3.10.3.3.1 Conduit

Conduit containing Class 1E cables located in Category I structures are considered safety-related and designed to resist gravity and SSE forces applied to the conduit and cable. The seismic qualification utilizes the same analysis methods as Seismic Category I subsystems described in Section 3.7.3 and limits allowable stress to 90% of the yield stress of the conduit material. The applicable damping requirements are defined in Table 3.7-2.

3.10.3.3.2 Supports

All conduit supports in Category I structures are designed to resist gravity and SSE forces applied to the conduit and cables. Supports for conduit containing Class 1E cables are designated Category I and stresses are limited to 90% of the yield stress of the material involved. Seismic load inputs are based on methods described in Section 3.7 and damping requirements are defined in Table 3.7-2. Supports for conduit containing only non-Class 1E cables are designated Category I(L) and designed and constructed to preclude a failure which could reduce the ability of Category I structures, systems, and components to perform their intended safety function.

Welding was in accordance with the American Welding Society (AWS), "Structural Welding Code," AWS D1.1 with revision 1-73 and 1-74, except later editions may be used for prequalified joint details, base materials, and qualification of welding procedures and welders. Nuclear Construction Issues Group documents NCIG-01 and NCIG-02 may be used after June 26, 1985, for weldments that were designed and fabricated to the requirements of AISC/AWS. Visual inspection of structural welds will meet the minimum requirements of NCIG-01 and NCIG-02 as specified on the design drawings or other design output. Inspectors performing visual examination to the criteria of NCIG-01 are trained in the subject criteria.

3.10.3.4 Conduit Banks

The Category I underground electrical conduit banks, which run from the Auxiliary Building to the Diesel Generator Building and to the Intake Pumping Station, were analyzed for seismic loads by the method outlined in Section 3.7.2.1.3. The conduit banks are designed in accordance with Section 3.8.4.2.

3.10.4 Operating License Review

3.10.4.1 TVA Supplied Instrumentation and Electrical Equipment

The results of the seismic qualification program for the Watts Bar Nuclear Plant described in Section 3.10.1, 3.10.2, and 3.10.3 are summarized by the following listing for Class 1E equipment and by Tables 3.10-1, 3.10-3, and 3.10-4.

	Equipment	TVA Contract No.
AC Auxiliary Power System	6.9kV Switchgear	74C2-84376
	6.9kV Shutdown Logic Relay Panels	75K2-85354
	6.9kV/480V Transformer	74C2-84647
	480V Switchgear	74C2-84647
	480V Motor Control Centers	74C5-84646
	480V Distribution Panelboards for Pressurizer Heater Backup Groups	75K3-86476
	Diesel Generator	74C63-83090
	Transfer Switches	75K5-87048
125V DC Class 1E System	Transfer Switches	75K5-87048
	Spare Transfer Switches	00072332
	Battery Chargers	00072332
	Vital Batteries	76K3-85763
	Vital Battery Boards	75C2-85281
120V AC Class 1E System	AC Vital Instrument Power Boards	74C4-85216
	Vital Inverters	34327, 69414

Miscellaneous Class 1E Equipment	Electrical Penetrations 7	76K61-87064
	BOP I&C Equipment	Multiple Contract No.
	Emergency DC Lighting	75C2-85737-1

REFERENCES:

1. Morrone, A., "Seismic Vibration Testing with Sine Beats," WCAP-7558, October, 1971.

2. Vogeding, E. L., "Seismic Testing of Electrical and Control Equipment," WCAP-7397-L (Proprietary) and WCAP-7817 (NonProprietary), December, 1971.

3. Vogeding, E. L., "Seismic Testing of Electrical and Control Equipment (WCID Process Control Equipment)," WCAP-7817, Supplement 1, December, 1971.

4. Potochnik, L. M., "Seismic Testing of Electrical and Control Equipment (Low Seismic Plants)," WCAP-7817, Supplement 2, December, 1971.

5. Vogeding, E. L., "Seismic Testing of Electric and Control Equipment (Westinghouse Solid State Protection System) (Low Seismic Plants)," WCAP-7817, Supplement 3, December, 1971.

6. Reid, J. B., "Seismic Testing of Electrical and Control Equipment (WCID NUCANA 7300 Series) (Low Seismic Plants)," WCAP-7817, Supplement 4, November, 1972.

7. Vogeding, E. L., "Seismic Testing of Electrical and Control Equipment (Instrument Bus Distribution Panel)," WCAP-7817, Supplement 5, March, 1974.

8. Faust III, C. E., Tang, D. T., and Yalich, M., "Equipment Qualification Test Report Reactor Trip Switchgear," WCAP 8687, Supplement 2-E20B, Revision 1, July, 1981.

9. Resistance Temperature Detectors - Equipment Qualification Data Packages: EQDP-ESE-6, Revision 7; EQDP-ESE-7, Revision 7; and, EQDP-ESE-66A, Revision 1 - WCAP-8587.

10. Fischer, E. G. and Jerecki, S. J., "Qualification of Westinghouse Seismic Testing Procedure for Electrical Equipment Tested Prior to May 1974," WCAP-8373, August, 1974.

11. Wyle Laboratory T. R. 42377-1, "Seismic Simulation Test Program on Instrument Rack."

12. Jareck, S. J., "General Method of Developing Multifrequency Biaxial Test Inputs for Bistables," WCAP-8624 (Proprietary) September, 1975.

13. Jareck, S. J. and Vogeding, E. L., "Multifrequency and Direction Seismic Testing of Relays," WCAP-8673 (Proprietary) December, 1975.

14. Jareck, S. J., Coslow, B. J., Croasdaile, T. R., and Lipchak, J. B., "Seismic Operability Demonstration Testing of the Nuclear Instrumentation System Bistable Amplifier," WCAP-8830 (Proprietary) October, 1976.

15. Jareck, S. J. Coslow B. J., Ellis, A. E., and Miller, R. B., "Seismic Operability Demonstration Testing of the Foxboro H-Line Series Process Instrumentation System Bistables," WCAP-8848 (Proprietary) November, 1976.

16. Miller, R. B., "Seismic Testing of Electrical and Control Equipment (low Seismic Plants)," WCAP-7817, Supplement 8 (Non-Proprietary) June, 1975.

17. Jareck, S. J., "General Method of Developing Multifrequency Biaxial Test Inputs for Bistables," WCAP-8695 (Non-Proprietary) September 1975.

18. Jareck, S. J. and Vogeding, E. L., "Multifrequency and Direction Seismic Testing of Relays," WCAP-8674 (Non-Proprietary) December 1975.

19. Jareck, S. J., Coslow, B. J., Croasdaile, T. R., and Lipchak, J. B., "Seismic Operability Demonstration Testing of the Nuclear Instrumentation System Bistable Amplifier," WCAP-8831 (Non-Proprietary) October 1976.

20. Jareck, S. J., Coslow, B. J., Ellis, A. E., and Miller R. B., "Seismic Operability Demonstration Testing of the Foxboro H-Line Series Process Instrumentation System Bistables," WCAP-8849 (Non-Proprietary) November 1976.

21. WCAP-8687, Supplement 2 - E69A, "Equipment Qualification Test Report, Eagle 21 Process Protection system" (Proprietary), May 1988.

22. WCAP-8687, Supplement 2 - E69B, "Equipment Qualification Test Report, Eagle 21 Process Protection System Components" (Proprietary), February 1990.

23. WCAP-8687, Supplement 2 - E69C, "Equipment Qualification Test Report, Eagle 21 Process Protection System Components" (Proprietary), February 1991.

24. System Description, N3-92-4003, "Neutron Monitoring System".

25. Thermo Fisher Scientific Qualification Report No. 864, Rev. 0, Class 1E Qualification of Source Range Intermediate Range and Wide Range Channels.

26. Westinghouse Report EQ-EV-39-WBT, Seismic Evaluation of Nuclear Instrumentation System Console 2-M-13 with Gammametrics Equipment for Watts Bar Unit 2, Revision 1, March 2009.

27. Rosemount D8400102 Rev. F, Qualification Report for Pressure Transmitter Model 1154.

28. Rosemount D8700096 Rev. I, Qualification Report for Rosemount Model 1154 Series H Pressure Transmitter.

29. Ametek Report No. TR-1136, Qualification Documentation Review Package for Ametek Aerospace Gulton-Statham Products Nuclear Qualified Pressure Transmitter Series Enveloping --- Gage Pressure Transmitter Series PG 3200, Differential Pressure Transmitter Series PO 3200 Differential High Pressure Transmitter Series PDH 3200, Draft Range Pressure Transmitter Series DR 3200, Remote Diaphragm Seal Differential Pressure Transmitter Series PO 3218, Remote Diaphragm Seal Differential High Pressure Transmitter Series PDH 3218.

30. Weed report 16690-QTR, Revision 0, Qualification Test Report for Environmental and Seismic Qualification of Week Model DTN2010 Pressure Transmitters.

31. EQLR-056A and EQLR-056B, Qualification of Eagle 21 Power Supplies.

32. EQLR-126, Qualification of Eagle 21 AC Distribution Panel Circuit Breaker (Unit 2 only).

33. General Atomics Electronic Systems 04508905-1SP, Qualification Test Report Supplement, RM-1000 Upgrade.

34. General Atomics Electronic Systems 04508905-2SP, Qualification Test Report Supplement, I-F Converter Upgrades.

35. General Atomics Electronic Systems 04038903-7SP, Qualification Basis for 04034101 (2-RE-90-271, 272, 273 & 274).

36. General Atomics Electronic Systems 04038903-QSR, Qualification Summary Report for Watts Bar Nuclear Plant Unit 2 Replacement Radiation Monitors.

37. General Atomics Electronic Systems 04038903-1SP, Qualification Basis for 04031101-001 (2-RE-90-130 &131).

38. General Atomics Electron Systems 04038903-2SP, Qualification Basis for 04031301-001 (2-RE-90-106).

39. General Atomics Electronic Systems 04038903-4SP, Qualification Basis for 04031501-001 (2-RE-90-112).

WBN
Unit 1
TABLE 3.10-1 (Sheet 1 of 5)

WBNP INSTRUMENTATION AND ELECTRICAL EQUIPMENT
SEISMIC QUALIFICATION SUMMARY

EQUIPMENT	LOCATION BLDG/EL*	TVA CONTRACT NO.	VENDOR	SEISMIC QUALIFICATION CRITERIA	QUALIFICATION METHOD	TEST METHOD	TEST LAB
ELECTRICAL PENETRATIONS	R-(ALL LEVELS)	76K6I-87064	CONAX CORP	IEEE 344-1971	ANALYSIS		
125V DC VITAL BATTERIES	A-757	76K3-85763	GOULD IND.	IEEE 344-1975; IEE 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 LAB
SPARE TRANSFER SWITCHES	A-772	00072332	AMETEK SCI	IEEE 344-1975	TEST	MULTIFREQUENCY, RANDOM, BIAXIAL	WYLE LAB
125V DC VITAL CHARGERS	A-772	00072332	AMETEK SCI	IEEE 344-1975	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	WESTINGHO USE
120V AC VITAL INVERTERS	A-772	34327, 69414	AMETEK SCI	IEEE 344-1971, DRAFT 5	TEST	MULTIFREQUENCY, RANDOM, BIAXIAL	WYLE LAB
120 AC VITAL INSTR. BOARDS	A-757	74C4-85216	WESTINGHOUSE	IEEE 344-1971, ENCLOSURE NO. 5	TEST	SINE BEAT, BIAXIAL, FOUR POSITIONS	WESTINGHO USE
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-REACTOR BLDG.
A-AUXILIARY BLDG
C-CONTROL BLDG.
D-DIESEL GEN. BLDG.

TABLE 3.10-1 (Sheet 2 of 5)

WBNP INSTRUMENTATION AND ELECTRICAL EQUIPMENT
SEISMIC QUALIFICATION SUMMARY

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 ENVIRON-MENTAL TESTING CORP.
INSTRUMENTAION 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 PRESSURE GAUGES, PRESSURE SWITCHES, & LEVEL SWITCHES	MULTIPLE LOCATIONS SEE NOTE 1	73C38-92800	H. K. PORTER	IEEE 344-1974 (DRAFT REVISION TO IEEE 344-1971)	TEST	MULTIFREQUENCY, BIAXIAL	WYLE LAB
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
DUAL BATTERY CHARGER ASSEMBLIES	A-742	129810		IEEE 344-1971	TEST	TRIAXIAL MULTIFREQUENCY	QUALTECH NP
STANDBY DIESEL GENERATORS				IEEE 344-1971	ANALYSIS		
EMERGENCY DC LIGHTING	A-757 1-772	75C2-85737-1	GRAYBAR ELECTRIC, INC.	IEEE 344-1971	TEST	MULTIFREQUENCY, BIAXIAL	WYLE LAB
NUCLEAR INSTRUMENTATION	CB 755	92NLF-75345A	GAMMA METRICS	IEEE 344-1974	TEST	BIAXIAL, MULTIFREQUENCY	WYLE LAB
FOXBORO SPEC 200 CONTROLLERS	CB 755	75514A	FOXBORO	IEEE 344-1974	TEST	BIAXIAL, MULTIFREQUENCY	FOXBORO

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

WBNP INSTRUMENTATION AND ELECTRICAL EQUIPMENT
SEISMIC QUALIFICATION SUMMARY

EQUIPMENT	LOCATION BLDG/EL*	TVA CONTRACT NO.	VENDOR	SEISMIC QUALIFICATION CRITERIA	QUALIFICATION METHOD	TEST METHOD	TEST LAB
CONTROL INSTRUMENT LOOPS	MULTIPLE LOCATION S	73C3-92784	BAILEY METER CO	IEEE 344-1971	TEST	SINGLE AXIS	ACTION ENVIRON-MENTAL TESTING CORP.
INSTRUMENTATION AND CONTROLS	MULTIPLE LOCATION S	77K3-87352	ROBERTSHAW CONTROLS CORP	IEEE 344-1974	TEST	RANDOM FREQUENCY, MULTIAXIS	WYLE LAB
CONTROL INSTRUMENT LOOPS (Unit 2)	MULTIPLE LOCATION S	69016/71252	FOXBORO SPEC 200	IEEE 344-1975	TEST	MULTIAXIS	NUCLEAR QUALIFICATION SERVICES
PANELS 2-L-11-A AND 2-L-11-B				IEEE 344-1975	ANALYSIS		
FABRICATION OF LOCAL PANELS AND INSTALLATION OF INSTRUMENTS	MULTIPLE LOCATION S	73C38-92800	H. K. PORTER	IEEE 344-1974 (DRAFT REVISION TO IEEE 344-1971)	TEST	MULTIFREQUENCY, BIAXIAL	WYLE LAB
PROCESS TRANSMITTERS, PRESSURE GAUGES, PRESSURE SWITCHES, & LEVEL SWITCHES, REPLACEMENT PARTS FOR OBSOLETE EQUIPMENT	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

TABLE 3.10-1 (Sheet 4 of 5)

WBNP INSTRUMENTATION AND ELECTRICAL EQUIPMENT
SEISMIC QUALIFICATION SUMMARY

EQUIPMENT	LOCATION BLDG/EL*	TVA CONTRACT NO.	VENDOR	SEISMIC QUALIFICATION CRITERIA	QUALIFICATION METHOD	TEST METHOD	TEST 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 1-772	75C2-85737-1	GRAYBAR ELECTRIC, INC.	IEEE 344-1971	TEST	MULTIFREQUENCY, BIAXIAL	WYLE LAB
ELECTRICAL PENETRATIONS	R-(ALL LEVELS)	76K6I-87064	CONAX CORP	IEEE 344-1971	ANALYSIS		
125V DC VITAL BATTERIES	A-757	76K3-85763	GOULD IND.	IEEE 344-1975; IEE 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 LAB
SPARE TRANSFER SWITCHES	A-772	00072332	AMETEK SCI	IEEE 344-1975	TEST	MULTIFREQUENCY, RANDOM BIAXIAL	WYLE LAB
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	69414	AMETEK SCI	IEEE 344-1971, DRAFT 5	TEST	MULTIFREQUENCY, RANDOM, BIAXIAL	WYLE LAB
120 AC VITAL INSTR. BOARDS	A-757	74C4-85216	WESTINGHOUSE	IEEE 344-1971, ENCLOSURE NO. 5	TEST	SINE BEAT, BIAXIAL, FOUR POSITIONS	WESTINGHOUSE

TABLE 3.10-1 (Sheet 5 of 5)

WBNP INSTRUMENTATION AND ELECTRICAL EQUIPMENT
SEISMIC QUALIFICATION SUMMARY

EQUIPMENT	LOCATION BLDG/EL*	TVA CONTRACT NO.	VENDOR	SEISMIC QUALIFICATION CRITERIA	QUALIFICATION METHOD	TEST METHOD	TEST LAB
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-REACTOR BLDG.
A-AUXILIARY BLDG
C-CONTROL BLDG.
D-DIESEL GEN. BLDG.

NOTE 1 - These instruments were purchased under various TVA contracts and were tested or qualified to IEEE 344-1971 or 344-1975 criteria.

TABLE 3.10-2 (SHEET 1 of 4)

QUALIFICATION OF INSTRUMENTATION AND CONTROL EQUIPMENT

Equipment	Qualification Method*	Standard to Which Qualified*	Organization Performance Testing/Analysis and Date of Completion
Reactor Trip and Bypass Breakers	1 & 3 testing		Westinghouse
Solid State Protection System	1 & 2 testing		Westinghouse
Eagle-21 Process Protection System	3 testing		Westinghouse
Nuclear Instrument System			
Unit 1 Cabinets	1, 2 & 6 testing and analysis		TVA & Westinghouse
Unit 2 Cabinets	1, 2 & 8 testing and analysis		Westinghouse
Power Range Electronics	1 & 2 testing		Westinghouse
Source & Intermediate Range Electronics	7 analysis (Unit 2)		Thermo Fisher Scientific
Neutron Detectors			
Power Range	1 testing		Westinghouse
Source/Intermediate Range	7 analysis (Unit 2)		Themo Fisher Scientific
Process Transmitters			
Unit 1	1 & 2 testing		Westinghouse
Unit 2	1, 2 & 11-17 testing		Manufacturer & Westinghouse
Containment Pressure Transmitters	3 testing		

TABLE 3.10-2 (SHEET 2 of 4)

QUALIFICATION OF INSTRUMENTATION AND CONTROL EQUIPMENT

Equipment	Qualification Method*	Standard to Which Qualified*	Organization Performance Testing/Analysis and Date of Completion
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
Unit 1 ICCM 86	1 & 2 testing		Westinghouse
Unit 2 Common Q	10 testing		Westinghouse

TABLE 3.10-2 (SHEET 3 of 4)

QUALIFICATION OF INSTRUMENTATION AND CONTROL EQUIPMENT (Cont'd)

*Qualification Method	Description of Method
1	Sine beat; single axis (Ref. WCAP-7558, WCAP-7817[[3], [4], [5], [6], [7] 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
5	Test documented in WCAP-8687, Supplement 2-E15A (Proprietary) and WCAP-8587, Supplement 2-E15A (Non-Proprietary)
6	See System Description, N3-92-4003, “Neutron Monitoring System” for a listing of the reference calculations.
7	Thermo Fisher Scientific Qualification Report No. 864, Rev. 0, Class 1E Qualification of Source Range, Intermediate Range and Wide Range Channels.
8	Westinghouse Report EQ-EV-39-WBT Revision 1, Seismic Evaluation of Nuclear Instrumentation System Console 2-M-13 with Gammametrics Equipment for Watts Bar Unit 2, Revision 1, March 2009.
9	WCAP-8587, “Methodology for Qualifying Westinghouse WRD Supplied NSSS Safety-Related Electrical Equipment, “Revision 6-A (NP), Dated March 1983
10	Ametek Report No. TR-1136, Qualification Documentation Review Package for Ametek Aerospace Gulton-Statham Products Neclear Qualified Pressure Transmitter Series Enveloping --- Gage Pressure Transmitter Series PG 3200, Differential Pressure Transmitter Series PO 3200 Differential High Pressure Transmitter Series PDH 3200, Draft Range Pressure Transmitter Series DR 3200, Remote Diaphragm Seal Differential Pressure Transmitter Series PO 3218, Remote Diaphragm Seal Differential High Pressure Transmitter Series PDH 3218.
11	Rosemount Report D2001019 Rev. B, Model 3051N Qualification Report

TABLE 3.10-2 (SHEET 4 of 4)

QUALIFICATION OF INSTRUMENTATION AND CONTROL EQUIPMENT (Cont'd)

*Qualification Method	Description of Method
12	Rosemount Report 117415 Rev, H. Qualification Tests for Rosemount Pressure Transmitter Model 1152
13	Rosemount Report D8300040 Rev. E, Qualification Report for Pressure Transmitters Rosemount Model 1153 Series D
14	Rosemount Report D8400102 Rev. F, Qualification Report for Pressure Transmitter Model 1154
15	Rosemount Report D8700096 Rev. I, Qualification Report for Rosemount Model 1154 Series H Pressure Transmitter
16	Weed report 16690-QTR, Revision 0, Qualification Test Report for Environmental and Seismic Qualification of Week Model DTN2010 Pressure Transmitters.

TABLE 3.10-3 (SHEET 1 of 17)

WATTS BAR SEISMIC QUALIFICATIONS

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. 42868-1.

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 Hz 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.

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.

Equipment: Power Transformers

Electrical Ratings: 6900 to 480-V AC, 60-Hz, 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 480V AC on the secondary and subjected to the following tests:

1. Resonance Search--A low level (0.2g) biaxial, sinusoidal 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.

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

TABLE 3.10-3 (SHEET 3 of 17)

WATTS BAR SEISMIC QUALIFICATIONS

Results:	No structural damage occurred and the 2000 KVA trans-former 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.
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 energized 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 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.
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). (WCAP-10448)
Equipment:	480V Motor Control Centers--I-T-E Imperial Corporation, subsidiary of Gould, Inc., Type 5600.

TABLE 3.10-3 (SHEET 4 of 17)

WATTS BAR SEISMIC QUALIFICATIONS

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, de-energized, in phase, and out-of-phase conditions. 3. Main circuits (480V AC) were de-energized during tests.
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 SC077 and Wyle Test Report TR-42926-1.
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.

TABLE 3.10-3 (SHEET 5 of 17)

WATTS BAR SEISMIC QUALIFICATIONS

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 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 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.

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, DDL Report No. A-5-73A, CCL Project No. 73-1024.

TABLE 3.10-3 (SHEET 6 of 17)

WATTS BAR SEISMIC QUALIFICATIONS

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 Tack.
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. Critical Weld in Air Tank Saddle Mount.
20. Maximum Pull Out of Concrete Insert.
21. Maximum Shear in Concrete Insert.

WATTS BAR SEISMIC QUALIFICATIONS

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

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

Seismic Test:

1. A resonant search test was conducted consisting of two low level (approximately 0.2g horizontally and 0.1g 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.

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. Analysis (B07 891005 019)

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.

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° 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 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 due to the seismic 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 phases of the diesel generator system; 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.

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

TABLE 3.10-3 (SHEET 10 of 17)

WATTS BAR SEISMIC QUALIFICATIONS

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).

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

Reference: Wyle Report No. 42749-1.
Wyle Job No. 42749.

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 switches 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.

2. Proof Testing--The switches were subjected to a 30 second 0.5 SSE of 0.76 g 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.

Equipment:	125V-dc Battery Charger.
Electrical Rating:	ac input-480V, 60Hz, 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. The control accelerometers were recorded on tape 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 tests followed by a full-level RRS test were performed in each orientation with the specimen energized and operating in its normal charging mode. Full-level RRS tests were also performed 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 plan. 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.
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.
Equipment:	125-Volt Battery (Cell 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.

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.

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. WYLE Report NO. 43479-1

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% 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.

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

Reference: Westinghouse Seismic Test Procedure No. CO-33697. PEI-TR-852001-12

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 monitored 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.

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

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

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 duration of the tests was 30 seconds. The horizontal and vertical input accelerations levels were phase incoherent. Five 1/2-level SSE's and one SSE 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. 51133-1.

Equipment: Electrical penetrations[1] (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 1/2 safe shutdown earthquake in accordance with paragraph NA-3250 of the ASME Boiler and Pressure Vessel Code, Section 111, Nuclear Power Plant Components.[2]

1. The analysis calculated the natural frequencies during a seismic event using standard formulas for stress and strain by the R. Roark or Rayleigh'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.

TABLE 3.10-3 (SHEET 17 of 17)

WATTS BAR SEISMIC QUALIFICATIONS

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 function.

Reference:

1. Conax Report IPS-212, Rev. A and addendum to IPS-212, Rev.A. IPS-209, IPS-752, IPS-1348
2. TVA Design Specification WBNP-DS-1805-2697-00.

TABLE 3.10-4 (SHEET 1 of 5)

Unit 1 Only

WATTS BAR SEISMIC QUALIFICATION
SAMPLE OF 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

TABLE 3.10-4 (SHEET 2 of 5)

WATTS BAR SEISMIC QUALIFICATION (Cont'd)

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 oscillations 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 of ability to function properly before, during, and after the test.
References:	Wyle Lab Test Report Nos: 43522-1, 42434-1, 43280-1, 43675-1, 43859-1

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 return 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.

Table 3.10-4 (SHEET 3 of 5)

WATTS BAR SEISMIC QUALIFICATIONS (Cont'd)

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.
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 a 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 orientation. 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.

TABLE 3.10-4 (SHEET 4 of 5)

WATTS BAR SEISMIC QUALIFICATIONS (Cont'd)

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.
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 orthogonal 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 cycle 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 3.0 g's in the horizontal axes or 2.0 g's in the vertical axis during the beat test.
Reference:	Action Environmental Test Corporation Report Nos. 10348, 10348-1
	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.

TABLE 3.10-4 (SHEET 5 of 5)

WATTS BAR SEISMIC QUALIFICATION

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.

TABLE 3.10-5

ALLOWABLE STRESSES FOR CABLE TRAY SUPPORTS

Load Case	Allowable Stress	Load Combination[2]
Case I	AISC Allowable	D + L
Case IA	AISC Allowable	D + E
Case IB	1.5 x AISC Allowable[1]	$D + E + T_o$
Case II	1.5 x AISC Allowable[1]	D + E'
Case IIA	1.5 x AISC Allowable[1]	$D + E' + T_o$
Case III	1.5 x AISC Allowable[1]	$D + E' + P_a + T_a$

1. Allowable stresses are limited not to exceed 0.9 F_y, except for shear, which is limited not to exceed 0.52F_y, and buckling, which is limited not to exceed 0.9 F_{CR}.

2. Key:

   D = Deadweight

   L = Live loads

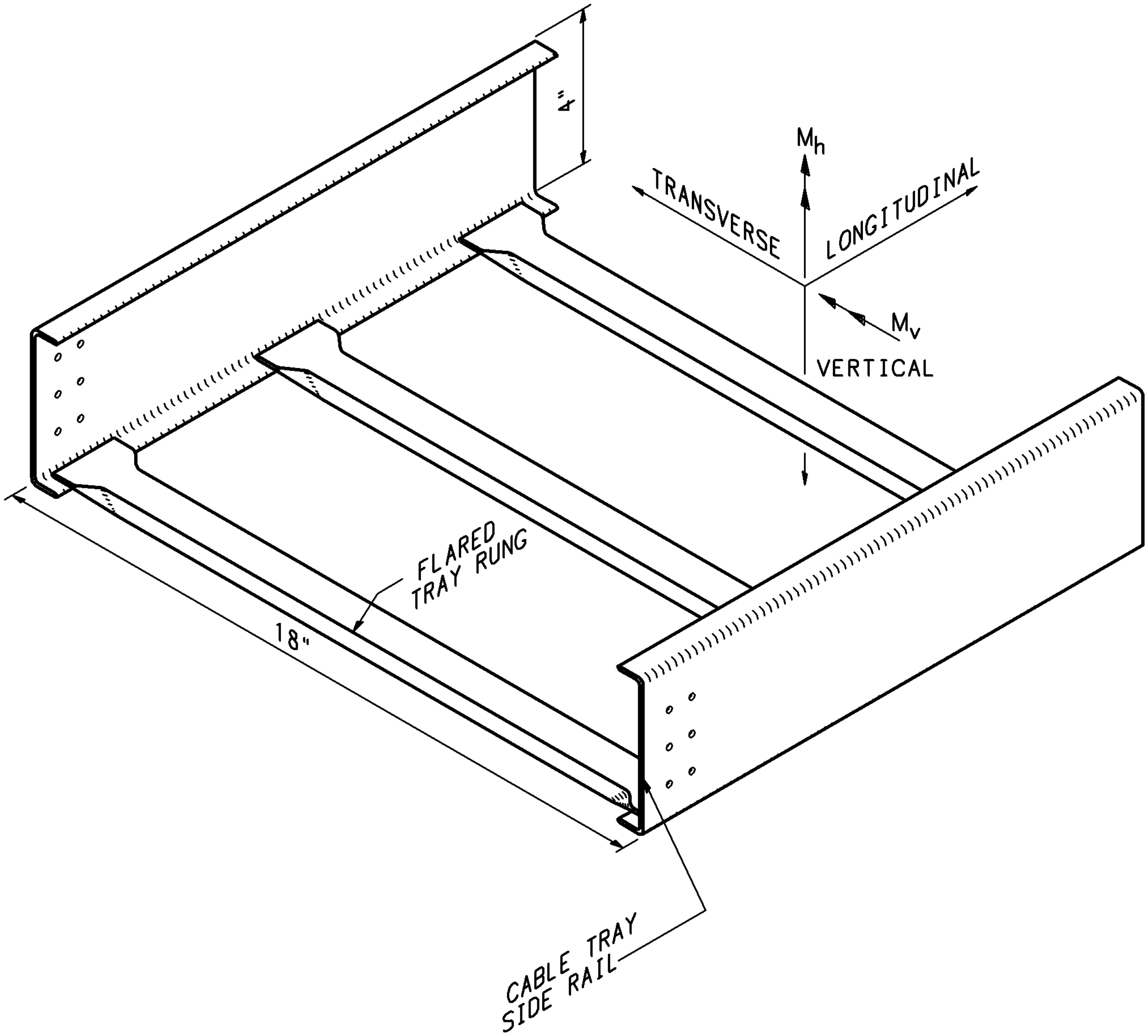
   E = Operating Basis Earthquake (OBE) loads

   E' = Safe Shutdown Earthquake (SSE) loads

   T_o = Thermal effects and loads during normal operating or shutdown conditions based on the most critical transient or steady-state condition.

   T_a = Thermal effects and loads during conditions generated by the design basis accident (DBA) transient condition and including T_o.

   P_a = Pressure load effects from a DBA, such as steel containment vessel (SCV) dynamic movements and cavity pressurization.



M_h IS THE BENDING MOMENT DUE TO LOADS IN THE TRANSVERSE DIRECTION.

M_v IS THE BENDING MOMENT DUE TO LOADS IN THE VERTICAL DIRECTION (OUT OF THE PLANE OF THE TRAY).

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FINAL SAFETY
ANALYSIS REPORT

Orientation of Cable Tray Axes

FIGURE 3.10-1

3.11 ENVIRONMENTAL DESIGN OF MECHANICAL AND ELECTRICAL EQUIPMENT

The method of assuring that mechanical and electrical components of safety-related equipment are qualified for their potential normal operational and worst-case accident environments is described in this section.

Two programs are in place to environmentally qualify safety-related electrical equipment (including cable) and active safety-related mechanical equipment to function or not fail for event mitigation. These programs involve:

1. Safety-related electrical equipment within the scope of 10CFR50.49.

2. Active, safety-related mechanical equipment located in a harsh environment.

Equipment within the scope of 10 CFR 50.49 excludes that equipment located in mild or essentially mild environments. A mild environment is defined as a room or building zone where (1) the temperature, pressure, or relative humidity resulting from the direct effects of a design basis event (DBE) (e.g., temperature rise due to steam release) are no more severe than those which would occur during an abnormal plant operational condition, (2) the temperature does not exceed 130°F due to the indirect effects of a DBE (e.g., increased heat loads from electrical equipment), (3) the event radiation dose is less than or equal to 1×10^4 rads, and (4) the total event plus the 40 year TID (total integrated dose) is less than or equal to 5×10^4 rad.[2]

The Mechanical Equipment Qualification (MEQ) program assures that active, safety-related mechanical equipment located in harsh environments will adequately perform the required design safety functions under all normal, abnormal, accident and post-accident environmental conditions in accordance with 10 CFR Part 50, Appendix A, General Design Criterion 4 (GDC-4).

3.11.1 Equipment Identification and Environmental Conditions

3.11.1.1 Identification of Safety Systems and Justification

Systems whose functioning is required to mitigate a loss-of-coolant accident (LOCA) or high-energy line break (HELB) for Watts Bar Nuclear Plant harsh environment areas are listed in Table 3.11-1. These systems were determined by identifying the systems upon which the safety analyses in the Final Safety Analysis Report and other referenced documents are dependent. Further, any systems which are necessary to support systems so identified were included in this table.

3.11.1.2 Identification of Equipment in Harsh Environments

The identification of the harsh environment is provided in Section 3.11.2. With the harsh environments defined, a survey of the safety-related electrical and active safety-related mechanical equipment in the affected areas was conducted. This survey was conducted using electrical instrument tabulations, mechanical piping drawings, mechanical heating and ventilation drawings, instrumentation and control drawings, electrical equipment drawings, and conduit and grounding drawings to identify the required components. The electrical components are identified in the Category and Operating Times Calculations. These calculations establish the 10 CFR 50.49 operating category and times for these components. 10 CFR 50.49 Category A or B electrical components located in a harsh environment are qualified in environmental qualification packages, which are referred to as the Environmental Qualification (EQ) Binders. These are a comprehensive set of documentation packages that demonstrate compliance with 10 CFR 50.49. In some instances Category A or B equipment may be contained in "Essentially Mild" (EM) calculations. EM calculations evaluate the 1E equipment located in plant harsh environments for the specific DBE(s). This evaluation concludes that for the specific DBE(s) for which the equipment must function, the environmental conditions (including normal plus accident dose) do not impose a significant environmental stress on the device.

Mechanical components are identified in the Mechanical Equipment List. This list identifies the active safety-related equipment which is required to perform a mechanical motion during the course of accomplishing a system safety function. This calculation identifies mechanical equipment in the portions of safety system flow paths which are required to mitigate 10 CFR 50.49 accidents. This equipment includes, but is not limited to valves, pumps, dampers, and fans.

Verification of qualification levels for equipment within the scope of 10 CFR 50.49 has been accomplished by a field walkdown of the installed components to provide traceability between the qualification documents and the in-situ equipment. This field verification walkdown is documented in the EQ binders.

The active safety-related mechanical equipment located within harsh environmental areas in the plant was identified by use of design data and confirmed by field verification walkdowns.

3.11.2 Environmental Conditions

3.11.2.1 Harsh Environment

Environmental conditions have been established for all harsh environment areas which contain safety-related electrical and active mechanical equipment exposed to a harsh environment resulting from a design basis event. Temperature, relative humidity, pressure, radiation dose, area type, chemical spray, and flooding were the parameters considered. (Only temperature and radiation were considered for mechanical equipment. The other parameters have no significant detrimental effect on mechanical equipment.) Values were based upon the following operational conditions:

1. Normal operating conditions - The environmental service conditions which the plant environmental control systems are designed to maintain on a normal design day.

2. Abnormal operating conditions - The environmental service conditions which result from outside temperature excursions, temporary greater than design heat loads, or degraded environmental control system operations. This condition can exist for up to 12 hours per excursion for non-Reactor Building spaces and will occur less than 1% of the plant life, unless alternate times and %0+ plant life conditions are specifically approved in Reference [4] and its associated environmental data drawings.

3. LOCA or HELB conditions resulting from small, intermediate, or large main steam line breaks inside containment.

4. High Energy Line Break conditions outside primary containment resulting from ruptures and critical cracks in various high energy lines throughout the Auxiliary Building and steam valve vaults.

5. Inadvertent containment spray initiation conditions resulting from accidental operation of the containment spray system.

6. Fuel Handling Accident (FHA)

The service conditions, resulting from the operational conditions listed above, are presented in Reference [4] and its associated TVA environmental data drawings. Temperature, pressure, and relative humidity vs. time curves are also provided on the drawings to clearly define the effects of various worst case HELB combinations on the area. These drawings include the environmental conditions for mild as well as harsh environmental areas.

For the purpose of 10 CFR 50.49, only design basis events 3, 4, and 6, above, are considered design basis accidents. Tornados, floods, or other natural phenomenon, including seismic, are expressly excluded from the scope of 10 CFR 50.49. Refer to Section 3.10 for Seismic Qualification.

3.11.2.2 Mild Environment

Mild environment qualification is applied to Class 1E electrical equipment only. Watts Bar satisfies the intent of NRC Generic Letter 82-09 by utilization of a preventive maintenance, surveillance, and testing program, as discussed in that generic letter.

For Class 1E equipment located in a mild environment and procured or installed before April 20, 1982 (date of issuance of NRC Generic letter 82-09), WBN demonstrates qualification by site preventative maintenance, testing, and surveillance programs.

For Class 1E equipment located in a mild environment and procured on or after April 20, 1982, WBN demonstrates qualification by the design or purchase specifications which identify environmental conditions and any other applicable design requirements as appropriate. These design activities are augmented by the site preventative maintenance, testing, and surveillance programs.

3.11.3 Electrical Equipment Within the Scope of 10 CFR 50.49

The process assuring that electrical equipment/cable is capable of performing its safety function is described in this section. A description of TVA's environmental qualification program is presented in Reference [1]. This reference provides documentation on the program and initial EQ binder preparation to denote that the components are qualified. TVA has implemented a program to ensure that all components will be fully qualified in accordance with 10 CFR 50.49 at fuel load. The EQ binders are maintained as controlled documents.

Safety-related electrical devices located in a harsh environment and required to function or not fail for mitigation of a specific DBA are identified on the Watts Bar Nuclear Plant 10 CFR 50.49 List (1E electrical equipment requiring qualification under 10 CFR 50.49). The methodology for establishing the 10 CFR 50.49 List for Watts Bar Unit 1 is located in Section III.2 of Reference [1]. The operating category, operating time, and safety function for the 10 CFR 50.49 devices are established by the Category and Operating Time Calculations. Devices on the 10 CFR 50.49 List are analyzed for qualification to the requirements defined by 10 CFR 50.49 and documented in the EQ binders.

3.11.4 Qualification Tests and Analyses

Qualification tests and analyses for safety-related electrical equipment were conducted in accordance with the requirements of 10 CFR 50.49 and the guidelines of NUREG-0588.[3] See Table 3.11-2 for compliance with NRC criteria and standards.

3.11.5 Qualification Test Results

Qualification test results are included or referenced in the EQ binder for safety-related electrical equipment in the 10CFR50.49 program.

3.11.6 Loss of Heating, Ventilating, and Air-Conditioning (HVAC)

Plant locations containing safety-related equipment that need a controlled environment to perform required accident mitigation operations are served by fully redundant environmental control systems, or operator actions specified to limit minimum and maximum temperatures (see Section 9.4 for details). Such redundancy and operator actions where specified, assure that no loss of safety-related equipment occurs from a single failure of HVAC equipment provided for controlling the local environment for this equipment. Data describing controlled local environmental conditions during accidents are valid for situations in which a loss of one train of HVAC is postulated.

3.11.7 Estimated Chemical and Radiation Environment

3.11.7.1 Chemical Spray

The worst case environment (normal or post-accident) chemical composition of the containment spray was based on the following sources and assumptions:

1. Ice Condenser

2. Cold Leg Injection Accumulators (4 tanks)

3. Refueling Water Storage Tank

4. Reactor Coolant System

The following assumptions were used in this analysis:

1. Calculations based on maximum pipe/tank volumes and boron concentrations and on minimum ice mass and sodium tetraborate concentration.

2. All solutions including completely melted ice mix completely.

3. Mass ratio of NaOH to boron in the ice is 1.85.

4. Density of borated water is equal to that of water.

5. Fission products, corrosion products, etc., will be neglected.

Results - The sources stated above yield a mixture of boric acid and sodium tetraborate with a pH greater than 7.5.[5]

3.11.7.2 Radiation

3.11.7.2.1 Inside Containment

The 40-year integrated normal operating dose and the maximum hypothetical accident doses are shown on the TVA environmental data drawings. The radiation exposure inside containment after a design basis LOCA was calculated based on a release to the containment atmosphere of 100% of the core inventory of noble gas, 50% of the core inventory of iodine, and 1% of the core inventory of solid fission products as determined by the ORIGEN computer code.[6] Removal of iodine is assumed to be due to interaction with the ice condenser only. The calculation of activity in containment after a LOCA is described in Section 15.5. Maximum gamma doses were calculated in the upper compartment, lower compartment, and ice condenser using a point-kernel-with-buildup computer code. Doses were integrated to determine equipment exposure for a 100-day period after the accident. Beta doses were calculated only for surfaces using the semi-infinite cloud equation in Regulatory Guide 1.4.

The calculation of radiation conditions inside containment complies with Paragraph 1.4 of NUREG-0588 except as noted below:

1. Paragraph 1.4(3) - The initial distribution of activity was assumed uniform throughout the containment even though the containment is broken up into upper compartment, lower compartment, and ice condenser. Air return deck fans are provided to aid mixing between these compartments.

2. Paragraph 1.4(5) - Natural deposition was not considered. Applicable deposition rates are unknown and actions of containment spray in the upper compartment, and steam condensation in the lower compartment can be expected to wash the deposited activity into the sump.

Unit 1 Only

For tritium production cores, the radiation exposure inside containment after a design basis LOCA was calculated based on a release to the containment atmosphere of 100% of the core inventory of noble gases, 50% of the core inventory of iodine, 1% of the core inventory of solid fission products and 100% of tritium as determined by the ORIGEN 2.1 computer code.[7] Following the same methodology as previously utilized, the resulting doses were determined to be less than those resulting from the previous determinations.

3.11.7.2.2 Radiation - Auxiliary Building Spaces

The normal operating radiation environment in the Auxiliary Building is shown on the TVA Environmental data drawings. The radiation exposure in the general spaces of the Auxiliary Building after a design basis LOCA is due to (1) containment sump fluid being circulated in the RHR, CS, and SI systems, (2) airborne activity in the Auxiliary Building, and (3) shine from activity in the containment. The source terms used for this accident are those determined by the ORIGEN computer code.[6]

Flow diagrams and equipment layouts were reviewed to determine the flow paths which would be used after an accident and to determine the volume and physical locations of contaminated fluids in the Auxiliary Building. The layout of the shield walls and equipment within the rooms were conservatively modeled. Source terms were calculated at various times after an accident. Dose rates were then calculated at several positions in the Auxiliary Building with respect to the contained sources and at various times after an accident.

The locations where dose rates were calculated were chosen to conservatively calculate the dose rates in corridors, outside equipment cubicles, in adjacent rooms, and within the equipment cubicles. These dose rates were then integrated to determine equipment exposure for a 100-day period after the accident. Airborne activity in the Auxiliary Building is due to gaseous leakage from the containment which is processed and exhausted through HEPA and charcoal filters in the Auxiliary Building gas treatment system (ABGTS). The dose rates through the Reactor Shield Building from activity released into the containment atmosphere were also calculated.

Radiation exposure due to a design basis FHA is due to airborne activity and shine from the affected spent fuel bundle and affects the refueling floor and the ABGTS room. Dose rates were calculated at a single position on the refueling floor and at several locations from the ABGTS filters. These dose rates were then integrated to determine equipment exposure for a 100-day period after the FHA.

The calculation of radiation conditions outside containment in the Auxiliary Building complies with Paragraph 1.4 of NUREG-0588.

REFERENCES

1. September 30, 1986, Letter from R. Gridley to B. Youngblood, "Environmental Qualification of Electrical Equipment Important to Safety for Nuclear Power Plants - Summary Status Report - Watts Bar Nuclear Plant - Unit 1".

2. Watts Bar Design Criteria, WB-DC-40-54, "Environmental Qualification to 10 CFR 50.49," Revision 2.

3. NUREG 0588, Interim Staff Report on Environmental Qualification of Safety-Related Electrical Equipment, Revision 1, July 1, 1981.

4. Watts Bar Design Criteria, WB-DC-40-42, Revision 2,"Environmental Design".

5. WCAP-15699, “Tennessee Valley Authority Watts Bar Nuclear Plant Unit 1 Containment Integrity Analyses for Ice Weight Optimization Engineering Report,” Revision 1, dated August 2001.

6. SCALE: A Modular Code System for Performing Standardized Computer Analyses for Licensing Evaluation, Vols. I-III, NUREG/CR-0200, Revision 5 (ORNL/NUREG/CSD-2/R5), March 1997.

7. Westinghouse Letter NDP-00-0288, dated June 27, 2000 and NDP-00-0291, dated July 14, 2000. (Unit 1 Only)

TABLE 3.11-1

SYSTEMS (OR PORTIONS OF SYSTEMS) REQUIRED TO MITIGATE LOSS-OF-COOLANT ACCIDENTS AND/OR HIGH ENERGY LINE BREAKS

Standby AC Power System (Includes Diesel Generators)
120V Vital AC System
Vital 125V DC Control Power System
Diesel Generator Fuel Oil System
Diesel Air Starting System
Emergency Lighting System
Auxiliary Control Air System
Nuclear Instrumentation System
Reactor Protection System

Containment Isolation Systems
Ice Condenser System
Containment Spray System
Residual Heat Removal System
Safety Injection System
Reactor Coolant System
Auxiliary Feedwater System
Containment Air Return Fan System
Essential Raw Cooling Water System
Component Cooling System
Main Steam System
Radiation Monitoring System
Chemical and Volume Control System
Emergency Gas Treatment Air Cleanup System
Auxiliary Building Gas Treatment System
Control Room Area Ventilation System
Engineered Safety Feature Coolers
Auxiliary Building Ventilation Subsystems:
- Shutdown Board Room Air Conditioning System
- Auxiliary Board Rooms Air Conditioning System
- Turbine-Driven Auxiliary Feedwater Pump Ventilation
- Shutdown Transformer Room Ventilation System

Spent Fuel Pool Cooling System
Main Feedwater System
Steam Generator Blowdown System
Feedwater Control System
Sampling System
Containment Lower Compartment Cooling System: Fan only (HELB only)
Reactor Building Purge Air Filter Trains
Diesel Generator Building Ventilation System

TABLE 3.11-2

COMPLIANCE WITH NRC CRITERIA AND STANDARDS

General Design Criteria 1	See Chapter 17
General Design Criteria 4	See Sections 3.5, 3.6
General Design Criteria 23	See Sections 7.1, 7.3
General Design Criteria 50	See Section 6.2
10 CFR 50, Appendix B, Criterion III	See Chapter 17
Regulatory Guide 1.30	Current activities generally conform to the requirements of N45.2.4.
Regulatory Guide 1.40	See Table 7.1-1
Regulatory Guide 1.63	See Paragraph 8.3
Regulatory Guide 1.73	See Table 7.1-1
Regulatory Guide 1.89	All 10 CFR 50.49 Equipment was qualified to IEEE 323-1971, or IEEE 323-1974
10 CFR 50.49/NUREG-0588	See References 1 and 3

3.12 CONTROL OF HEAVY LOADS

3.12.1 Introduction/Licensing Background

The Control of Heavy Loads program at WBN was established by the Generic Letter (GL) 81-07 Revised Response submitted as a letter from W. J. Museler (TVA) to U.S. NRC dated July 28, 1993 (T04 930728943). This letter superseded responses submitted to the NRC in letters dated February 6, 1984 and March 20, 1984.

In response to this submittal, the NRC concluded in Safety Evaluation Report Supplement 13 that WBN has adequately addressed NUREG-0612 guidelines.

3.12.2 Safety Basis

The safety basis for the Control of Heavy Loads is provided by assuring the risks associated with load-handling failures is acceptably low. This assurance is provided by meeting the requirements of NUREG-0612, Section 5.1.1, the use of an equivalent single-failure-proof crane for the reactor head lift.

3.12.3 Scope of Heavy Load Handling System

A heavy load for WBN is defined as any load weighing in excess of 2,059 lbs that is lifted in an area designated as a critical lift zone. Critical lift zones are those where an overhead handling system exists and the potential exists for a dropped load to impact irradiated fuel, impact safe shutdown equipment, or damage equipment required for spent fuel cooling. Overhead handling systems that meet these criteria are:

- Polar Crane
- Auxiliary Building Crane
- Intake Pumping Station (IPS) Hydraulic Pedestal Crane
- Hoists with capacities > 2059 lbs. as described in GL 81-07 Revised Response Table I

In addition, overhead handling systems were reviewed and excluded from this list on the basis that a load drop would not result in damage to any system required for plant shutdown or decay heat removal for one of the following reasons:

1. There is sufficient physical separation of the overhead handling system from any system or component required for safe shutdown or decay heat removal.
2. The system or component over which the load is carried is out of service while the load handling system is used.
3. The load weighs less than 2,059 lbs. and is not considered to be a heavy load.

3.12.4 Control of Heavy Loads Program

The Control of Heavy Loads Program consists of the following:

1. WBN commitments in response to NUREG-0612, Section 5.1.1 elements

2. For Reactor Pressure Vessel Head (RPVH) lifts, an equivalent Single-Failure-Proof crane

3.12.4.1 WBN Commitments in Response to NUREG-0612, Section 5.1.1

The control of heavy loads is performed by compliance with the seven guidelines outlined in NUREG 0612, Section 5.1.1.

These guidelines are met through the following:

Guideline	Compliance Method
1	Safe load paths - Safe load paths are as shown on drawing series 44W411. Directions contained within maintenance instructions provide requirements for control of any lift greater than 2,059 pounds, lifts in the auxiliary building, lifts in the upper compartments of the reactor buildings, and lifts at the IPS in those areas designated as critical lifting zones (CLZ). The critical lifting zones are defined as follows: 1. Reactor Building CLZ - the region inside the polar crane wall of the upper compartment El. 757’ and above as shown on drawing 44W411-7. 2. Auxiliary Building CLZ - all floor areas of the Auxiliary Building (AB) El. 757’ within the limits of hook travel of the AB crane 0-CRN-271-A1 as shown on drawing 44W411-5. 3. Intake Pumping Station (IPS) CLZ - area over Quality and/or Safety Related equipment required for safe-shutdown or decay heat removal within the IPS as shown on drawing 44W411-10. 4. Any area in which temporary hoists and rigging must be used for lifts greater than 2,059 pounds over operable quality and/or safety related equipment required for safe-shutdown or decay heat removal.

To control load movement, maintenance instructions direct the crane operator to raise and transfer the load to its destination, following safe load paths which have been designated by the 44W411 series drawings. To ensure that the established load paths are followed, all lifts performed per these instructions are done under the supervision of a designated individual (person-in-charge) who will verify the load path is clear prior to load movement. Deviations from approved load paths require prior approval of the plant operations review committee (PORC).

2 Procedures - Load handling procedures for the Heavy Load Handling Systems in Section 3.12.3 are contained in Maintenance Instructions. These instructions contain sections covering scope of control, references, prerequisites, precautions and limitations, acceptance criteria, performance, inspections, tables of approved heavy load lifts, and drawings identifying safe load paths. Tables of the various approved heavy load lifts identify the crane to be used, approved rigging or lifting devices, component weights, and reference drawings and procedures.

3 Crane Operators - Requirements for crane operator training, qualification, and conduct are contained in TVA Safety Procedures. The training includes:

1. Operating Practices and Functional Characteristics
2. Rigging Fundamentals
3. Electrical Maintenance
4. Certification Skills for Overhead cab-operated Cranes

These training programs incorporate all of Chapter 2.3 of ANSI (ASME) B30.2.

4 Special Lifting Devices - WBN Special Lifting Devices are any devices designed and dedicated to handle a specific critical load or loads, such as the reactor pressure vessel head lift rig and internals lift rig. Qualification of the head and internals lift rig devices is provided by WCAP 10313, including Addenda 1, 2, and 3, and inspection of these lift rigs is performed on a 10 year interval using Acoustic Emission Testing (AET). Acceptance of Acoustic Emission Testing for the lift rigs in lieu of the requirements of ANSI N14.6 was accepted by the NRC in a letter dated October 1, 1991 (A02 911007 002).

5 Lifting devices that are not specially designed - All slings and other lifting devices not specially designed used with cranes subject to NUREG-0612, Section 5.1, are designed, inspected, and tested in accordance with ANSI (ASME) B30.9 or ANSI N14.6, respectively. Evaluation of dynamic loads imposed by handling systems has been performed to determine if specialized selection and markings are required. Only one crane (IPS 20 ton hydraulic pedestal crane) was determined to generate dynamic loads in excess of 15% of rated load, with lifting devices used by this crane utilizing a dynamic factor of 20%. The only below-the-hook lifting device used with this crane is the stoplog lifting beam, which has been evaluated and shown to comply with the necessary design requirements. No special markings or selection criteria are necessary for the slings.

6 The crane should be inspected, tested, and maintained in accordance with Chapter 2-2 of ANSI (ASME) B30.2-1976 - Cranes and hoists at WBN are inspected, tested, and maintained in accordance with specific site maintenance (MI) and preventative maintenance (PM) instructions which implement the requirements of the applicable ANSI (ASME) standard. Each handling system as listed below has its own unique instruction or procedure to control inspection and testing. The load handling system and applicable standard are as follows:

Handling System	Procedure	Reference Standard
Polar Crane	MI	ANSI (ASME) B30.2-1976
Auxiliary Building Crane	MI	ANSI (ASME) B30.2-1976
IPS Hydraulic Pedestal Crane	PM	ANSI (ASME) B30.5-1989

7 The crane should be designed to meet the applicable criteria and guidelines of Chapter 2-1 of ANSI B30.2-1976 and CMAA-70 - The actual design data for the auxiliary building crane and the reactor building crane were compared with the guidelines of CMAA-70 and ANSI (ASME) B30.2. Where specific compliance was not evident by review, an evaluation was made by imposing these guidelines on the actual design. Principally, this was the approach used for evaluating the design of major structural components by using load combinations and allowable stresses given in CMAA-70. The results of this review and analysis indicate that both cranes meet or exceed the requirements of CMAA-70 and ANSI (ASME) B30.2. The remaining overhead handling system subject to compliance with NUREG-0612 is the IPS hydraulic pedestal crane, which has been verified to be compliant with applicable industry standards.

3.12.4.2 Reactor Pressure Vessel Head (RPVH) Lifting Procedures

WBN maintenance instructions are used to control the removal and replacement of the reactor pressure vessel head. These instructions and TVA Safety Procedures contain requirements to ensure the single-failure-proof equivalency of the reactor building crane is maintained. These requirements include:

- Upper containment temperature is at least 70°F
- Periodic (at start of refueling outage) inspection of the crane has been completed.
- All safety functions of the crane are verified to be operational prior to performing the lift (per NEI 08-05).

The WBN reactor building crane was evaluated against NUREG-0554 as part of the station response to NUREG-0612, Section 5.1.3 (1) (and thus Section 5.1.6) compliance. This evaluation indicated that the crane is equipped with numerous single-failure-proof features. These features, as also described in part in UFSAR Section 3.8.6.1, include:

- Master Switches with Spring Return to Off Feature
- Cab Mounted Emergency Stop Buttons
- Floor Mounted Emergency Stop Buttons
- Overload Protection
- Overspeed Detection
- Dual Wire Ropes with a Factor of Safety Between 5:1 and 10:1
- Drum Safety Plates
- Two independent Holding Brakes of at least 125% of head lift hoisting torque each. Brakes apply automatically when power is removed from the hoisting motor.
- Dual interconnected gear trains
- Two Upper Limits Switches (2nd upper limit switch is a power disconnect)
- Stress Limits meet CMAA 70-1970
- Designed for Safe Shutdown Earthquake with the Maximum Critical Load

The reactor building crane wire rope does not provide a 10:1 factor of safety against breaking strength for the rated load. Thus, the reactor building crane is not fully single-failure-proof.

NEI 08-05 defines the requirements for an equivalent single-failure-proof crane for the purposes of lifting the reactor head. In addition to having the required safety features, the following equivalency measures are provided for the reactor head lift -

- Crane is a Class C design with a design margin of between 8% and 15%
- Ambient air temperature is at least 70° F
- All safety functions of the crane are verified to be operational prior to performing the lift
- Direct communications are provided between the Crane Operator, Person-In-Charge and Signal Person via headsets
- Emergency stop buttons are manned during lift
- Backup Emergency Stop Signal is provided
- Pre-job brief performed that includes identification of supervisory oversight, establishment of lift management protocol, acceptable travel limits of crane, verification of emergency stop button locations, and manning of emergency stop buttons
- Maintenance rule (a)(4) measures addressed in outage safety plan

With the equivalency measures provided in NEI 08-05, the reactor building crane is equivalent to single- failure-proof based for lifting the reactor head.

3.12.5 Safety Evaluation

Heavy load lifts at WBN are done safely and in accordance with NUREG-0612. Basis is provided by:

- Controls implemented by NUREG-0612, Section 5.1.1, make the risk of a load drop very unlikely.
- The use of an equivalent single-failure-proof crane makes the risk of a reactor head load drop extremely unlikely and acceptably low.
- The risk associated with the movement of heavy loads is evaluated and controlled by station maintenance instructions and the outage safety plan.