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DEC 26 1992

U.S. Nuclear Regulatory Commission
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Gentlemen:

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

WATTS BAR NUCLEAR PLANT (WBN) - NUREG-0737 ITEM II.D.1, RELIEF AND SAFETY VALVE TESTING (TAC M79992)

This letter provides TVA's response to the NRC request for additional information (RAI) dated October 10, 1991. The RAI contained 16 questions for TVA to answer concerning WBN's implementation of the requirements in NUREG-0737 Item II.D.1 for performance testing of relief and safety valves. Enclosure 1 restates these 16 questions and gives TVA's answer to each one. Enclosure 2 is a detailed listing of the reference documents cited in Enclosure 1. Enclosures 3 through 7 are excerpts from TVA design documents that are cited as part of the responses to some of the questions in Enclosure 1.

If you have any questions, please telephone John Vorees at (615) 365-8819.

Very truly yours,

W. J. Museler

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Enclosures
cc: See Page 2

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50-390 WATTS BAR 1 TVA

TVA RESPONSE TO NRC QUESTIONS DATED 10/10/91
RELIEF AND SAFETY VALVE TESTING

REC'D W/LTR DTD 12/26/92...9301060103

ENCLOSURE 1

TVA Responses to NRC Questions

ENCLOSURE 1

REQUEST FOR ADDITIONAL INFORMATION
WATTS BAR NUCLEAR PLANT, UNITS 1 AND 2
DOCKET NUMBERS 50-390 AND 50-391

Questions Related to Inlet Fluid Conditions

1. Safety Valve Inlet Pressure Drop

Question:

The EPRI Test Conditions Report (Reference 4) stated that a method of demonstrating safety valve stability is to compare the total pressure drop of the inlet piping for the plant safety valve with the total pressure drop of the inlet piping for the EPRI test valve. The total inlet piping pressure drop is comprised of frictional and acoustic wave components evaluated under steam conditions. The inlet pressure drop provided in Reference 1 (30 psi at rated flow) appears to be too low relative to the EPRI test pressure drop of 263 psi on valve opening and 181 psi pressure rise on valve closing for the Crosby 6M6 test valve. Clarify how the value provided was calculated and ensure it includes both the frictional and acoustic wave components (see Reference 3). Provide a similar value for the inlet pressure rise on valve closing; the WBN value for inlet pressure rise should also include both frictional and acoustic wave components. Provide the requested information for both WBN units. Also, if the WBN calculated values exceed the test values, justify why the EPRI test results are applicable to the WBN valve configuration.

Response:

TVA's submittal of July 22, 1983 (Reference 1), indicated that the pressure drop for WBN's safety valve inlet piping was 30 psi at rated flow. This value was a conservative estimate of the frictional pressure drop only and did not include the acoustic wave component. TVA has since evaluated the total inlet piping pressure drop for both WBN Units 1 and 2 using MPR Associates' "EPRI PWR Safety and Relief Valve Test Program Guide for Application of Valve Test Program Results to Plant-Specific Evaluations" (Reference 3). The resulting maximum pressure drops are shown in the following table.

Safety Valve Position	Frictional Differential Pressure (psi)	Acoustic Wave Differential Pressure (psi)	Total Differential Pressure (psi)	Steady-State Differential Pressure (psi)
Opening	15.62	240.89	256.51	15.62
Closing	6.04	146.69	152.73	6.04

The above calculated maximum pressure drops of 256.51 psi for valve opening and 152.73 psi for valve closing are less than the comparable EPRI test pressure drops that are provided in Table 3 of Reference 3. Therefore, the WBN safety valves will perform satisfactorily based on this comparison to the EPRI results for the tested piping configuration (piping "G") of the Crosby 6M6 safety valve.

2. Backpressure

Question:

The submittal in Reference 1 provided the maximum backpressure calculated for the WBN discharge piping (610 psi). Because this value was provided in 1983, clarify if it is still applicable to the WBN Units 1 and 2 safety valves. Also, because Reference 4 identified the Target Rock PORV as susceptible to backpressure effects, provide the maximum calculated backpressure at WBN Units 1 and 2 for the PORVs. If the maximum plant backpressure for the safety valves or PORVs exceeds the tested backpressure, justify the applicability of the EPRI tests to the WBN valve configuration. In particular, if the backpressure of 610 psi given in Reference 1 is also applicable to the PORVs, justify how the EPRI tests, where the maximum backpressure measured for the test Target Rock PORV was 520 psi in a water seal simulation test, show operability of the WBN PORVs.

Response:

The calculated maximum backpressure for the WBN discharge piping is based on the simultaneous opening of the two PORVs followed 3 seconds later by simultaneous opening of the three safety valves. The calculated value of 610 psia that was provided in TVA's letter of July 22, 1983 (Reference 1) is no longer applicable. The current calculated value of maximum backpressure is 550 psia for both WBN Units 1 and 2. Note that this is essentially a steady-state pressure in the discharge piping, and, as such, it is the backpressure seen by both the PORVs and the safety valves.

The comment in EPRI-NP-2460 (Reference 4) that Target Rock PORVs are susceptible to backpressure effects requires clarification. In contrast to Target Rock PORVs, Dresser, Crosby, and Garrett PORVs have external pilot valves. Consequently, the pilot disc for these PORVs has no mechanical linkage to the main valve disc. Hydraulic forces alone operate the main disc. This type of PORV cannot open at low or zero pressure. Also, changes in backpressure may have some effect on the operability of these PORVs, especially at low inlet pressures.

The design of Target Rock PORVs is significantly different than the design of Dresser, Crosby, and Garrett PORVs. A Target Rock PORV has an internal pilot valve with the main and pilot discs mechanically linked together. In this configuration, the solenoid force applied to the pilot disc assists in opening the main valve disc. With low or zero pressure across this type of PORV, the solenoid force alone is able to lift the main disc. Also, for any given upstream (PORV inlet) pressure, the linked main disc experiences a magnetic lifting force from the pilot solenoid and is held in its open position by this magnetic force. It cannot be influenced by changes in pressure at the PORV inlet or by changes in backpressure at the PORV outlet. Based on information obtained through discussions with Target Rock personnel, an increased backpressure makes it easier to open or close the valve, but does not affect the ability of the valve to remain open. In summary, the backpressure exerted on a Target Rock PORV only affects the flow rate through the valve and the valve's actuation and deactuation times.

As previously indicated in Reference 1, the PORVs installed at WBN are 3" x 3" Target Rock Model 82UU-001 valves. The PORV used in the EPRI valve testing was a 2½" x 4" Target Rock Model 80X-006. This was the prototype model valve for the 82UU-001 production model valve. The minor variations -- other than valve size -- that exist between the prototype model and the production model were made primarily in response to the results determined by the EPRI tests. Therefore, the operational characteristics of the Model 82UU-001 PORV equal, or may slightly exceed, those of the Model 80X-006 PORV. Also, refer to TVA's Response to Question 10 for additional information about differences in PORV models.

The EPRI PORV tests, which were conducted at the Marshall and Wyle test facilities, demonstrated that the Model 80X-006 valve would open fully on demand and close fully on demand. Backpressures used during the tests ranged from 1 psia to 520 psia. Flow rates were in the range of 170,000 lb/hr for steam conditions and 266,000 - 698,000 lb/hr for water discharge. The Model 82UU-001 PORVs at WBN are designed for a flow rate of 210,000 lb/hr at 2339 psia.

In addition to the above "generic" PORV testing at Marshall and Wyle, TVA obtained more specific test data by contracting in 1983 for Target Rock to perform a special series of tests on one of WBN's PORVs. This PORV was subjected to 500 cycles of saturated steam at 400 psig, 500 cycles of saturated steam at 2335 psig, and 500 cycles of saturated steam at 1300 psig. The backpressure during these tests was varied from 400 psig to 2335 psig. Valve operation was normal throughout the testing, and no anomalies were experienced.

TVA considers that the EPRI valve testing program, in conjunction with the additional Target Rock PORV testing described above, demonstrated the operational adequacy of WBN's Model 82UU-001 PORVs under anticipated worst-case conditions.

3. Cold Overpressure Transient

Question:

The expected inlet fluid conditions for the PORV during cold overpressure transients were not provided by the licensee. Provide the temperature range expected at the PORV inlet for both the low and high pressure setpoints and the maximum pressure calculated to occur during a cold overpressure transient for both the low and high pressure setpoints. Compare the expected inlet conditions to the test inlet conditions for the Target Rock PORV. If the expected plant inlet conditions are not bounded by the test conditions, justify the applicability of the EPRI tests to WBN.

Response:

WBN uses the Westinghouse-designed cold overpressure mitigation system (COMS) to prevent reactor coolant system (RCS) pressure from exceeding the limits established in 10 CFR 50 Appendix G. These limits ensure that reactor vessel integrity is maintained during low temperature operation of the RCS. When activated for low temperature conditions, COMS controls the pressurizer PORVs by varying their setpoints based on RCS temperature. These setpoints vary linearly within a series of incremental RCS temperature ranges that are defined as follows:

RCS Temperature (°F)	Setpoint for PORV PCV-455A (psig)	Setpoint for PORV PCV-456 (psig)
70	470	490
170	470	490
190	470	500
210	485	525
230	550	585
250	615	655
270	685	735
380	685	735
450	2350	2350

These conditions are bounded by the valve inlet fluid conditions that are described by Figure 5-1 in EPRI-NP-2296 (Reference 5). The maximum pressure that is expected to occur during a cold overpressure transient, starting from either the lowest or highest RCS temperature in the above range, is 2350 psig. The associated PORV inlet conditions for this maximum transient are enveloped by tests 4-TR-5W (2536 psia and 645°F water test) and 5-TR-2W (690 psia and 114°F water test). Other tests, such as 6-TR-4W and 7-TR-7W, fall within this envelope or bound the expected valve inlet conditions.

TVA is currently upgrading WBN's process protection system to incorporate the new Eagle-21 digital electronics system developed by Westinghouse. In conjunction with the Eagle-21 upgrade, TVA plans to incorporate a revised low temperature overpressure protection system (LTOPS). The setpoint program for LTOPS includes allowances for the increased process instrument delay time that is associated with the Eagle-21 electronics and the updated reactor vessel pressure-temperature limits given in Revision 2 of Regulatory Guide 1.99, "Radiation Embrittlement of Reactor Vessel Materials." These pressure-temperature limits are based on a reactor vessel exposure of 7 effective full-power years (EFPY) for WBN Unit 1 and 32 EFPY for WBN Unit 2. The preliminary incremental ranges for RCS temperature and PORV pressure setpoints are as follows:

RCS Temperature (°F)	Setpoint for PORV PCV-455A (psig)	Setpoint for PORV PCV-456 (psig)
70	485	515
100	485	515
150	490	520
200	520	555
250	580	625
275	615	665
300	652	702
350	693	748
450	2350	2350

Previously identified EPRI tests 4-TR-5W (2536 psia and 645°F water test) and 5-TR-2W (690 psia and 114°F water test) still bound these preliminary revised PORV setpoints.

4. Feedwater Line Break Inlet Conditions for WBN, Unit 2

Question:

Reference 5 identified the feedwater line break (FWLB) valve inlet conditions for WBN, Unit 1. The inlet conditions for WBN, Unit 2, were not given. Clarify if the Unit 1 conditions are also applicable to Unit 2; if not, provide the maximum pressure and pressurization rate, the maximum liquid surge rate into the pressurizer when the valves are passing liquid, and the range of liquid temperatures at the valve inlet for Unit 2. If the expected plant inlet conditions are not bounded by the test conditions, justify the applicability of the EPRI tests to WBN, Unit 2.

Response:

Tables 5-2 and 6-2 in EPRI-NP-2296-LD (Reference 5) inadvertently omitted indication that they are applicable to WBN Unit 2. However, they are applicable since WBN Unit 2 is essentially identical to WBN Unit 1. Page 1-4 of EPRI-NP-2296-LD does clearly refer to WBN Unit 2. All analyses, fluid conditions, pressurization rates, and discussions for WBN Unit 1 in EPRI-NP-2296-LD are also applicable to WBN Unit 2. This was confirmed in a letter from Westinghouse to TVA dated April 25, 1985 (Reference 7).

5. Applicability of Valve Inlet Conditions

Question:

Reference 5, the Westinghouse valve inlet conditions report, is now almost 10 years old, and some of the information in the report is based on even older analyses. For example, the Unit 1 FWLB valve inlet conditions given in Reference 5 were based on a 1977 FSAR analysis. Clarify if the valve inlet conditions in Reference 5 are still applicable to WBN Units 1 and 2 for FSAR steam discharge, FSAR liquid discharge, extended high pressure injection, and cold overpressure protection transients. If not, provide updated valve inlet conditions for WBN Units 1 and 2 and identify the applicable EPRI tests for the new valve inlet conditions. If none of the EPRI tests are applicable to the new inlet conditions or the EPRI tests applicable to the new inlet conditions indicate potential valve operability problems (chatter, test valve did not close, etc.) for the safety valves or PORVs, provide information and test data to justify valve operability for the new valve inlet conditions.

Response:

The valve inlet fluid conditions in EPRI-NP-2296 (Reference 5) are still applicable to WBN Units 1 and 2 except for those associated with a feedwater line break (FWLB) accident. WBN's design-basis FWLB accident was reanalyzed in 1991 to determine the minimum acceptable auxiliary feedwater flow rate. This FWLB reanalysis considered cases both with and without pressurizer pressure control (i.e., with and without operation of the PORVs). The most limiting result (i.e., the minimum margin to RCS hot leg saturation) was obtained for the case that included pressurizer PORV operation. Note that for this case the pressurizer safety valves (PSVs) were not actuated.

The valve inlet conditions for both of the FWLB cases that were analyzed are presented below. The valve inlet conditions that are shown for the first and most limiting case are based on actuation of only the PORVs. The valve inlet conditions for the second case are based on actuation of only the PSVs.

Analysis Case	Initial Water Relief Temperature (°F)	Final Water Relief Temperature (°F)	Duration of Water Relief (sec)
FWLB with PORVs	603.7	624.6	3038
FWLB without PORVs	607.2	629.1	3124

Since the PSVs are not actuated in the first case, the EPRI test results for safety valves do not apply. For the second case where the PSVs can actuate, the FWLB transient has been evaluated in WCAP-11677 (Reference 8). This report compares data from the EPRI valve test program with transient response results from FWLB accident analyses. Because WCAP-11677 was prepared in 1988, the conditions for WBN in Table 2.1 of WCAP-11677 are slightly different than those listed in the second case above for WBN's current FWLB analysis. Also, the valve inlet conditions in Table 4.4 of WCAP-11677 indicate that two water discharge cycles occur during the FWLB transient. For the current FWLB analysis results in the second case above, the number of water discharge cycles increases to three. However, these minor updates to WBN's FWLB analysis do not change the basic conclusion of the evaluation in WCAP-11677 that the Crosby 6M6 PSV can pass slightly subcooled water a minimum of three times without damage. Therefore, WBN can be expected to withstand a FWLB transient without any degradation of PSV operability.

The EPRI PORV tests that were conducted at the Marshall and Wyle test facilities demonstrated that the valve would open fully on demand and close fully on demand. Test temperatures were 656°F in the Marshall tests and 668°F in the Wyle tests for steam conditions, and ranged from 113°F to 590°F in the Wyle tests for water discharge. The EPRI tests for water discharge were, therefore, performed at a temperature that was close to the discharge temperature determined in WBN's current FWLB analysis. Based on this similarity, WBN can be expected to withstand a FWLB transient without any degradation of PORV operability.

6. Valve Ring Settings

Question:

References 1 and 2 did not provide the ring settings for the WBN Units 1 and 2 Crosby 6M6 safety valves. Provide the settings for the upper and lower rings in the WBN valves for review. Compare these ring settings with those used in the EPRI tests and identify which of the tests are applicable to WBN valves (both ring settings and inlet conditions should be considered). These settings should be provided relative to the level position to be consistent with the method used to report the ring positions in the EPRI tests. If the ring settings at WBN are not comparable to applicable EPRI tests on the 6M6 valve, justify the applicability of the EPRI tests to the WBN safety valves.

Response:

WBN's safety valve ring settings are provided below. The nozzle ring is adjusted to assure proper popping action when the safety valve opens. The guide ring is adjusted to control valve blowdown. These ring settings are specified with respect to the level position, which is consistent with the format used in the 1982 EPRI valve test program to report ring settings. In general, the WBN ring settings listed below (taken from Reference 9) are comparable to the ring settings used in the EPRI tests.

Valve Serial Number	Nozzle Ring Setting (from level position)	Guide Ring Setting (from level position)
N56964-06-0029	-18	-111
N56964-06-0033	-18	-106
N56964-06-0034	-18	-123
N56964-06-0095	-18	-106
N56964-06-0096	-18	-100
N56964-06-0097	-18	-103
N56964-06-0105	-18	-101
N56964-06-0106	-18	-81
N56964-06-0107	-18	-129

The installation of the flexidisc internals in WBN's Crosby 6M6 safety valves did not require any changes to the valves' ring settings, which had been established by the manufacturer prior to the valves' original shipment to WBN. The manufacturer's ring settings were determined by testing each individual valve in the same manner that was used during the EPRI safety valve test program which was conducted in 1982 by Combustion Engineering. In view of this common approach to the determination of ring settings, WBN's safety valves are expected to have blowdown and stability characteristics similar to the Crosby HB-BP-86 6M6 valve that was tested for EPRI.

7. Bending Moments

Question:

The information in References 1 and 2 did not provide the maximum bending moment calculated to occur on the valve discharge flanges of the safety valves and PORVs at both WBN units. Compare the worst-case, plant-calculated values to those applied to the valves in the EPRI tests. The calculated bending moments should include the effects of deadweight, thermal expansion, earthquake (SSE), and valve actuation loads. If the bending moments for the plant safety valves or PORVs exceed those applied to the test valves, justify that the plant valves will operate satisfactorily with the higher bending moment. Also, because the WBN and test PORVs are not identical, justify that none of the differences between the plant and test valves invalidates the use of the EPRI PORV bending moment data to demonstrate operability of the WBN PORVs with the plant-specific bending moment.

Response:

The following information on bending moments applies only to the valves installed in WBN Unit 1. Similar information for WBN Unit 2 will be determined during a reanalysis of that unit's pipe support loads per the commitment that is restated in the response to Question 16.

Pressurizer Safety Valves (PSVs):

The WBN PSVs were manufactured by Crosby. The maximum bending moment presented in EPRI Report NP-2460-SR, December 1982 (Reference 4), is 31,600 in-lb. The following table shows the actual valve end loads for each PSV outlet as determined in the Code of Record analysis (Reference 10).

Valve Identification	Node Point	Local My Moment (maximum faulted value)	Local Mz Moment (maximum faulted value)
1-RFV-68-563	99A	29,628 in-lb	28,104 in-lb
1-RFV-68-564	78B	18,540 in-lb	62,616 in-lb
1-RFV-68-565	59A	26,280 in-lb	64,704 in-lb

The values presented in this table exceed the EPRI test allowable value. However, the loads generated by the piping analysis for each valve have been evaluated by Westinghouse and found to be acceptable. This was confirmed in a letter from Westinghouse to TVA dated June 22, 1992 (Reference 11).

PORVs:

The WBN PORVs were manufactured by Target Rock. The maximum bending moment presented in EPRI Report NP-2460-SR, December 1982 (Reference 4), is 32,900 in-lb. The following table shows the actual valve end loads for each PORV outlet as determined in the Code of Record analysis (Reference 10).

Valve Identification	Node Point	Local My Moment (maximum faulted value)	Local Mz Moment (maximum faulted value)
1-PCV-68-340A	28	5,640 in-lb	18,408 in-lb
1-PCV-68-334	45B	5,244 in-lb	23,352 in-lb

The values presented in this table are less than the EPRI test allowable value. Therefore, it can be concluded that WBN's PORVs will remain operable under worst-case conditions. See the response to Question 10 for a description of the minor differences between WBN's PORVs and the PORVs that were tested by EPRI. As stated in this response, it is valid to use the EPRI test data to demonstrate the operability of WBN's PORVs.

8. Block Valve Motor Operator Torque

Question:

The Westinghouse 3GM88 valve in the EPRI tests was shown to open and close completely with a motor operator torque output of 182 ft-lbs. In Reference 2, TVA stated the block valve operators at WBN were modified from torque control closure to limit control closure to ensure complete closure. To ensure that the plant block valve operators provide sufficient torque to open and close the valves at WBN, clarify whether the torque supplied by the motor operators at the plant is greater than or equal to 182 ft-lbs when using the limit control method. If the torque output of the plant operators is less than 182 ft-lbs, justify that they provide sufficient torque to close the valves under all expected inlet fluid conditions. This justification should be supported by test data.

Response:

The modification of WBN's block valve operators was somewhat more complicated than a simple change from torque control closure to limit control closure. The operators are now wired to close using a limit switch control scheme that bypasses the torque switch until just before the valve reaches its seated position. When this position is reached, the torque switch regains control for final valve closure.

Westinghouse testing, which was documented in a letter dated February 24, 1986 (Reference 12), demonstrated that each 3GM88 valve operator is capable of providing approximately 210 ft-lbs of torque at stall with a minimum design condition of 80% of nominal voltage. This exceeds the 182 ft-lbs of torque that was shown by the EPRI test program to be adequate to open and close this type of valve.

Although not specifically mentioned in the above question, Generic Letters (GLs) 89-10 and 90-06 identify a number of recommendations and improvements that are applicable to WBN's block valves. TVA has committed in a letter dated December 21, 1989 (Reference 13), to follow the recommendations in GL 89-10 for safety-related motor-operated valve (MOV) testing and surveillance. TVA has also committed in a letter dated December 21, 1990 (Reference 14), to implement the improvements identified in GL 90-06 for power-operated relief valve and block valve reliability.

9. Extended Safety Valve Blowdown

Question:

The safety valve blowdown in the applicable EPRI tests ranged from 4.8% to 12.7%. This indicates operation of the plant safety valves may result in blowdowns that exceed the design safety valve blowdown of 5%. Provide sufficient information to show: (a) the extended safety valve blowdown will not cause voiding of the primary system or degrade decay heat removal if voiding occurs, (b) the safety valves will operate acceptably if the extended safety valve blowdown results in filling the pressurizer, and (c) the extended safety valve blowdown will not challenge plant safety systems.

Response:

Westinghouse performed an evaluation to address the three concerns listed above and sent their results to TVA in a letter dated August 3, 1992 (Reference 15). This evaluation determined the impact of 13% blowdown from the pressurizer safety valves (PSVs) on WBN's various accident analyses. The conclusions were as follows:

(a) - An extended PSV blowdown of up to 13% will not cause voiding of the primary system for any licensing-basis accident.

(b) - An extended PSV blowdown of up to 13% will not result in filling the pressurizer for any licensing-basis accident beyond those accidents for which analysis has already determined that the pressurizer will become water solid.

(c) - An extended PSV blowdown of up to 13% will not challenge any safety systems that were not previously challenged in licensing-basis accidents.

10. Similarity of Test and Plant PORVs

Question:

TVA stated in Reference 1 that the Target Rock Model No. 82UU-001 PORVs at WBN Units 1 and 2 are the same type valve as the Target Rock Model No. 80X-006 PORV tested by EPRI. Provide additional information to clarify this statement. At the time of the EPRI valve justification report (Reference 6), only the now-canceled Midland plant was identified as using Target Rock PORVs. The information in Reference 6 justified the similarity of the Midland and EPRI PORVs. However, the model number for the Midland PORVs (81CC-001) is different from the model number for the WBN PORVs (82UU-001). Therefore, additional information is needed to justify that the tests on the EPRI PORV are applicable to the WBN PORVs. List all differences between the plant and test valves and justify that the differences do not affect operability. If operability is affected, justify the applicability of the EPRI tests to the WBN PORVs.

Response:

The Target Rock Model 80X-006 PORV that was tested by EPRI was an engineering prototype of the production Model 82UU-001 PORVs that are installed in WBN Units 1 and 2. The general size, configuration, and principle of operation of the production model are the same as those for the prototype model. The differences that do exist between the production model and the prototype model evolved as a result of field experience, some of which was gained during the EPRI test program. Differences between the 80X-006 valve and the 82UU-001 valve are described below.

Body Dimensions and Attached Flanges:

80X-006 -- The flanges on the valve body are 2½" 2500 lb for the inlet and 4" 300 lb for the outlet. The overall length of the valve body is 20.00".

82UU-001 -- The flanges on both the inlet and outlet of the valve body are 3" 2500 lb. The overall length of the valve body is 22.75". The body bore is 2.000". The distance from the top surface of the body to the seat contact point is 0.065" greater than the equivalent dimension for the 80X-006 valve. This provides a main disc lift that is 0.065" greater for the 82UU-001 valve than for the 80X-006 valve. The changes in body dimensions were made in response to customer requirements for 3" 2500 lb flanges and for a higher flow rate through the valve.

Bonnet, Fixed Core, and Magnetic Sleeve:

80X-006 -- The valve design incorporates an "inside magnetic sleeve" wherein a cylindrical magnetic pole piece is placed over a portion of the bonnet with a reduced outside diameter.

82UU-001 -- The valve design incorporates an "outside magnetic sleeve" wherein the magnetic pole piece is placed above the solenoid. This change was made to increase the fixed core's cross-sectional area and, thereby, to improve its ability to carry magnetic flux without saturating.

Main Disc, Pilot Disc, and Pilot Seat Insert:

80X-006 -- The pilot disc is made of stainless steel with hardfaced guiding and seating surfaces. The pilot seat insert, which is welded into the main disc, is made of Haynes 25 material that is cold-worked and age-hardened at 700°F.

82UU-001 -- The pilot disc is made of wrought Stellite 6B with a hardfaced seat only. The pilot disc material was changed, in comparison to the 80X-006 valve, primarily for ease of manufacture. The pilot seat insert is made of stainless steel with a Stellite seating surface. This insert is welded into the main disc, which, in comparison to the 80X-006 valve, has Stellite on its guiding and seating surfaces. Target Rock added Stellite to these wear points after the EPRI tests revealed heavy scratching of the main disc's guiding surfaces where they move within a sleeve. Also, Target Rock relocated the piston ring grooves for the 82UU-001 valve so that they were not as close to the observed area of scratching.

Sleeve Material:

80X-006 -- The sleeve is made of wrought Stellite 6B.

82UU-001 -- The sleeve is made of hardened AISI 440C steel that is flash-chrome-plated for increased corrosion resistance. This is the material normally used by Target Rock for solenoid valves of less than 4" pipe size. A Stellite 6B sleeve was used in the prototype 80X-006 valve because, when it was manufactured, no AISI 440C steel sleeves were available.

Piston Rings:

80X-006 -- The piston ring gap was originally 0.023"/0.028". During the EPRI tests, the ring gap was enlarged to 0.037"/0.042" to prevent gap closure during severe thermal transients.

82UU-001 -- The piston ring gap is 0.037"/0.042", which is identical to the ring gap of the 80X-006 valve after it was modified during the EPRI tests. Expander rings supplement the piston rings in the production 82UU-001 valve to compensate for an observed loss of initial tension (i.e., contact stress against the sleeve wall) of the piston rings when they are used in service conditions of high differential pressure. Grooves in the main disc have been deepened to accommodate the expander rings.

Plunger and Moveable Core:

80X-006 -- The valve design relies on the bonnet wall to guide the plunger and the moveable core. However, inspections after the EPRI tests indicated that there was a need to improve this arrangement since scratch marks were found on both the plunger and the moveable core, as well as the inner surface of the bonnet tube.

82UU-001 -- The valve incorporates a design improvement by guiding the plunger on the inner disc rod that connects the moveable core to the main disc.

Solenoid and Electrical Parts:

80X-006 -- The solenoid coil has a nominal power input of 120 watts.

82UU-001 -- The solenoid coil is wound differently than the coil of the 80X-006 valve to achieve a nominal power input of 163 watts. This increases the magnetic flux and the magnetic operating force margin. In 1990, the solenoid coil and all external parts of the 82UU-001 valves at WBN were retrofitted with new electrical parts having a higher radiation tolerance. The switch clamps that are used on the valve were also replaced with a newer style of clamp from Target Rock. The new solenoid coils that are now on WBN's 82UU-001 valves have the same magnetic characteristics as the previous coils.

In summary, the basic designs of the Target Rock Model 80X-006 PORV and the Model 82UU-001 PORV are the same. The changes to the design of the production 82UU-001 valve -- relative to the prototype 80X-006 valve -- were made to improve the performance and operability characteristics of the valve, based primarily on the results of the EPRI valve test program. The most significant changes were: (1) an increase in the piston ring gap and (2) the addition of expander rings under the piston rings. With these improvements and the other enhancements listed above, the 82UU-001 valve is expected to exhibit stable operation and to perform at least as well as the 80X-006 valve.

11. Block Valve Orientation

Question:

The Westinghouse 3GM88 block valve was tested in the horizontal position (valve stem vertical) by EPRI. Clarify the orientation of the plant block valves (vertical or horizontal). If the plant orientation is different from the EPRI test orientation, clarify how the EPRI data justifies the operability of the WBN Units 1 and 2 block valves or provide other test data to support the operability of the plant valves.

Response:

The Westinghouse 3GM88 block valves at WBN are installed in the horizontal position with their valve stems vertical (i.e., the same orientation that was used in the EPRI tests). This is shown on as-constructed drawings 47W465-2 and 47W465-7.

12. PORV Control Circuitry

Question:

As noted in the introduction, NUREG-0737, Item II.D.1, requires qualification of the PORV control circuitry.

A. For environmental qualification, the NRC staff agreed that meeting the licensing requirements of 10CFR50.49 for this circuitry is satisfactory and specific testing per NUREG-0737 is not required. Therefore, verify whether the PORV control circuitry was reviewed and accepted under the requirements of 10CFR50.49.

   If the PORV circuitry has not been qualified to the requirements of 10CFR50.49, provide information to demonstrate that the control circuitry is qualified per the guidance provided in Reg. Guide 1.89, Revision 1, Appendix E.

   As an alternative, the staff has determined that the requirements of NUREG-0737 regarding the qualification of the PORV control circuitry may be satisfied if one or more of the following conditions is met.

   a. The PORVs are not required to perform a safety function to mitigate the effects of any design basis event in a harsh environment and failure in a harsh environment will not adversely impact safety functions or mislead the operator (PORVs will not experience any spurious actuations and, if emergency operating procedures do not specifically prohibit use of PORVs in accident mitigation, it must be ascertained that PORVs can be closed under harsh environment conditions).

   b. The PORVs are required to perform a safety function to mitigate the effects of a specific event, but are not subjected to a harsh environment as a result of that event.

   c. The PORVs perform their function before being exposed to a harsh environment and the adequacy of the time margin provided is justified; subsequent failure of the PORVs as a result of the harsh environment will not degrade other safety functions or mislead the operator (PORVs will not experience any spurious actuations and, if emergency operating procedures do not specifically prohibit use of PORVs in accident mitigation, it must be ascertained that PORVs can be closed under harsh environment conditions).

   d. The safety function can be accomplished by some other designated equipment that has been adequately qualified and satisfies the single-failure criterion.

B. Clarify how the PORV control circuitry is qualified for normal operation. That is, clarify what tests are done to ensure the PORV control circuits will respond properly to operator actions in normal operation or emergency situations or automatic signals in emergency situations.

Response:

A. The pressurizer PORV control circuitry at WBN contains inputs that are not environmentally qualified per the requirements of 10CFR50.49. However, this control circuitry does satisfy one of the alternate methods of qualification stated above in that the PORVs are not required to perform a safety function to mitigate the effects of any design basis event in a harsh environment and failure in a harsh environment will not adversely impact safety functions or mislead the operator. The PORVs can be closed under harsh environment conditions.

   No credit is taken for the operation of the PORVs to mitigate the consequences of an accident, except for high-point venting of the reactor coolant system (RCS). Such venting is accomplished by remote-manual opening of the PORVs using portions of the control circuitry that are independent of of the non-qualified inputs. The failure of one or more of these non-qualified inputs does not preclude the remote-manual operation of the PORVs. The PORVs themselves and those portions of their control circuitry that are used for remote-manual operation and that are located in a harsh environment are qualified to the requirements of 10CFR50.49.

   In the event one or both PORVs opens spuriously due to an environmentally induced failure of a non-qualified input to the control circuitry, the qualified portions of the control circuitry that are used for remote-manual operation of the PORVs will still be available to close the affected PORV(s). Thus, operator action from the control room can quickly isolate the failure without degrading safety functions. Plant emergency operating procedures instruct the operator to close the PORVs whenever RCS pressure is less than 2335 psig. Positive indication of PORV position is provided through the post-accident monitoring system (PAMS). If remote-manual closing of a PORV cannot be accomplished due to a postulated single failure, plant emergency operating procedures instruct the operator to close the block valve upstream of the PORV. The block valve serves as a backup isolation device to terminate RCS blowdown (depressurization) through the inoperable PORV. Each block valve is environmentally qualified in WBN's mechanical equipment qualification program. The control circuitry for the block valve is environmentally qualified to the requirements of 10CFR50.49. Block valve position indication is also provided by PAMS.

B. TVA submitted proposed technical specifications for WBN Unit 1 for NRC review in a letter dated August 27, 1992 (Reference 16). These proposed technical specifications include surveillance requirements (SRs) to ensure the operability of the PORVs, block valves, and their associated control circuits. SR 3.3.4.2 verifies proper control circuit operation for each PORV and block valve every 18 months. SR 3.4.11.1 physically cycles each block valve every 92 days. SR 3.4.11.2 physically cycles each PORV every 18 months. SRs 3.4.12.6 and 3.4.12.7 confirm proper PORV control circuit operation when the PORVs are being used for cold overpressure protection as previously discussed in the response to Question 3.

Questions Related to Thermal-Hydraulic Analysis

13.

Question:

The following information is needed to complete the review of the WBN Units 1 and 2 thermal-hydraulic analysis:

A. The computer programs used for the thermal-hydraulic analysis were identified as WATHAM and STEHAM. Verification of STEHAM and WATHAM was provided in other utilities' submittals if STEHAM and WATHAM are Stone & Webster computer programs. Clarify if STEHAM and WATHAM were developed by Stone & Webster. If not, provide verification of STEHAM and WATHAM and the post processor, if any, used in conjunction with the thermal-hydraulic analysis program to compute the fluid forces. The verification effort should include comparisons to EPRI/CE data or another benchmarked code.

B. For all thermal-hydraulic analyses, identify parameters such as valve flow rates, valve opening/closing times, valve opening pressure, pressure ramp rate, peak pressure, choked flow location, steam and water temperatures, fluid qualities, and time steps. Discuss the rationale for their selection relative to expected valve inlet conditions and/or EPRI test results on valve performance. If applicable, provide information on the node spacing used in STEHAM and WATHAM and justify the node sizes used in the analysis. Provide evidence to show that with the parameters used bounding forces were calculated, i.e., piping forces calculated with WATHAM and STEHAM were not underestimated due to numerical smearing because of the nodalization or time step size used. Also, provide evidence to show the conditions used result in forces that bound the expected forces based on plant conditions and EPRI test results.

C. Reference 2 stated that the analysis of the pressurizer relief piping included the following transients: (a) safety valve opening/closing, (b) PORV opening/closing, and (c) PORV opening/closing during a cold overpressure transient. In case (a), clarify if both PORVs were closed while the safety valves actuated. In case (b), clarify if all safety valves were closed while the PORVs actuated. If simultaneous actuation of the safety valves and PORVs was assumed, justify that the forces calculated would bound the forces calculated assuming safety valve actuation only or PORV actuation only.

D. Justify that the conditions analyzed in cases a, b, and c above result in forces that bound the forces from all transient conditions expected at WBN Units 1 and 2. This would include steam discharge only transients, steam-to-water transition with hot water (such as the feedwater line break), steam-to-water transition with cold water (such as a cold overpressure transient), and hot and cold water discharge only transients.

E. Because the ASME Code requires derating of the safety valves to 90% of actual flow capacity, the piping analysis for safety valve discharge should be based on a flow rating at least equal to 111% of the flow rate stamped on the valve, unless another flow rate can be justified. Also, a higher flow rate may need to be used if higher safety valve or PORV flow rates were measured in the EPRI tests. Describe the methods used to establish flow rates for the safety valves and PORVs in the thermal-hydraulic analyses. If a flow rate less than the maximum flow rate measured in the EPRI tests was used in the thermal-hydraulic analysis, justify that the analysis provided bounding forces on the piping and supports.

Response:

A. STEHAM and WATHAM are industry computer programs that were used by Stone & Webster Engineering Corporation (SWEC) for fluid transient analyses, including the analyses they performed for WBN. STEHAM is used to determine the fluid transient dynamic forcing functions due to the actuation of the pressurizer safety valves (PSVs) and PORVs with subsequent steam discharge. WATHAM is used for water discharge from the pressurizer relief valves. Both of these programs have been verified and are maintained for use in nuclear safety calculations by SWEC. The specific versions of these programs that were used by SWEC for the WBN analyses were:

- Steam Hammer Analysis for Piping Systems, STEHAM, ME 167, Version 2, Level 3, created 83.167 by SWEC.
- Water Hammer Analysis for Piping Systems, WATHAM, ME 168, Version 2, Level 6, created 88.221 by SWEC.

Both STEHAM and WATHAM create output in NUPIPE-SW format, which is compatible with various other SWEC computer programs. THFMT is a simple, post-processor computer program that is used to convert the forcing functions from NUPIPE-SW format to a format which is compatible with the TPIPE computer program used by TVA for pipe stress analysis. Qualification of THFMT was provided within the fluid transient calculation (Reference 17).

B. WBN's thermal-hydraulic analyses cover the piping that is both upstream and downstream of the PSVs and PORVs and that extends from the pressurizer nozzles to the pressurizer relief tank (PRT). The following parameters, which were used in the thermal-hydraulic analyses performed by SWEC, are summarized from References 17 and 18:

Analysis Parameter	PSVs	PORVs
Stamped valve capacity flow rates (lbm/hr)[1]	420,006	210,000
Valve opening/closing times (sec)[2]	0.008	0.06
Valve setpoint pressure (psig)[3]	2485	2335
Valve opening pressure (psia)[4]	2574.3	2420
Peak pressure (psia)[5]	2748.2	2524.6
Valve closing pressure (psia)[6]	2375.5	2400
Pressure ramp rate (psi/sec)[7]	54	54

[1] The stamped valve capacity for each PSV is for 650°F and 2485 psig and is taken from Crosby manufacturer data report sheets that are included in Attachment Ib of Reference 18. The stamped valve capacity for each PORV is for 650°F and 2339 psig and is taken from the letter from Target Rock to TVA that is included in Attachment Id of Reference 18.

[2] The fastest pop-opening time for the PSVs is based on Reference 20. The minimum opening time for the PORVs, as computed from the letter from Target Rock to TVA that is included in Attachment Id of Reference 18, is 0.08 sec - (0.08 sec x 0.25) = 0.06 sec.

[3] The setpoint pressure for the PSVs is taken from Crosby manufacturer data report sheets that are included in Attachment Ib of Reference 18. The setpoint pressure for the PORVs is listed in Table 2C of Reference 18.

[4] The opening pressure for the PSVs is taken from Reference 17 based on the valve "setpoint pressure" with 3% accumulation (i.e., 2485 psig x 1.03 + 14.7 psia = 2574.3 psia). The opening pressure for the PORVs during normal plant operation is computed by adding an allowance of 70 psi for possible instrument inaccuracies to the setpoint pressure. The opening pressure for the PORVs in their COMS mode of operation is 604.7 psia as discussed for Case 6 in Part D of this response.

[5] A peak pressure of 2748.2 psia was determined in Reference 17 for the case where the PSVs open with the PORVs remaining closed. A peak pressure of 2524.6 psia was determined in Reference 17 for the case where the PORVs open, but the PSVs remain closed.

[6] The closing pressure for the PSVs is 95% of the setpoint pressure (i.e., 2485 psig x 0.95 + 14.7 psia = 2375.5 psia). The closing pressure for the PORVs is 20 psi below their opening pressure (i.e., 2420 psia - 20 psi = 2400 psia) per Reference 18. The closing pressure for the PORVs in their COMS mode of operation is 849.7 psia as discussed for Case 5 in Part D of this response.

[7] The pressurization ramp rate that was used in the fluid transient analyses is the maximum rate for any "upset" plant condition. It was assumed that, since the transient events which were analyzed occurred within a very short time period (i.e., less than 1.0 second), this approach was reasonable. The upset ramp rate bounds the emergency and faulted ramp rates because the ASME Code allows a pipe stress that is 50-100% higher for these conditions.

Fluid temperatures, qualities, flow rates and densities were determined by the computer programs and varied as a function of time. The initial conditions for these parameters are described in Part D of this response. The computer runs are documented in Reference 17.

Choked flow was predicted to occur by these computer analyses at various locations in the piping systems. Such locations were typically downstream of the valves and in the tailpipe section.

The STEHAM and WATHAM computer programs use the method of characteristics with a finite difference approximation in both space and time to solve the governing partial differential equations. The spatial characteristics of the system are defined by the flow parameters ascribed to each node. One node is placed at each end of a pipe and the remainder are equally spaced along the pipe. Node sizes were chosen in accordance with the guidelines prescribed in the STEHAM and WATHAM computer manuals. Segment lengths were adjusted as necessary to satisfy nodalization requirements for the computer models. Typical node lengths were 1 - 2 feet. Sketches of piping models used in the analyses are provided in Enclosure 3.

Discretization of the flow problem with respect to time is governed by the integration time step. The time step (dt) is limited by the Courant number of the model. That is,

$dt < (x_i/a_i)_{min}$

where

x_i = nodal spacing,
a_i = speed of sound for the ith pipe.

Typical time step sizes used in the analyses were 0.0006 - 0.001 second.

The initial fluid conditions that were used in the fluid transients are described in Part D of this response.

C. In case (a) for PSV opening/closing (equivalent to Cases 3 and 4 as defined in Part D of this response), both PORVs remained closed during the transient. Only the PSVs actuated.

In case (b) for PORV opening/closing (equivalent to Cases 1 and 2 as defined in Part D of this response), all PSVs remained closed during the transient. Only the PORVs actuated.

In case (c) for PORV opening/closing during a cold overpressure transient (equivalent to Cases 5 and 6 as defined in Part D of this response), all PSVs remained closed during the transient. Only the PORVs actuated.

Simultaneous actuation of the PSVs and the PORVs was not modeled because this scenario is bounded by the scenarios of PSV actuation only and PORV actuation only.

D. Several different scenarios were considered during the development of the forcing functions for PSV and PORV actuation events. A total of six cases were modeled for transients associated with actuation of the PSVs and PORVs.

Case 1 - This case simulates the opening of the two PORVs at 2420 psia with air initially in the downstream piping and with a water column at the PRT. The initial fluid temperature is 663°F. The discharged steam causes significant blowdown forces at the PRT. The pressure rise is terminated before it reaches the setpoint pressure of the PSVs, which, therefore, remain closed throughout the transient.

Case 2 - This case simulates the PORVs closing after the pressure has been reduced 20 psi below the setpoint pressure of Case 1 (i.e., to 2400 psia). The initial conditions for the case assume that the transient occurs after a steady-state run at a reservoir pressure of 2525 psia. The initial fluid temperature is 663°F and the fluid is saturated. The PSVs remain closed throughout the transient.

Case 3 - This case simulates the opening of the three PSVs at 2574.3 psia with air initially in the downstream piping and with a water column at the PRT. The initial fluid temperature is 673°F and the fluid is saturated. The PORVs are assumed to be inoperable and remain closed throughout the transient.

Case 4 - This case simulates the PSVs closing after the pressure has been reduced to 95% of the setpoint pressure of Case 3 (i.e., to 2445.6 psia). The initial conditions for the case assume that the transient occurs after a steady-state run at a reservoir pressure of 2445.6 psia. The initial fluid temperature is 673°F and the fluid is saturated. The PORVs remain closed throughout the transient.

Cases 5 and 6 model PORV actuation when the PORVs are used in conjunction with the COMS as previously discussed in the response to Question 3.

Case 5 - This case simulates a COMS event with the PORVs closing. The fluid conditions prior to the transient are a water temperature of 380°F and pressure of 849.7 psia. This high-pressure case represents the worst loading condition for the upstream piping.

Case 6 - This case simulates a COMS event with the PORVs opening. The fluid conditions prior to the transient are a water temperature of 70°F and pressure of 605 psia. This low-water-temperature case represents the worst loading condition for the downstream piping because of the higher water density and the absence of two-phase flow.

The resulting maximum pipe segment inertial forces that were determined for these scenarios are as follows (Reference 17):

Case	Piping Location (Pipe, Segment)	Maximum Inertial Force (lbf)
1	Tailpipe (10,4)	3857
2	Tees Downstream of PORVs (16,1)	1307
3	Tailpipe (10,4)	7984
4	Tailpipe (10,4)	6280
5	Pressurizer Connection (1,2)	2643
6	(5,All)	425

The transient calculated by WATHAM for Case 5 with the PORVs closing during a COMS event resulted in the peak loads for the piping upstream of the PORVs. The transient calculated by STEHAM for Case 4 resulted in the peak loads for the piping upstream of the PSVs. The transient calculated by STEHAM for Case 3 and the transient calculated by hand for Case 6 generated the bounding loads for the downstream piping, except for pipes 13, 15, and 16. The loads on these three pipes just downstream of the PORVs are bounded by the transient calculated by STEHAM for Case 1. The maximum calculated force of 7984 lbs is applied to pipe 10, segment 4. A listing of the maximum forces applied to other pipe segments is given in Enclosure 4.

E. Relevant PSV and PORV flow rates are as follows:

Flow Rate Basis	PSVs	PORVs
Stamped data from manufacturer (i.e., rated flow) (lbm/hr)*	420,006	210,000
111% of rated flow to allow for derating to 90% of capacity per ASME Code (lbm/hr)	466,673	231,000

* The rated flows for the PSVs and PORVs are discussed in Part B of this response.

The computer programs (described in Part A of this response) that were used for the fluid transient analyses calculate PSV flow rates based on fluid properties, valve throat area, and pressure differentials. The maximum calculated flow rates from the analyses that are documented in Reference 17 exceed the above values for 111% of rated flow. This satisfies the ASME Code requirement for derating of the PSVs to 90% of their rated flow capacity. The EPRI test data in Reference 19 for flow rates from the Crosby PSVs was incomplete so that an adequate comparison with the flow rate data for WBN's PSVs could not be made. However, the computer analyses which were performed for WBN used conservative assumptions to provide a high level of confidence that calculated flow rates would always exceed actual flow rates. Therefore, WBN's calculated flow rates provide bounding forces on the piping and supports.

Questions Related to Structural Analysis

14.

Question:

The submittal does not present details of the structural analysis. To allow for a complete evaluation of the methods used and results obtained from the structural analysis, please provide the following information:

A. Reference 2 indicated TPIPE was used to perform the structural analysis for WBN Units 1 and 2. Clarify how this program was verified. The verification effort should include comparisons to EPRI/CE data or another benchmarked code.

B. Describe the methods used to model supports, the pressurizer and relief tank connections, and the safety valve bonnet assemblies and PORV actuator. Identify the time step, the mass point spacing, damping factors, and the cutoff frequency used in the analysis model for various pipe sizes. Give the rationale for the choice of the computation time step, mass point spacing, damping, and cutoff frequency. Justify that they provide bounding analyses for the WBN Units 1 and 2 pressurizer piping system. The values for the parameters chosen should adequately analyze the piping system response to frequencies of at least 100 Hz. For example, the time steps chosen should be approximately 0.001 sec to allow a minimum of eight points per cycle to define the forces applied to the piping. If the parameters chosen do not adequately address frequencies of at least 100 Hz, provide sufficient information to justify that the structural analysis accounts for the dominant piping frequencies at both WBN units.

C. Identify the load combinations used in the analysis and the allowable stress limits. Provide the load combinations used for the piping and supports upstream and downstream of the safety valves and PORVs. Explain the mathematical methods used to perform the load combinations. If the load combinations and methods differ from those suggested in Reference 3, discuss how the load combinations used satisfy the FSAR commitment for the piping and supports. Identify the governing design codes and standards used to determine the adequacy of the upstream and downstream piping and supports.

D. Provide an evaluation of the results of the structural analysis. Present tables listing the worst-case load or stress for the piping and supports upstream and downstream of the safety valves and PORVs compared to the applicable design load or allowable stress. Identify the associated load combination equation. Indicate the piping location or support number, location, and type with respect to the piping model (i.e., node number) requested in Item F below. Discuss the modifications made to the piping or supports, if any, and clarify when the modifications were completed.

E. Compare the stresses and loads calculated for the pressurizer nozzles for the safety valves and PORVs to the allowable stresses and loads. If the calculated stresses and loads exceed the allowable values, discuss the modifications TVA will make to bring the system into compliance.

F. Provide a sketch of the structural model showing lumped mass locations, pipe sizes, support locations, and application points of fluid forces.

Response:

A. TPIPE is the computer program that TVA uses for static and dynamic analyses of piping systems. It is described in FSAR Section 3.9.1.2.1 including its verification and comparison with other computer programs that are used throughout the industry.

B. Note: The following information is applicable to the structural analysis for WBN Unit 1. Refer to the response to Question 15 for the approach that will be used for Unit 2.

Pipe supports were modeled in the analysis as rigid and designed in accordance with the requirements established in FSAR Section 3.9.3.4.2. The pressurizer was modeled in the analysis as a flexible piece of equipment with a frequency evaluation performed to ensure that its frequencies were compatible to the values provided by Westinghouse in the Pressurizer Stress Report. For the pressurizer relief tank (PRT) connection nozzle, stiffness characteristics were calculated based on Westinghouse drawings and then used as input to the analysis. The pressurizer safety valves (PSVs) and PORVs were modeled as nonflexible using standard valve modeling techniques and valve properties. This approach was based on vendor reports for the PSVs and PORVs which indicate that they are rigid.

The structural analysis calculation evaluated the time histories of the PSVs and PORVs for four different cases involving an opening and closing transient for each PSV and PORV. The mass point spacing, damping factors, and cutoff frequency were the same for all four cases.

Damping Values and Cutoff Frequency:

The method of analysis was direct integration time history. This method was chosen to ensure that all mass would be accounted for in the analysis. The mass and stiffness constants were established such that damping would be at or below the values given in Regulatory Guide 1.61 for frequencies between the piping system first mode frequency and the cutoff frequency (500 Hz). A sensitivity study was performed by varying the frequency which was used to determine the time step and damping constants until convergence was achieved.

Mass Point Spacing:

The following table presents the point spacing that TPIPE uses for various sizes of pipe. These values are the maximum values used by TPIPE. The actual values that are used for a piping analysis problem are, in general, considerably less than these table values.

Pipe Size (in)	Spacing (ft)
3	3.5
6	5.0
12	8.0

The above table includes only the specific pipe sizes that make up the main piping connected to the PSVs and PORVs and shows the value of mass point spacing associated with each of these sizes. The forcing function input for the evaluated transient event is axial in nature. The above values of mass point spacing are acceptable to represent mode shapes that are excited by axial forcing functions.

Solution Time Step:

The following table shows the solution time steps that were used in the analyses for the four time history events.

Time History	Solution Time Step
SRV Open	0.00025 sec
SRV Close	0.00025 sec
PORV Open	0.00025 sec
PORV Close	0.00025 sec

In each case, a solution time step of 0.00025 second was chosen since it was at least half of the input time step. This allowed the direct integration time history analysis to account for modes up to 500 Hz.

C. The load combinations used for the piping analysis and support loads were based on TVA Design Criteria WB-DC-40-31.7. Pertinent excerpts from WB-DC-40-31.7 are attached as Enclosure 5. The calculated stresses for the piping upstream of the PSVs and PORVs satisfy the allowable stress limits of both ASME Class 1 and ASME Class 2,3 requirements. The piping downstream of these valves to the PRT satisfies the stress limits of ASME Class 2,3 requirements. The pipe supports both upstream and downstream of the valves satisfy the allowable stress limits of TVA Design Criteria WB-DC-40-31.9. The applicable portion of WB-DC-40-31.9 is attached as Enclosure 6. The welded attachments satisfy the requirements of WB-DC-40-31.7.

The algebraic combinations of stresses and support loads are included in WB-DC-40-31.7 (see Enclosure 5). These combinations were established in accordance with the relevant commitments in the FSAR for the application and combination of design loading events to Category I and I(L) piping and its supports.

D. Piping Stress Review:

The following table presents the maximum calculated piping stress values as a ratio with respect to the allowable stress values based on the applicable methodology of the ASME Code. Stress ratios for piping both upstream and downstream of the PSVs and PORVs are shown.

ASME Equation	Upstream Node	Stress Ratio	Downstream Node	Stress Ratio
8	68	0.375	74	0.560
10	46A	0.437	6	1.051
11	46A	0.381	6	0.851
9U	107	0.604	89C	0.709
9E	86	0.468	89C	0.474
9F	86	0.397	89C	0.356

Pipe Support Review:

The following table presents the design margins for two supports upstream of the PSVs and PORVs and three supports downstream of these valves.

Support Identifier	Node	Location	Type*	Margin Factor	Element**
1-68-414	45	Downstream of PORV 1-PCV-68-334	RR(X)	2.80	Weld stress
1-68-424	76A	Downstream of PSV 1-RFV-68-564	DS(Y)	1.26	Baseplate stress
47A465-2-66	A64A	Upstream of PSV 1-RFV-68-565	DS(SX)	1.26	Anchor bolts
47A465-2-67	A64B	Upstream of PSV 1-RFV-68-565	DS(SZ)	1.41	Member stress
1-68-445	97A	Downstream of PSV 1-RFV-68-563	DS(SX)	1.38	Anchor bolts

* -- RR denotes a rigid restraint and DS denotes a dynamic snubber.
** -- The element is the component that corresponds to the minimum margin factor.

Pipe Support Modifications:

The pipe support configuration was modified as part of the hanger and analysis update program (HAAUP) for Unit 1. This modification was made to bring the piping system into compliance with the requirements of WB-DC-40-31.7 and to qualify the pressurizer nozzles. In addition, the supports located on the PSV valve flanges were removed to help qualify each of these valves to the normal operating requirements established by Crosby. No modifications were made to supports for the PORVs. Design change notice (DCN) K-6034 has been issued to implement the above modifications. The modifications are scheduled for completion prior to fuel load for Unit 1.

E. The stresses and loads for the PSV and PORV nozzles were determined in TVA Calculation WCG-ACQ-0351 (Reference 20). These stresses and loads were evaluated both by TVA personnel who were familiar with component qualification and by Westinghouse. The stresses and loads were found to be acceptable.

F. The requested sketch of the structural model is shown on the analysis isometrics in Enclosure 7. These isometrics also show the piping and segment application points for the fluid forces.

Questions Related to Watts Bar, Unit 2

15.

Question:

The list of commitments included in Reference 2 indicated that the fluid transient loads for Unit 2 would be reanalyzed. This would indicate that Unit 2 is different from Unit 1, and the differences are being accounted for in the piping analyses. Identify the differences between Units 1 and 2, and clarify whether the differences were considered when determining items such as: (a) valve inlet/outlet conditions, (b) valve operability, (c) the maximum safety valve inlet piping pressure drop/rise, (d) the maximum backpressure for the safety valves and PORVs, and (e) the maximum bending moments on the safety valve and PORV discharge flanges.

Response:

The fluid transient load calculations and piping analyses associated with Unit 2's pressurizer safety valves and PORVs have not yet been performed. TVA plans to reevaluate the fluid transient loads for Unit 2 as part of that unit's hanger and analysis update program (HAAUP). Unit 2's HAAUP is a reconciliation effort that is planned to be performed when construction of that unit is substantially complete. The program compares the physical piping and support configurations for Unit 2 against the equivalent configurations for Unit 1 and also against fundamental design requirements. TVA does not expect that there will be significant differences between Unit 1 and Unit 2. However, any differences that are identified are evaluated and, if required, a separate piping or structural analysis is then performed for Unit 2. Any such analyses for Unit 2 will be performed prior to fuel loading of Unit 2 per the commitment that is restated in the response to Question 16.

16.

Question:

The list of commitments in Reference 2 stated that any modifications to the Unit 2 safety and relief valve piping would be completed before Unit 2 was turned over to Operations. The NRC staff position is that any modifications should be completed prior to Unit 2 licensing. Clarify if TVA can meet the NRC-required schedule for Unit 2.

Response:

TVA's commitment in Reference 2 stated: "Using the new fluid transients, the support loads for Unit 2 will be reanalyzed, and any necessary modifications will be completed before Unit 2 system turnover to Operations." TVA's normal practice in planning and scheduling includes turnover of all plant systems required to operate a WBN unit to the Operations organization before fuel loading of that unit can proceed. This is the approach currently being used for WBN Unit 1, and TVA expects to use the same approach for WBN Unit 2. Therefore, the intent of the commitment in Reference 2 was to complete the reanalysis of support loads and any resulting modifications before fuel loading of WBN Unit 2.

In view of this and TVA's understanding that "licensing" of Unit 2 is essentially synonymous with fuel loading, TVA can meet the NRC-required schedule in the above question. For clarity, TVA is rewording the commitment as follows: "Using the new fluid transients, the pressurizer safety and relief valve piping support loads for Unit 2 will be reanalyzed, and any necessary modifications will be completed before fuel loading of Unit 2."

ENCLOSURE 2

References

ENCLOSURE 2

List of References

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2. Letter from E.G. Wallace (TVA) to U.S. Nuclear Regulatory Commission, "Watts Bar Nuclear Plant (WBN) Units 1 and 2 - NUREG 0737, Item II.D.1 - Safety and Relief Valve Testing (TAC No. 79992)," July 11, 1991 (TVA RIMS No. L44910711802).

3. MPR Associates, Inc., "EPRI PWR Safety and Relief Valve Test Program Guide for Application of Valve Test Program Results to Plant-Specific Evaluations," Revision 2, Interim Report, July 1982.

4. PWR Valve Program Staff, Electric Power Research Institute, "EPRI PWR Safety and Relief Valve Test Program, Test Condition Justification Report," EPRI-NP-2460, December 1982.

5. Westinghouse Electric Company, "Valve Inlet Fluid Conditions for Pressurizer Safety and Relief Valves in Westinghouse-Designed Plants," EPRI-NP-2296, December 1982.

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7. Letter from E.A. Novotnak (Westinghouse) to J.A. Raulston (TVA), "Pressurizer Safety and Relief Valves," WAT-D-6525, April 25, 1985 (TVA RIMS No. B45850429618).

8. R.J. Dickinson and J.C. Bass, Westinghouse Electric Corporation, "Pressurizer Safety Relief Valve Operation for Water Discharge during a Feedwater Line Break," WCAP-11677, January 1988 (TVA RIMS No. B26880308351).

9. Letter from J.W. Irons (Westinghouse) to W.L. Elliott (TVA), "NUREG-0737, Item II.D.1 - EPRI Safety and PORV Valve Testing - Response to NRC Questions," WAT-D-8937, July 31, 1992 (TVA RIMS No. T33920810930).

10. TVA Piping Analysis Calculation No. 0600200-13-03 R14 (TVA RIMS No. B26910328152).

11. Letter from J.W. Irons (Westinghouse) to W.L. Elliott (TVA), "Pressurizer Safety Valves - Outlet Loads Evaluation," WAT-D-8887, June 22, 1992 (TVA RIMS No. T33920629920).

12. Letter from E.A. Novotnak (Westinghouse) to E.R. Ennis (TVA), "Data Base for Motor Operated Valves," WAT-D-6874, February 24, 1986 (TVA RIMS No. B26890322304).

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14. Letter from E.G. Wallace (TVA) to U.S. Nuclear Regulatory Commission, "Generic Letter 90-06 - Resolution of Generic Issue (GI)-70, 'Power-Operated Relief Valve and Block Valve Reliability,' and GI-94, 'Additional Low-Temperature Overpressure Protection for Light-Water Reactors,' Pursuant to 10 CFR 50.54(f)," December 21, 1990 (TVA RIMS No. L44901220804).

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16. Letter from W.J. Museler (TVA) to U.S. Nuclear Regulatory Commission, "Watts Bar Nuclear Plant (WBN) Unit 1 - Proposed Technical Specifications (TS)," August 27, 1992 (TVA RIMS No. T04920827975).

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19. PWR Valve Program Staff, Electric Power Research Institute, "Safety and Relief Valve Test Report," EPRI-NP-2628-LD, Interim Report, September 1982.

20. "Evaluation of 6" PORV and Safety Valve Nozzles on the Pressurizer and the 12" Nozzle on the Pressurizer Relief Tank," TVA Calculation No. WCG-ACQ-0351 R0 (TVA RIMS No. B26910319151).

ENCLOSURE 3

Sketches of Piping Models Used for Fluid Transient Analyses

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

DEC 23 1988

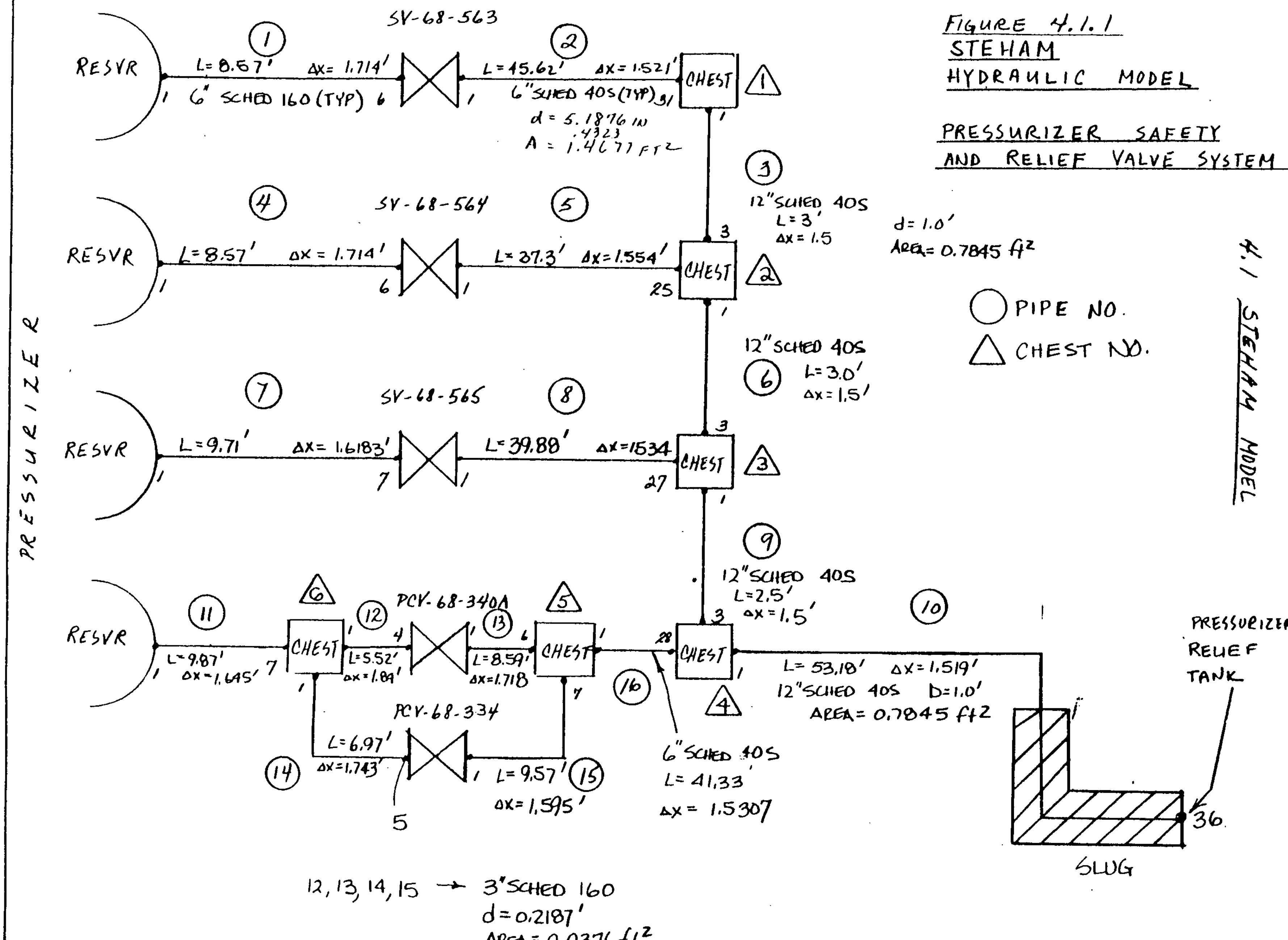
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	PAGE
17190.6005	NP(B)	11	N/A	16

CALCULATION IDENTIFICATION NUMBER

4.1 STEHAM MODEL

FIGURE 4.1.1
STEHAM
HYDRAULIC MODEL

PRESSURIZER SAFETY
AND RELIEF VALVE SYSTEM



4.1 (Cont'd)

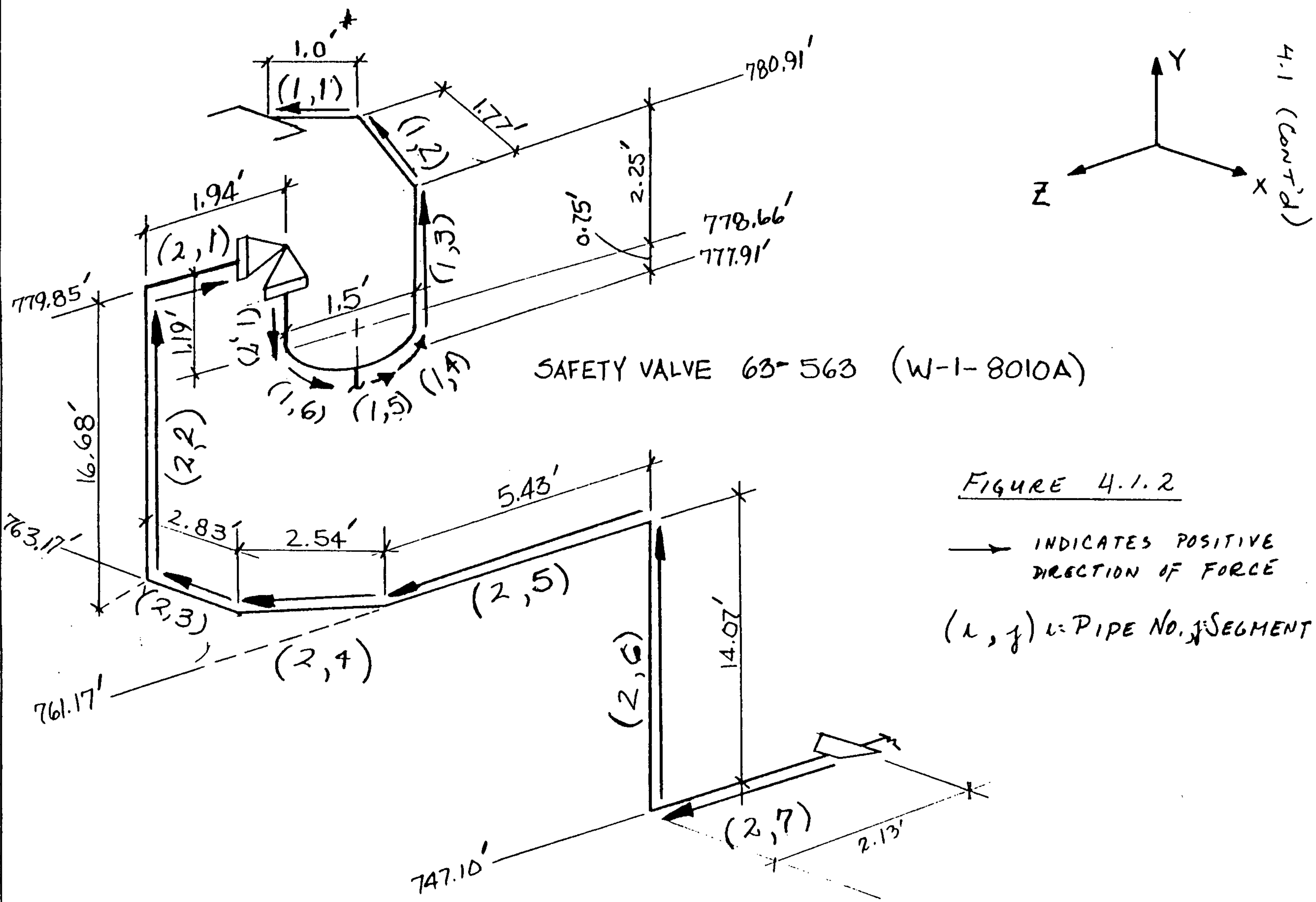


FIGURE 4.1.2

→ INDICATES POSITIVE DIRECTION OF FORCE

(i, j) i: PIPE No. j: SEGMENT No.

* ASSUMED

PIPES 1 AND 2

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

DEC 23 1988

5010.65

CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	PAGE
17190.6005	NP(B)	11	N/A	18

4.1 (CONT'd)

SAFETY VALVE 68-564 (W-1-8010B)

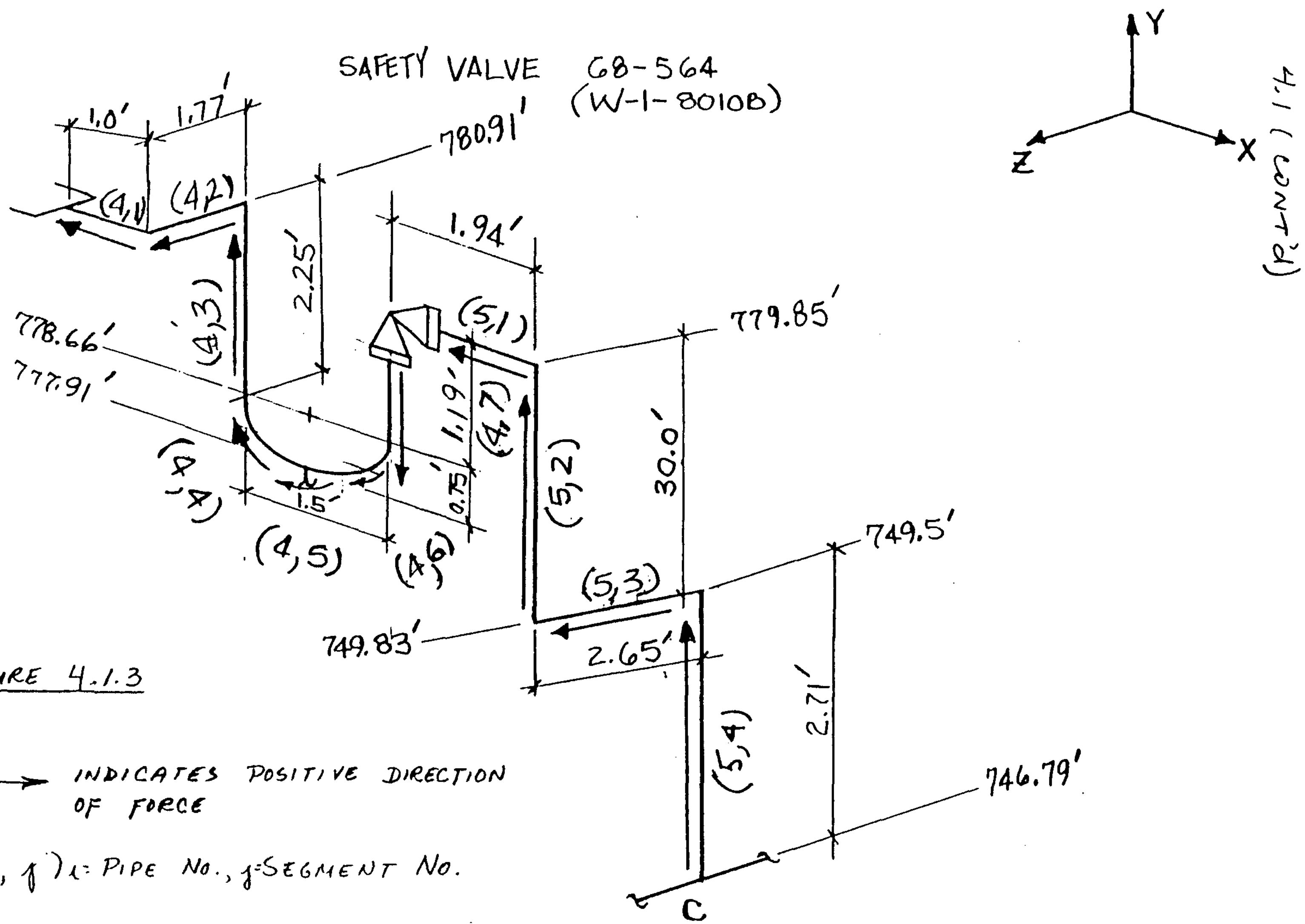


FIGURE 4.1.3

→ INDICATES POSITIVE DIRECTION OF FORCE

(i, j) i = PIPE No., j = SEGMENT No.

PIPES 4 AND 5

J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION IDENTIFICATION NUMBER: CALCULATION NO.	OPTIONAL TASK CODE	PAGE
17190.6005	NP(B)	11	N/A	19

4.1 (CONT'd)

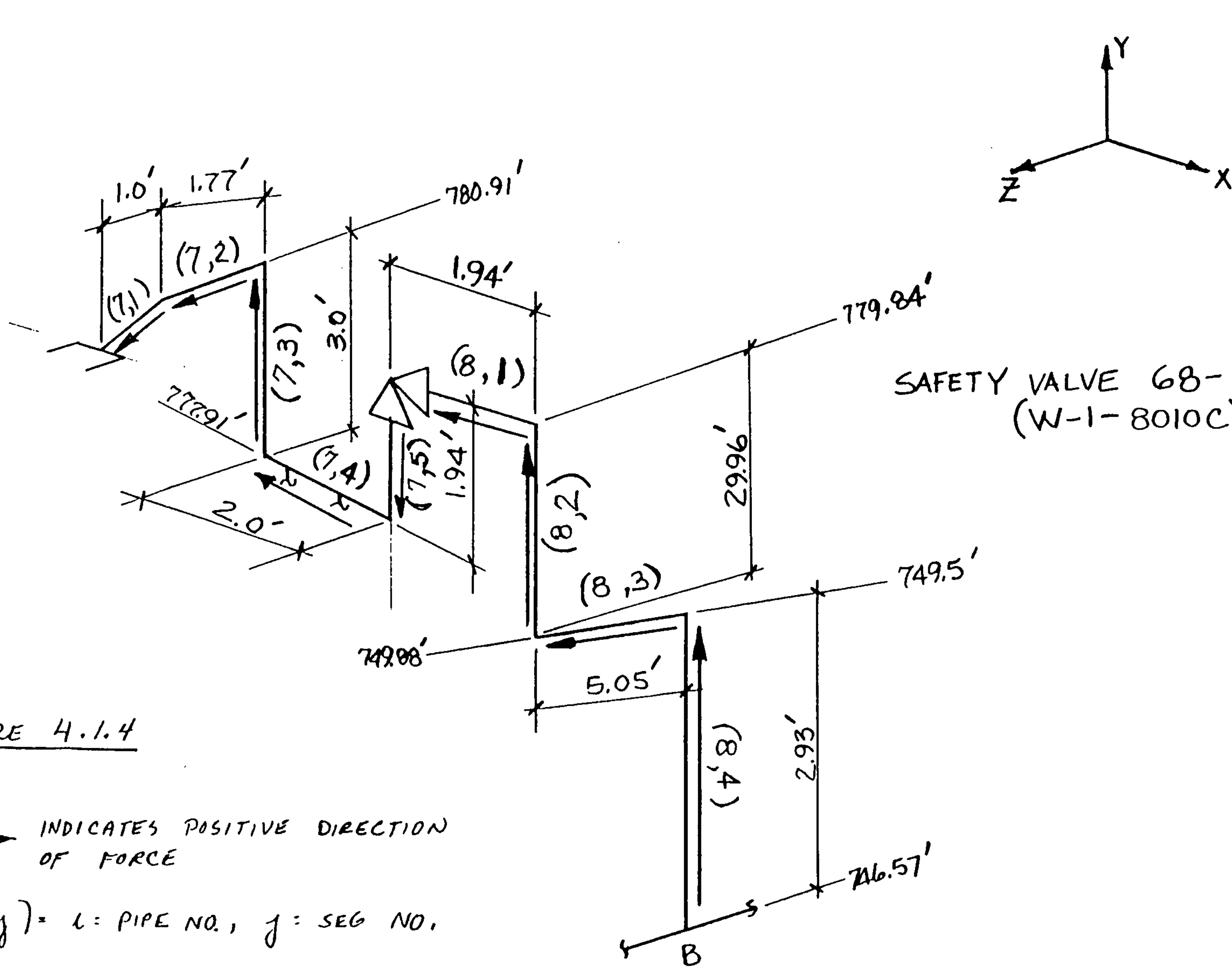


FIGURE 4.1.4

⟶ INDICATES POSITIVE DIRECTION OF FORCE

(i, j) = i: PIPE NO., j: SEG NO.

PIPES 7 AND 8

4.1 (CONT'd)

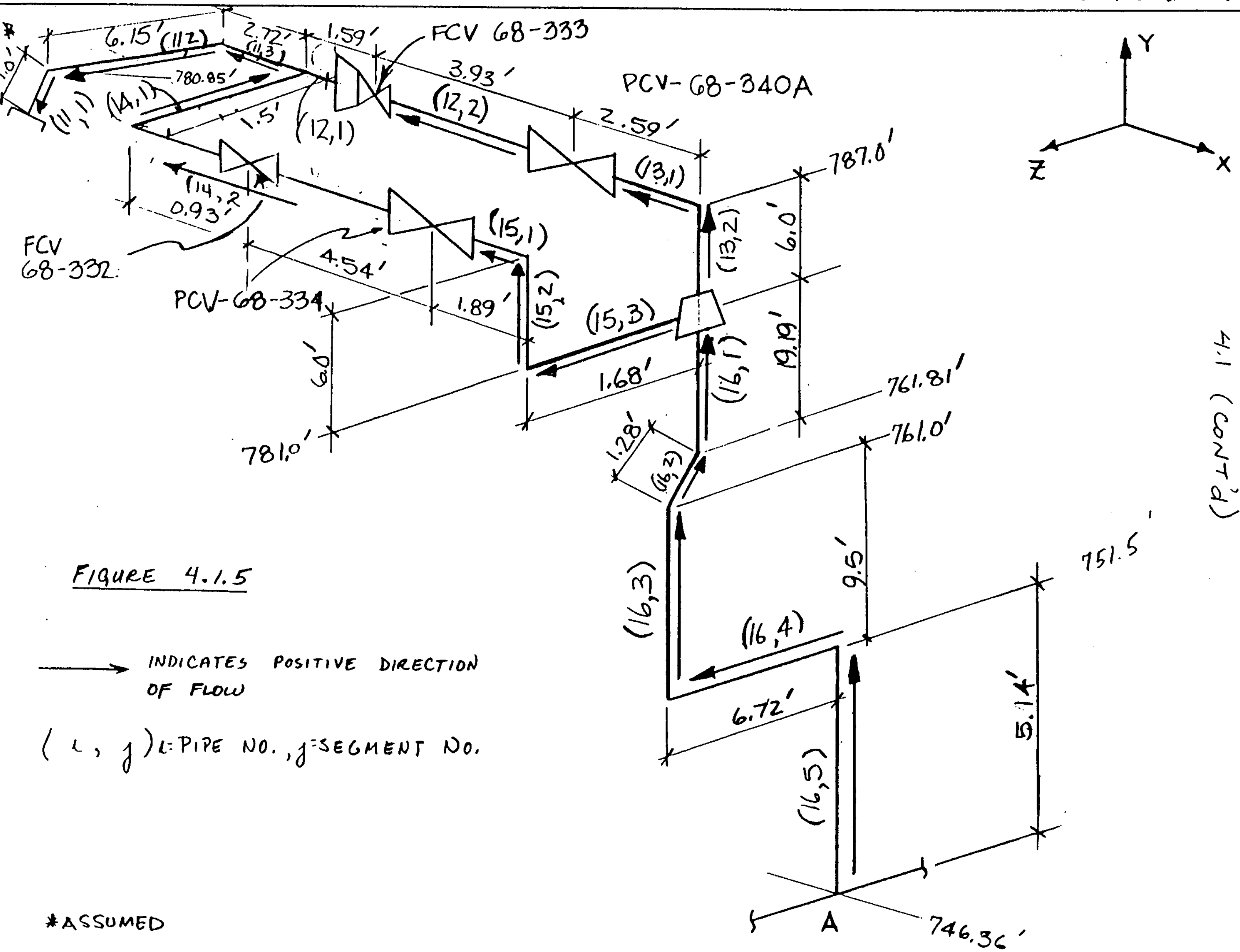


FIGURE 4.1.5

→ INDICATES POSITIVE DIRECTION OF FLOW

(i, j) i=PIPE NO., j=SEGMENT NO.

*ASSUMED

PIPES 11, 12, 13, 14 AND 15

4.1 (CONT'd)

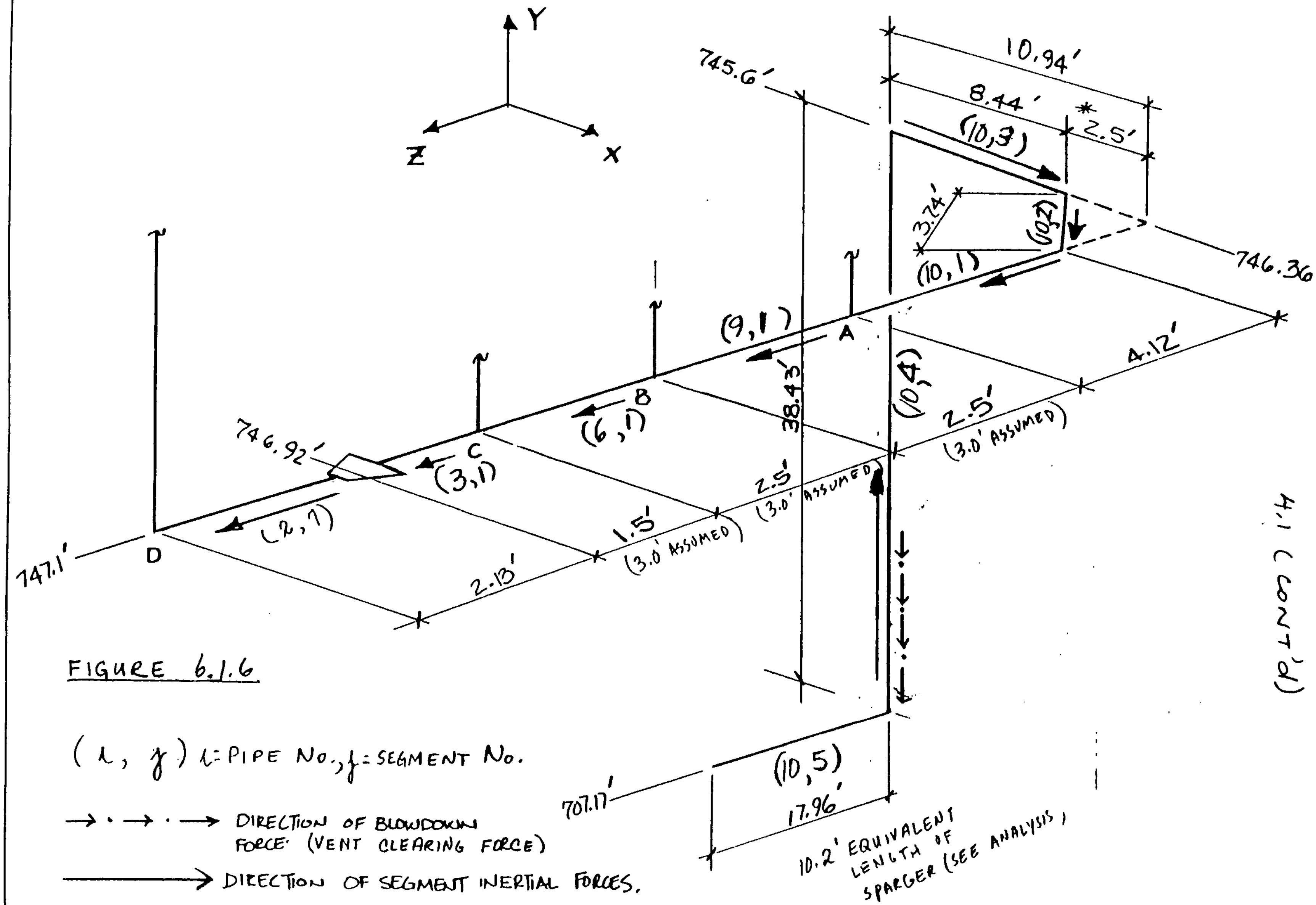


FIGURE 6.1.6

(i, j) i = PIPE No., j = SEGMENT No.

→ · → · → DIRECTION OF BLOWDOWN FORCE (VENT CLEARING FORCE)

⟶ DIRECTION OF SEGMENT INERTIAL FORCES.

* SCALED DIMENSION

PIPES 3, 6, 9 AND 10

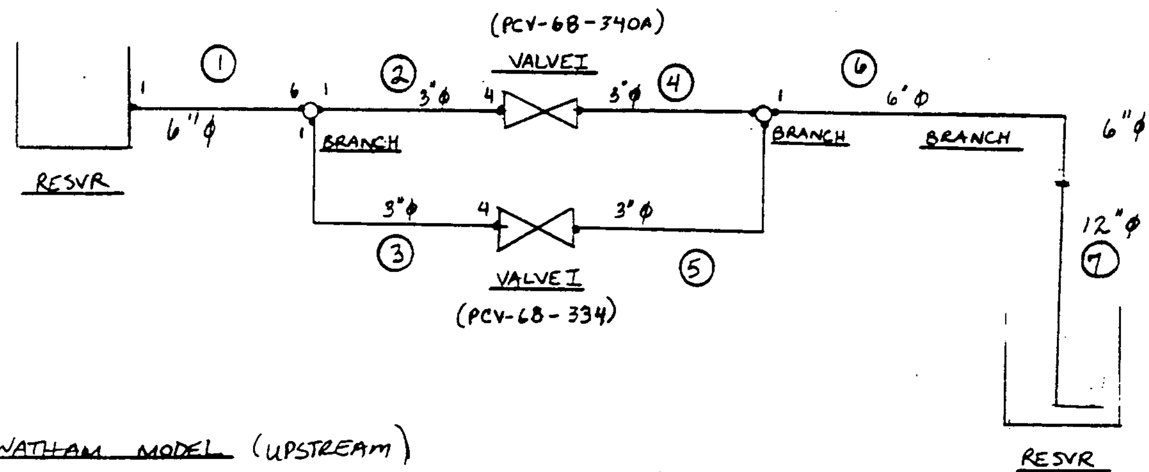
CALCULATION IDENTIFICATION NUMBER				PAGE 29
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	
17190.6005	NP(B)	11	N/A	

4.3 PIPING MODEL & PIPING ISOMETRIC

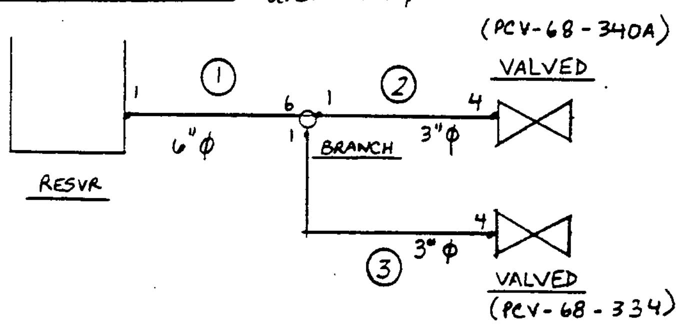
WATHAM LEGEND

•	= NODE NO.
—	= EQUIPMENT
(i)	i = PIPE NO.

WATHAM MODEL (UPSTREAM AND DOWNSTREAM)



WATHAM MODEL (UPSTREAM)



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CALCULATION SHEET

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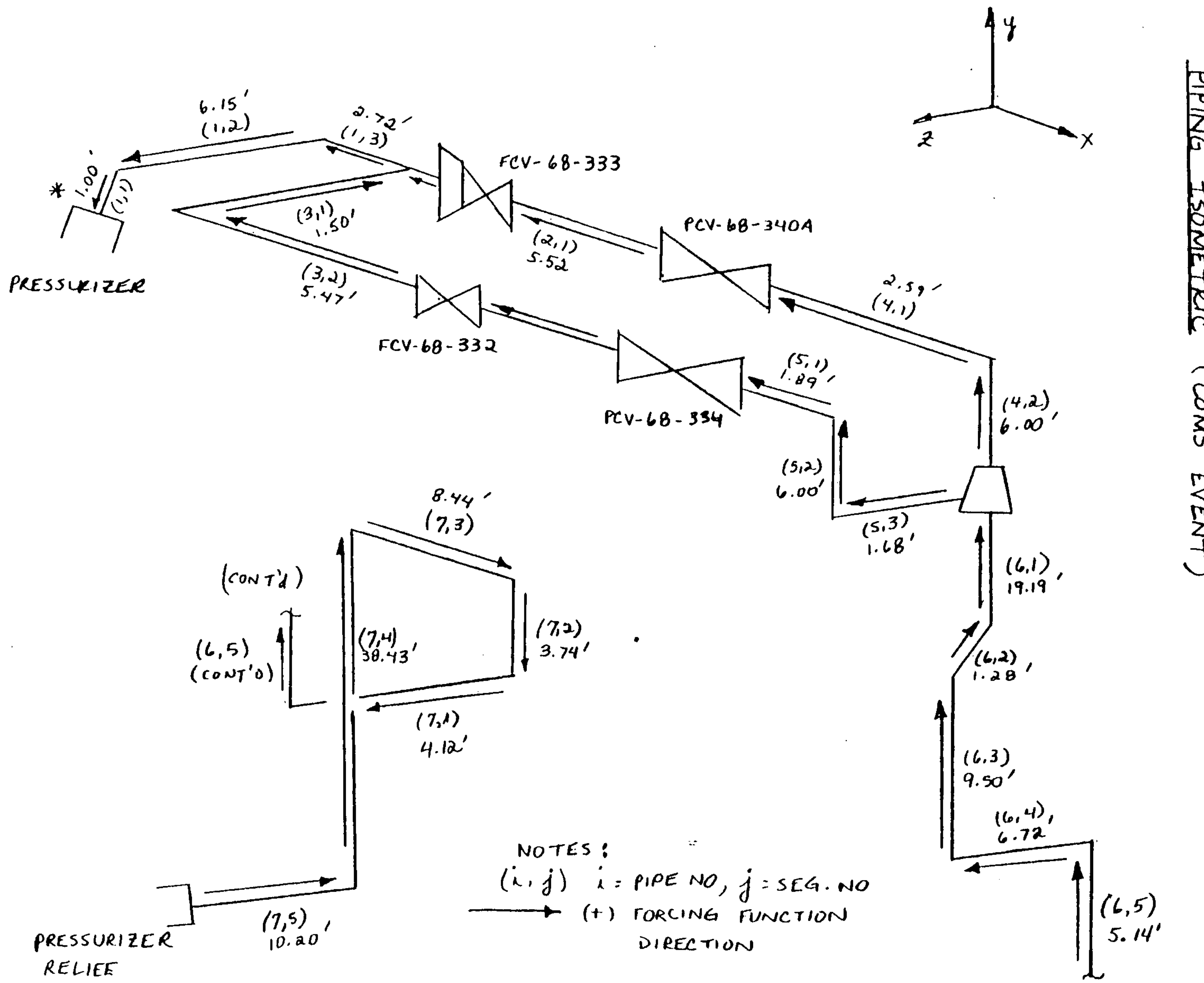
CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	PAGE
17190.6005	NP(B)	11	N/A	30

4.3 (CONT'D)

PIPING ISOMETRIC (COMS EVENT)



NOTES:

(i, j) i = PIPE NO, j = SEG. NO

⟶ (+) FORCING FUNCTION DIRECTION

* INCREASED TO 1.50' FOR MODELING

ENCLOSURE 4

Maximum Inertial Forces Applied to Pipe Segments for Fluid Transient Cases

***** MAXIMUM SEGMENT INERTIAL FORCES *****

CASE 1 - RV OPENING

PIPE NO.	SEGMT NO.	INERTIAL FORCE (LBF)	TIME (SEC)	NUPIPE CURVE NO.
1	1	1.41	0.00270	1
	2	2.06	0.00340	2
	3	2.16	0.00480	3
	4	0.73	0.00550	4
	5	0.53	0.00610	5
	6	0.47	0.00610	6
	7	0.20	0.00610	7
2	1	-4.70	0.08620	8
	2	282.93	0.48877	9
	3	66.05	0.48337	10
	4	60.85	0.48157	11
	5	134.76	0.47797	12
	6	368.04	0.47077	13
	7	65.49	0.46297	14
3	1	141.51	0.45817	15
4	1	1.41	0.00270	16
	2	2.06	0.00340	17
	3	2.16	0.00480	18
	4	0.73	0.00550	19
	5	0.53	0.00610	20
	6	0.47	0.00610	21
	7	0.20	0.00610	22
5	1	-4.56	0.07620	23
	2	505.82	0.47977	24
	3	58.53	0.46657	25
	4	62.04	0.46417	26
6	1	246.03	0.45637	27
7	1	1.42	0.60826	28
	2	2.04	0.00340	29
	3	2.86	0.00550	30
	4	1.62	0.00670	31
	5	0.65	0.00670	32
8	1	-3.87	0.07420	33
	2	441.15	0.47917	34
	3	86.41	0.46897	35
	4	52.71	0.46657	36
9	1	317.36	0.45517	37

***** MAXIMUM SEGMENT INERTIAL FORCES *****

CASE 2 - RV CLOSING

PIPE NO.	SEGMT NO.	INERTIAL FORCE (LBF)	TIME (SEC)	NUPIPE CURVE NO.
1	1	-0.86	0.06890	1
	2	-0.79	0.06950	2
	3	-0.57	0.29799	3
	4	-0.19	0.29889	4
	5	-0.12	0.29979	5
	6	-0.12	0.29979	6
	7	-0.05	0.29979	7
2	1	1.05	0.07490	8
	2	76.00	0.07730	9
	3	21.30	0.08280	10
	4	20.54	0.08420	11
	5	47.56	0.08630	12
	6	140.06	0.09190	13
	7	23.08	0.09610	14
3	1	33.90	0.09400	15
4	1	-0.86	0.06890	16
	2	-0.79	0.06950	17
	3	-0.57	0.29799	18
	4	-0.19	0.29889	19
	5	-0.12	0.29979	20
	6	-0.12	0.29979	21
	7	-0.05	0.29979	22
5	1	0.74	0.00060	23
	2	79.29	0.00600	24
	3	12.38	0.01620	25
	4	13.56	0.09190	26
6	1	51.28	0.09120	27
7	1	-0.71	0.18500	28
	2	-0.78	0.12900	29
	3	-0.61	0.13040	30
	4	-0.27	0.02280	31
	5	0.15	0.30429	32
8	1	0.71	0.00060	33
	2	85.63	0.00720	34
	3	23.69	0.01800	35
	4	13.95	0.01860	36
9	1	66.54	0.08770	37

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6. SUMMARY OF RESULTS (CONT'D)
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CASE 1 - (CONT'D)

PIPE NO.	SEGMT NO.	INERTIAL FORCE (LBF)	TIME (SEC)	NUPIPE CURVE NO.
10	1	467.31	0.45337	38
	2	440.28	0.45097	39
	3	990.06	0.44557	40
	4	3856.67	0.42218	41
	5	* 5430.30	0.40298	42
11	1	145.40	0.01690	43
	2	804.29	0.01960	44
	3	299.98	0.02110	45
12	1	224.91	0.00610	46
13	1	106.93	0.00270	47
	2	-332.90	0.16269	48
14	1	69.33	0.02500	49
	2	216.11	0.02560	50
15	1	75.85	0.00270	51
	2	215.52	0.00610	52
	3	-109.85	0.18869	53
16	1	1176.83	0.02110	54
	2	164.03	0.02440	55
	3	949.17	0.02920	56
	4	787.92	0.03460	57
	5	679.62	0.03820	58
VERTICAL BLOWDOWN FORCE (LBS)		2721.	0.25919	1079
RUN NO. / JOB NO.		391801B / #9077	N/A	N/A

CASE 2 (CONT'D)

PIPE NO.	SEGMT NO.	INERTIAL FORCE (LBF)	TIME (SEC)	NUPIPE CURVE NO.
10	1	-126.61	0.08910	38
	2	-112.00	0.09050	39
	3	-244.38	0.09330	40
	4	-1006.44	0.10170	41
	5	* -253.49	0.11710	42
11	1	-112.33	0.02520	43
	2	-657.42	0.02520	44
	3	-255.08	0.02700	45
12	1	-207.05	0.05990	46
13	1	-96.41	0.05930	47
	2	-243.28	0.06110	48
14	1	-67.99	0.02880	49
	2	-218.30	0.02940	50
15	1	-70.06	0.05930	51
	2	-239.95	0.06050	52
	3	-73.00	0.06290	53
16	1	-1307.13	0.06470	54
	2	-76.13	0.07430	55
	3	-521.58	0.07610	56
	4	-344.63	0.08150	57
	5	-502.03	0.05880	58
VERTICAL BLOWDOWN FORCE (LBS)	—	N/A	N/A	N/A
RUN NO. / JOB NO.	—	391801D / #1448	N/A	N/A

* SPURIOUS FORCE DUE TO STEHAM MODELING LIMITATION (SEE MODELING ASSUMPTION 3.3.8)

6. SUMMARY OF RESULTS

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***** MAXIMUM SEGMENT INERTIAL FORCES *****

CASE 3 - SV OPENING

PIPE NO.	SEGMT NO.	INERTIAL FORCE (LBF)	TIME (SEC)	NUPIPE CURVE NO.
1	1	766.06	0.01060	1
	2	1325.03	0.01010	2
	3	1415.50	0.00960	3
	4	434.08	0.00910	4
	5	365.98	0.00810	5
	6	359.76	0.00410	6
	7	555.83	0.00290	7
2	1	1195.10	0.00230	8
	2	6439.96	0.00910	9
	3	3018.67	0.01310	10
	4	2867.39	0.01460	11
	5	4341.26	0.01660	12
	6	4328.31	0.01960	13
	7	2304.91	0.02610	14
3	1	1092.86	0.02760	15
4	1	766.96	0.01060	16
	2	1327.04	0.01010	17
	3	1416.93	0.00960	18
	4	434.45	0.00910	19
	5	366.17	0.00810	20
	6	359.81	0.00410	21
	7	555.84	0.00290	22
5	1	1182.02	0.00230	23
	2	6171.48	0.00910	24
	3	2545.12	0.02010	25
	4	2411.35	0.02160	26
6	1	1399.44	0.03160	27
7	1	757.57	0.01110	28
	2	1302.34	0.01110	29
	3	1772.48	0.01060	30
	4	891.84	0.00510	31
	5	901.87	0.00290	32
8	1	1187.96	0.00230	33
	2	6222.93	0.00910	34
	3	3499.41	0.02060	35
	4	2496.95	0.02310	36
9	1	1733.21	0.02560	37

***** MAXIMUM SEGMENT INERTIAL FORCES *****

CASE 4 - SV CLOSING

PIPE NO.	SEGMT NO.	INERTIAL FORCE (LBF)	TIME (SEC)	NUPIPE CURVE NO.
1	1	-943.13	0.01190	1
	2	-1535.67	0.01120	2
	3	-1531.61	0.00980	3
	4	-471.67	0.00910	4
	5	-413.79	0.00840	5
	6	-408.13	0.00840	6
	7	-594.16	0.00770	7
2	1	-931.21	0.00770	8
	2	-5324.49	0.00980	9
	3	-836.15	0.01680	10
	4	-711.92	0.01820	11
	5	-1403.53	0.02030	12
	6	-2913.98	0.02590	13
	7	-438.33	0.02940	14
3	1	-463.96	0.03710	15
4	1	-943.96	0.01190	16
	2	-1537.39	0.01120	17
	3	-1533.61	0.00980	18
	4	-472.14	0.00910	19
	5	-414.04	0.00840	20
	6	-408.34	0.00840	21
	7	-594.32	0.00770	22
5	1	-929.88	0.00770	23
	2	-5387.57	0.01050	24
	3	-669.05	0.02590	25
	4	-729.24	0.02590	26
6	1	-670.53	0.03710	27
7	1	-950.17	0.01260	28
	2	-1527.16	0.01190	29
	3	-1931.34	0.01050	30
	4	-993.93	0.00840	31
	5	-959.52	0.00770	32
8	1	-929.51	0.00770	33
	2	-5413.19	0.01050	34
	3	-1097.57	0.02590	35
	4	-707.45	0.02730	36
9	1	-1047.93	0.03430	37

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6. SUMMARY OF RESULTS (CONT'D)

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CASE 3 (CONT'D)					CASE 4 (CONT'D)				
PIPE NO.	SEGMT NO.	INERTIAL FORCE (LBF)	TIME (SEC)	NUPIPE CURVE NO.	PIPE NO.	SEGMT NO.	INERTIAL FORCE (LBF)	TIME (SEC)	NUPIPE CURVE NO.
10	1	1327.93	0.02910	38	10	1	-1083.70	0.03710	38
	2	1233.27	0.03210	39		2	-945.90	0.03920	39
	3	2655.14	0.03960	40		3	-1991.04	0.04200	40
	4	7983.53	0.27939	41		4	-6280.41	0.05460	41
	5	* 14320.87	0.26319	42		5	*-1415.34	0.06580	42
11	1	-1.71	0.03510	43	11	1	-0.64	0.19950	43
	2	6.52	0.00810	44		2	1.54	0.13510	44
	3	3.09	0.00610	45		3	2.18	0.18200	45
12	1	1.10	0.01210	46	12	1	-0.48	0.18200	46
13	1	-38.09	0.06370	47	13	1	4.79	0.06090	47
	2	-154.25	0.06190	48		2	45.68	0.06090	48
14	1	-0.61	0.11710	49	14	1	0.29	0.17570	49
	2	1.02	0.01260	50		2	0.29	0.07700	50
15	1	-21.21	0.06430	51	15	1	2.76	0.06160	51
	2	-137.94	0.06250	52		2	40.53	0.06160	52
	3	-47.40	0.06010	53		3	17.23	0.06090	53
16	1	-1286.68	0.05410	54	16	1	730.61	0.05530	54
	2	-127.12	0.04410	55		2	62.07	0.05040	55
	3	-762.01	0.04210	56		3	491.77	0.04690	56
	4	-515.98	0.03410	57		4	394.64	0.04130	57
	5	-380.15	0.02910	58		5	302.38	0.03710	58
VERTICAL BLOWDOWN FORCE (LBF)		6763.	0.1684	1079	—		N/A	N/A	
Run No.		391803A			391803D				
HASP#		#7496	—	—	#590				

* SPURIOUS FORCE DUE TO STEHAM MODELING LIMITATIONS. (SEE MODELING ASSUMPTION 3.3.8)

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6. SUMMARY OF RESULTS

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***** MAXIMUM SEGMENT INERTIAL FORCES *****

CASE 5 COMS RV CLOSING (UPSTREAM PP6)

PIPE NO.	DIAM (IN)	SCALE FACTOR	SEGMT NO.	SEGMENT LENGTH (FT)	INERTIAL FORCE (LBF)	TIME (SEC)	UNIT FORCE (LBF/FT)	NUPIPE CURVE NO.
1	5.1876	1.000	1	1.500	1517.00	0.17550	1011.33	1
			2	6.150	2643.03	0.14800	429.76	2
			3	2.720	-1019.65	0.08750	-374.87	3
2	2.6244	1.000	1	5.520	-777.00	0.06000	-140.76	4
3	2.6244	1.000	1	1.500	440.94	0.18900	293.96	5
			2	5.470	-662.43	0.06000	-121.10	6

R3918809
HASP# 6235 dated 12-20-88

6. SUMMARY OF RESULTS

17190.6005-NP(B)-11

DEC 23 1988

pg. 43

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

DEC 2 8 1988

▲ 5010.65

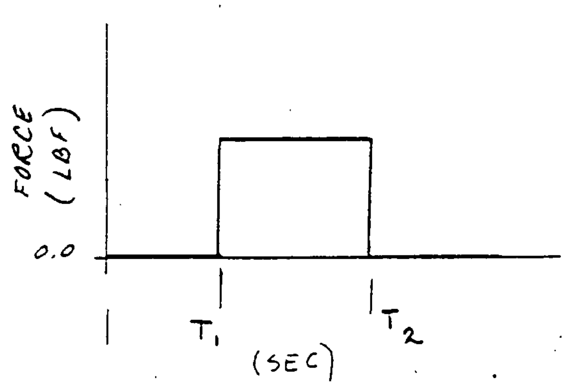
CALCULATION IDENTIFICATION NUMBER				PAGE 44
J.O. OR W.O. NO.	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	
17190.6005	NP(B)	11	N/A	

6. SUMMARY OF RESULTS (CASE 6)

COMS - RV OPENING (DOWNSTREAM PIPING)

PIPE NO.	SEGMENT NO.	FORCE (lbf)	T_1 = START TIME (SEC)	T_2 = STOP TIME (SEC)
4	1	335	0.000	0.038
	2	↓	0.038	0.127
5	1	425	0.000	0.025
	2	↓	0.025	0.104
	3	↓	0.104	0.126
6	1	287	0.127	0.835
	2	↓	0.835	0.882
	3	↓	0.882	1.232
	4	↓	1.232	1.480
	5	↓	1.480	1.670
7	1	73	1.670	2.264
	2	↓	2.264	2.803
	3	↓	2.803	4.019
	4	↓	4.019	9.556
	5	↓	9.556	11.026

APPLICATION OF FORCES:



ENCLOSURE 5

Excerpt from Design Criteria WB-DC-40-31.7

QA Record T29 920706 821

TVA
TENNESSEE VALLEY AUTHORITY

TENNESSEE VALLEY AUTHORITY
DIVISION OF NUCLEAR ENGINEERING

NE NUCLEAR ENGINEERING

DESIGN CRITERIA

NUMBER WB-DC-40-31.7

WATTS BAR NUCLEAR PLANT

TITLE: ANALYSIS OF CATEGORY I AND I(L) PIPING SYSTEMS

* See previous revisions for original signatures

	REVISION 0	R15	R16	R17
EFFECTIVE DATE	1-30-76	8-12-91	JUL 06 1992	
PREPARED	K.G. FRAZIER	*	WRBibb	
CHECKED	T.C. CRUISE	*	S.E. [illegible]	
REVIEWED	P.A. EVENS	*	[illegible]	
APPROVED	W.A. ENGLISH	*	[illegible]	
ACCEPTED	R.G. DOMER	*	WL Elliott	

Total 73 Pages

Table 3.2-1 LOAD SOURCES

LOAD CASES	DESCRIPTION	LOAD SYMBOL
BS	Building Settlement	BS
CS	Cold Spring	CS
DW	Deadweight	DW
ML	Mechanical Loads Normal, Upset: BL + PL Faulted, Test: BC + BL + PL	ML
	Load on SCV Bellows Due to SCV Internal Pressure.	BC
	Pressure Load on Untied Bellows	BL
	Preload (additional loads imposed on the piping by spring supports, constant force supports, and bellows precompression).	PL
	PRESSURES	
P_d	Design Pressure	P
P_o	Range of Operating Pressure	P_o
P_s	Max. Service Pressure	P_s
P_T	Maximum Test Pressure	P_T
	SEISMIC	
OBE	OBE inertia	E1
SSE	SSE inertia	E2
OBESAM	OBE Seismic Anchor Motion	EDO
SSESAM	SSE Seismic Anchor Motion	EDS

Table 3.2-1 LOAD SOURCES (Continued)

LOAD CASES	DESCRIPTION	LOAD SYMBOL
	Thermal	
THi	Thermal Mode, including Anchor Movement (i = mode number) (Normal, Upset)	Ti
THTi	Thermal Test Mode, (i = mode number)	TTi
THFi	Thermal Faulted Mode (i = mode number)	TFi
TH	Envelope of Ti	TE
THT	Envelope of TFi	TTE
THF	Envelope of TFi and Ti	TFE
SCVTHM	Thermal Anchor Point Movements of SCV (Normal Oper. Conditions)	SD
DT1	Linear Thermal Gradient (Class 1 only)	TL
DT2	Nonlinear Thermal Gradient (Class 1 only)	TN
TATB	Thermal Discontinuity (Class 1 only)	TD
	PIPE RUPTURE	
JET	Loads due to jet impingement (JIT or JIS)	JET
	Jet Impingement (Transient)	JIT
	Jet Impingement (Steady State)	JIS
PW	Pipe Whip	PW
WHB	Water Hammer due to pipe break (Faulted)	WHB

Table 3.2-1 LOAD SOURCES (Continued)

LOAD CASES	DESCRIPTION	LOAD SYMBOL
	DBA	
DBA	Inertia effects associated with a DBA (SCV only)	EA
LOCA	LOCA Motion of the RCL	LM
SCVDBM	Steel Containment Vessel Movements due to DBA: (CP + CT) or DM	
	Maximum Pressure Movements	CP
	Thermal Movement (Envelope of CTA1 and CTA2)	CT
	Movement occurring 2000 seconds after the postulated DBA begins (after ice melt down).	CTA1
	Movement occurring 60000 seconds after the postulated DBA begins (after ice melt down).	CTA2
	Containment Pressure Pulse Movement consisting of:	DM
	Radial Movement	DMR
	Vertical Movement	DMV
	Tangential Movement	DMT
SCVMVT	Total Steel Containment Vessel Movement (CP + CT) or (SD + DM)	

Table 3.2-1 LOAD SOURCES (Continued)

LOAD CASES	DESCRIPTION	LOAD SYMBOL
	VALVE THRUST	
VT	Valve Thrust (VTT or VTS)	
	Valve Thrust (Transient)	VTT
	Valve Thrust (Steady State)	VTSi
	Envelope of VTSi	VTS
	OTHER LOADS	
WHU	Water Hammer or similar dynamic load source (Upset).	WHU
WHE	Water Hammer or similar dynamic load source (Emergency)	WHE
WHF	Water Hammer or similar dynamic load source (Faulted)	WHF
WINDU	Wind (Upset, Emergency)	W1
WINF	Wind (Faulted)	W2

Table 4.1-1 STRESS CRITERIA FOR ASME CLASS 1 PIPING

CONDITION	NB-3650 EQUATIONS	STRESS LIMITS	LOADING EQUATION [1,2]
Primary Stress			
DESIGN (Normal, Upset)	9	$1.5S_m$	P_d+DW+ML[3]+OBE
			P_d+DW+ML[3]+WHU+VT[10]
EMERGENCY	9	$2.25S_m$	P_s[4]+DW+ML[3]+SRSS(OBE,WHE)+VT[10]
FAULTED	9	$3.0S_m$	P_s[5]+DW+ML[3]+SRSS(SSE,WHF)+VT[10]
			P_s[5]+DW+ML[3]+SRSS(SSE,(DBA+LOCA[11]))
			P_s[5]+DW+ML[3]+SSE
			P_s[5]+DW+ML[3]+WHB
			P_s[5]+DW+ML[3]+JET[11]
			P_s[5]+DW+ML[3]+PW[11]
Primary & Secondary Stress[6]			
NORMAL and UPSET			
	10	3.0Sm	P_o+SRSS[12](OBE,OBESAM)+THi+SCVTHM+TATB+DT1
			P_o+WHU+VT[10]+THi+SCVTHM+TATB+DT1
	11	See Note 7	P_o+SRSS[12](OBE,OBESAM)+THi+SCVTHM+TATB+DT1+DT2
			P_o+WHU+VT[10]+THi+SCVTHM+TATB+DT1+DT2
If (10) is not met, then evaluate (12) and (13)			
	12	$3.0S_m$	THi+SCVTHM
	13	$3.0S_m$	P_o+DW+ML[3]+OBE+TATB
			P_o+DW+ML[3]+WHU+VT[10]+TATB
Cold Spring	NB-3672.8	$2.0S_m$	CS[8]

Table 4.1-1 (Continued) STRESS CRITERIA FOR ASME CLASS 1 PIPING

CONDITION	STRESS LIMITS	LOADING EQUATION [1,2]
Testing (NB-3226)[9]		
PRIMARY MEMBRANE	$0.9S_y$	P_T
PRIMARY MEMBRANE and BENDING	$1.35S_y$	P_T+DW+ML[3]
Pressure Design (NB-3640, 3655, 3656)	PRESSURE LIMITS	
DESIGN	P_A	P
UPSET	P_A	P_s
EMERGENCY	1.5 P_A	P_s
FAULTED	2.0 P_A	P_s

Nomenclature

D_o = Outside diameter of pipe.

P_A = Maximum allowable internal pressure = $\dfrac{2\,S_m\,t'}{D_o - 2yt'}$

= Design Pressure (rounded to higher 10) for reinforced branch connections.

S_m = Allowable design stress intensity value at temperature.

S_y = Yield stress at temperature.

t' = Nominal wall thickness minus the allowances for material removed in threading, corrosion or erosion allowances, manufacturing tolerances, bending allowance, or material to be removed by counterboring.

y = 0.4

Notes for Table 4.1-1

1. Loading Equations:
   a. The worst loading equation for each condition will meet the stress limits.
   b. Combine results from directional loads by algebraic summation. Results due to reversing loads are combined with results of other load cases by absolute summation unless otherwise noted.
   c. Wind loads are not considered, since all Class 1 piping is inside containment.

2. The secondary load sources resulting from the SCV movements due to DBA will be evaluated for piping which penetrates or is supported from the SCV.

3. Stresses will be combined such that the stress due to load case BC or BL does not relieve the stress resulting from other load sources.

4. Pressure for the emergency condition is limited by Code sub-paragraph NB-3655.1.

5. Pressure for the faulted condition must meet the limits established by Appendix F, sub-article F-1360, of the ASME Code.

6. The range of pressure, temperature, moment between two load sets is used in the calculations. Non-cyclic loads such as VT steady-state and sustained mechanical load need not be considered in the range loading. Dynamic loads (WH & VT) need not be considered acting concurrently with the earthquake loading. See NB-3653.1 for additional description.

7. S_{ALT} for all load-sets shall be calculated in accordance with NB-3653.3 or Equation (14). Using the alternative stress-intensity values calculated by the above procedures, determine the cumulative usage factor in accordance with NB-3653.4 and NB-3653.5. The cumulative usage factor shall not exceed 1.0.

8. Cold spring loads must be considered in load evaluation on supports and equipment. Use of cold spring shall be limited by the requirements of sub-paragraph NB-3672.8 of ASME Section III.

9. If there are more than 10 hydrostatic, pneumatic or other tests, then such extra tests shall be considered in the fatigue evaluation of the component.

10. Valve thrust (VT) loads are assumed to be concurrent with Water Hammer loads (WH). If VT and WH are not concurrent, the loading equation may be modified to consider only the worse of the two events:
    VTT (transient) will be combined with other occasional loads by SRSS.
    VTS (steady-state) will be combined with other occasional loads by ABSUM.

11. Jet Impingement (JET) and Pipe Whip (PW) loads will be combined with LOCA by SRSS if the break is in the Reactor Coolant System pressure boundary.

12. Absolute summation of OBE and OBESAM shall be used if single zone method of response spectrum analysis technique is used.

Table 4.1-2

STRESS CRITERIA FOR ASME CLASS 2, 3 AND OTHER TVA LOWER CLASS CATEGORY I PIPING

CONDITION	NC-3652 EQUATIONS[2]	STRESS LIMITS	PRESSURE		LOADING EQUATIONS[1] SUSTAINED + OCCASIONAL		EXPANSION
NORMAL (Pressure + Sustained)	8	1.0Sh	Pd	+	DW+ML[3]		
UPSET (Pressure[4]+ Sustained + Occasional)	9	1.2Sh	Pd	+	DW+ML[3] +SRSS[11] (OBE, OBESAM[5])		
			Pd	+	DW+ML[3]+WHU+VT[6]		
EMERGENCY (Pressure[4]+ Sustained + Occasional)	9	1.8Sh	Pd	+	DW+ML[3] +SRSS(OBE,WHE)+VT[6]		
FAULTED (Pressure[4]+ Sustained + Occasional + DBA)	9	2.4Sh	Pd	+	DW+ML[3] +SRSS(SSE,WHF)+VT[6]		
			Pd	+	DW+ML[3] +SRSS[SSE,(DBA+LOCA[8])]		
			Pd	+	DW+ML[3] +WHB		
			Pd	+	DW+ML[3] +JET[8]		
			Pd	+	DW+ML[3] +PW[8]		
SECONDARY (Expansion)	10	S_A					(THi+SCVTHM)[9] + OBESAM[5]
or							
(Pressure + Sustained + Expansion)	11	S_A + Sh	Pd	+	DW+ML[3]	+	(THi+SCVTHM)[9] + OBESAM[5]
			Pd	+	DW+ML[3]		
(One Time Secondary)	10A	3.0Sc				- - -	BS+SCVDBM
(Cold Spring)	NA	0.5(S_A+Sh)					CS
TEST							
(Pressure[7] + Sustained + Test)	NA	1.2Sh	PT	+	DW+ML[3]		
(Secondary)	NA	S_A					THTi
or							
(Pressure[7]+ Sustained + Test + Sec.)	NA	S_A+ Sh	PT	+	DW+ML[3]	+	THTi

Nomenclature

S_h = Basic material allowable stress at design temperature, psi
S_A = Allowable expansion stress per NC-3611, psi
S_c = Basic material allowable stress at minimum (cold) temperature, psi

NA = Not Applicable

NOTES FOR TABLE 4.1-2

1. Loading Equations:

   a. Worst loading equation for each condition will meet the stress limits.

   b. Combine results from directional loads by algebraic summation. Results due to reversing loads are combined with results of other load cases by absolute summation unless otherwise noted.

2. All Code references are for ASME code, subsection NC for Class 2 piping. The corresponding equations in ASME Code, subsection ND and ANSI B31.1 for Class 3 and lower class piping should be used as applicable.

3. Stresses will be combined such that the stress due to load case BC or BL does not relieve the stress resulting from other load sources.

4. In accordance with ASME III and the design specifications, design pressure is used in Equation 9 since peak pressure and earthquake need not be taken as acting concurrently.

5. For piping stress evaluation, OBESAM stress shall be included in equations 10 & 11. However, if equations 10 and 11 are not satisfied, then OBESAM stresses shall be included in equations (9U). For lug stress evaluation (Table 4.1-5), OBESAM stresses shall always be included in secondary and in secondary plus sustained conditions.

6. Valve Thrust (VT) loads are assumed to be concurrent with Water Hammer Loads (WH). If VT and WH are not concurrent, the loading equation may be modified to consider only the worse of the two events:
   VTT (transient) will be combined with other occasional loads by SRSS
   VTS (steady-state) will be combined with other occasional loads by ABSUM

7. It is not necessary to use hydrostatic test pressure when evaluating stress due to other test conditions. However, design pressure should be used unless it is determined that the test condition does not occur simultaneously with internal pressure.

8. Jet Impingement (JET) and Pipe Whip (PW) loads will be combined with LOCA by SRSS if the break is in the Reactor Coolant System pressure boundary.

9. Thermal loads will represent the range of the thermal modes and thermal modes plus anchor point movements of the SCV.

10. If wind loads are acting on the piping they must be considered in the evaluation of primary stresses. The loading need not be considered acting concurrently with earthquake or any other dynamic event.

11. Absolute summation of OBE and OBESAM shall be used if single zone method of response spectrum analysis technique is used.

Table 4.1-4

SUPPORT DESIGN LOAD FOR CATEGORY I PIPE SUPPORTS

LOADING CONDITIONS	SUPPORT LOAD EQUATION[4]
Normal	DW+ML[2] + TH+SCVTHM+CS+BS
Upset	DW+ML[2]+TH+SCVTHM+CS+SRSS[10](OBE,OBESAM) DW+ML[2]+TH+SCVTHM+CS+WHU+VT[7]
Emergency	DW+ML[2]+TH+SCVTHM+CS+SRSS(OBE[10], OBESAM[10],WHE)+VT[7]
Faulted	DW+ML[2]+THF+SCVMVT+CS+SRSS(SSE[10], SSESAM[10],WHF)+VT[7] DW+ML[2]+THF+SCVMVT+CS+SRSS[SSE[10], SSESAM[10], (DBA+LOCA[8])] DW+ML[2]+THF+SCVMVT+CS+WHB DW+ML[2]+THF+SCVMVT+CS+JET[8] DW+ML[2]+THF+SCVMVT+CS+PW[8]
Test	DW+ML[2]+THT+CS

ENCLOSURE 6

Excerpt from Design Criteria WB-DC-40-31.9

QA Record T29 920706 822

TVA
TENNESSEE VALLEY AUTHORITY

TENNESSEE VALLEY AUTHORITY

DIVISION OF NUCLEAR ENGINEERING

NE NUCLEAR ENGINEERING

DESIGN CRITERIA

NUMBER WB-DC-40-31.9

WATTS BAR NUCLEAR PLANT

TITLE: CRITERIA FOR DESIGN OF PIPING SUPPORTS AND SUPPLEMENTAL STEEL IN CATEGORY I STRUCTURES

See previous revisions for original signatures

	REVISION 0	R12	R13	R14
EFFECTIVE DATE	08-29-75	04-12-91	11-06-91	JUL 06 1992
PREPARED	K.G. FRAZIER	S.J. EDER	H. A. Cusick	WRBibb
CHECKED	T.C. CRUISE	R.D. HOOKWAY	W. R. Bibb	Howard A. Cusick
REVIEWED	E.D. MYSINGER	T.R. KIPP	S. E. Azzazy	S.E. Azzazy
APPROVED	W.A. ENGLISH	J.G. ADAIR	J. G. Adair	[illegible]
ACCEPTED	R.G. DOMER	J.K. McCALL	J. K. McCall	W. A. Elliott

Total 56 Pages

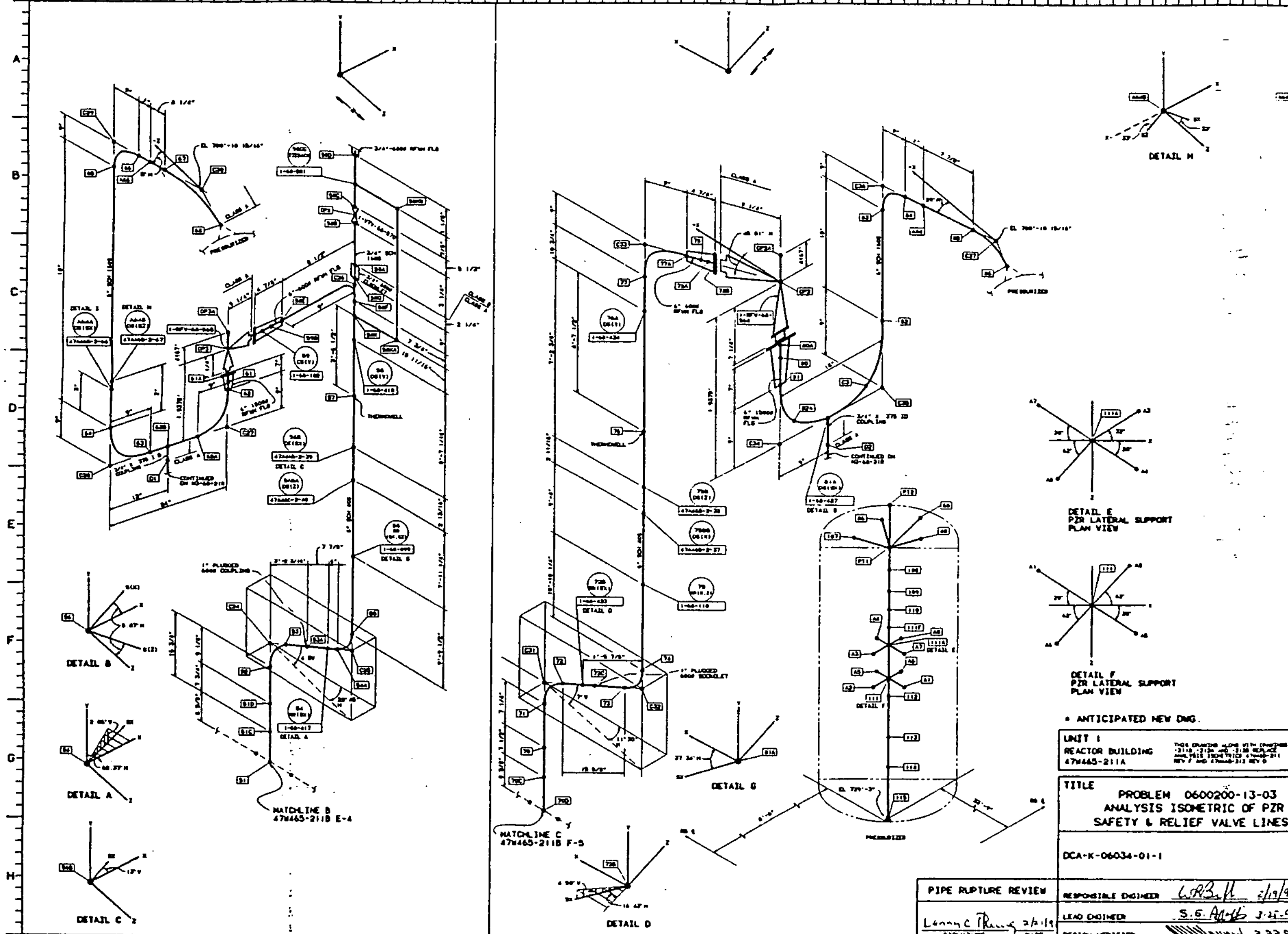
TABLE B-2
Support Design Allowable Stresses For
Category I Pipe Supports

Load Condition	Supplemental Structural Steel, Welds & Structural Bolts	Component Standard Supports W/ LCDS' Except Unistrut Clamps	Component Standard Supports W/O LCDS' Except Unistrut Clamps*
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

* See Section 3.8.2 for Unistrut-type clamp allowables. Civil Design Standard DS-C1.2.6 may be used for design of U-bolt clamps. Saddles without center stiffeners (MSS-SP-58 type 39A and 39B), heavy duty clamps for pipe sizes less than 4 inches, adjustable clevis (MSS-SP-58 type 1), Bergen Paterson beam attachment (Part No. 117, Cat. No. 66R) shall be qualified by linear analysis - vendor allowables shall not be used. Additionally, linear allowables may be used to qualify other component standard supports on a case by case basis.

ENCLOSURE 7

Isometric Sketches of Model Used for Structural Analysis



NOTES

1. [illegible]
2. THE STRESS ANALYSIS CALCULATION FOR THIS PIPING CAN BE RETRIEVED BY CALCULATION NO 0600200-13-03
   THE CLASS 1 DESIGN REPORT FOR THIS STRESS ANALYSIS CAN BE RETRIEVED BY CALCULATION NO CL1-0600200-13-03
3. THE PIPING ANALYZED IN THIS STRESS CALCULATION IS HIGH ENERGY (CLASS A & B PORTIONS ONLY)
   THE PIPE RUPTURE INFORMATION FOR THIS STRESS ANALYSIS CAN BE RETRIEVED BY THE CALCULATION NO PR-0600200-13-03
4. ALL SUPPORTS ARE ATTACHED TO THE ICS
5. DIMENSIONS ARE FOR SUPPORT LOCATION ONLY. ADDITIONAL DIMENSIONS ARE PROVIDED FOR USE IN THE MATH MODEL.
6. CONSTRUCTION SPECIFICATIONS NOX-912 AND G-43 MUST BE USED TO PROVIDE CLEARANCES FOR PIPING AND TOLERANCES FOR SUPPORT LOCATIONS
7. ALL PIPING IS TVA CLASS B UNLESS OTHERWISE NOTED
8. WHERE INDICATED, WELDING ELBOWS HAVE BEEN TRIMMED FOR NOTED DEGREES / ANGLES LESS THAN 90°

4-4-91

DCN K-06034 / B

PAGE 165

* ANTICIPATED NEW DWG.

UNIT 1
REACTOR BUILDING
47W465-211A

THIS DRAWING ALONG WITH DRAWINGS -211B, -212A AND -212B REPLACE ANALYSIS ISOMETRICS 47W465-211 REV F AND 47W465-212 REV D

TITLE
PROBLEM 0600200-13-03
ANALYSIS ISOMETRIC OF PZR
SAFETY & RELIEF VALVE LINES

DCA-K-06034-01-1

WATTS BAR NUCLEAR PLANT

TENNESSEE VALLEY AUTHORITY

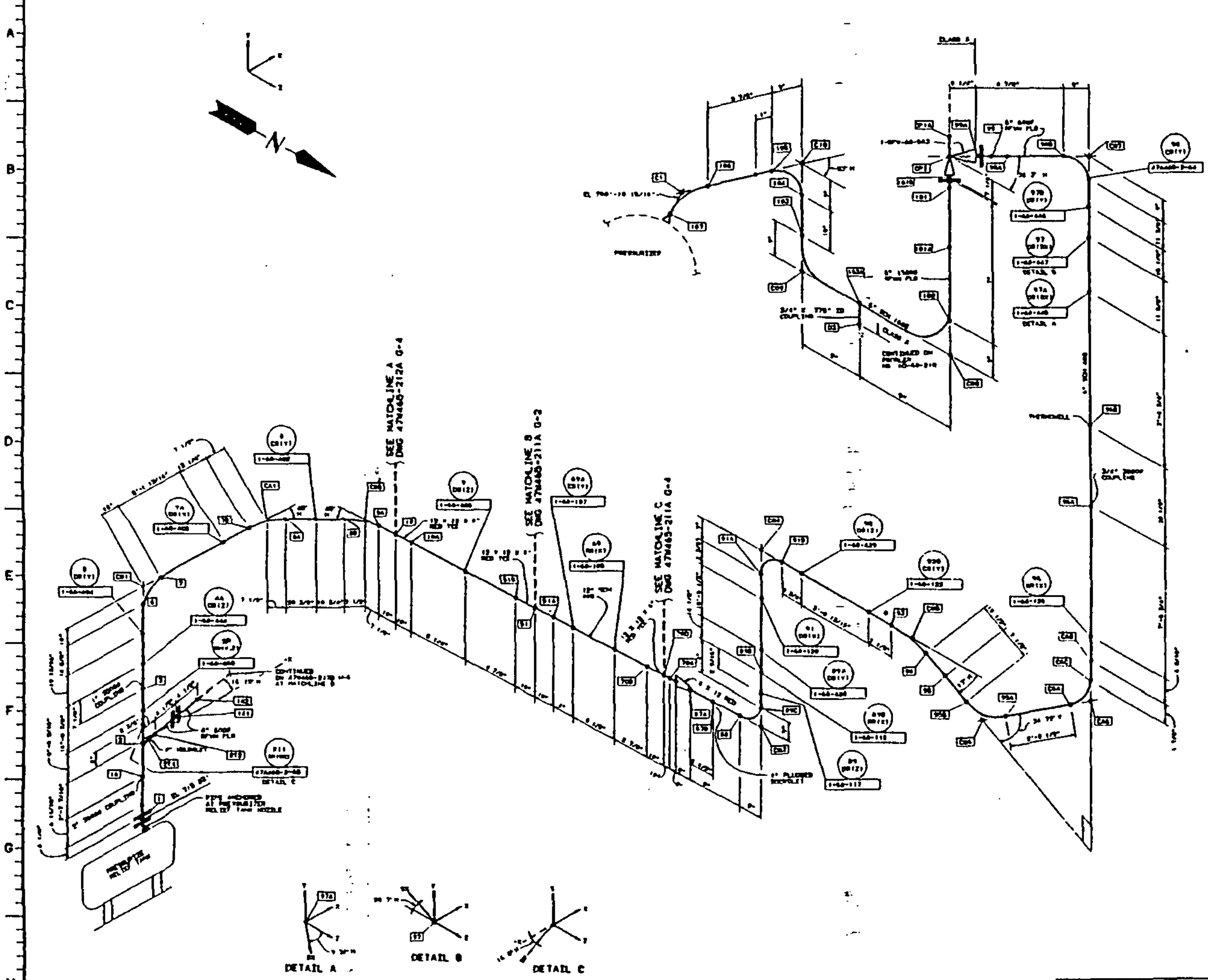
SCALE NTS EXCEPT AS NOTED

PIPE RUPTURE REVIEW

Lenny C Pheng	2/21/91
SIGNATURE	DATE

RESPONSIBLE ENGINEER	WRB	2/19/91
LEAD ENGINEER	S.G. Abbott	3-25-91
DESIGN VERIFIED	[illegible]	3.22.91

ISSUED BY



DCN K-06034/B
PAGE 166
@ 7-7-91

* ANTICIPATED NEW DWG.

UNIT 1
REACTOR BUILDING
47W465-211B

TITLE
PROBLEM 0600200-13-03
ANALYSIS ISOMETRIC OF PZR
SAFETY AND RELIEF VALVE PIPING

DCA-K-06034-02-1

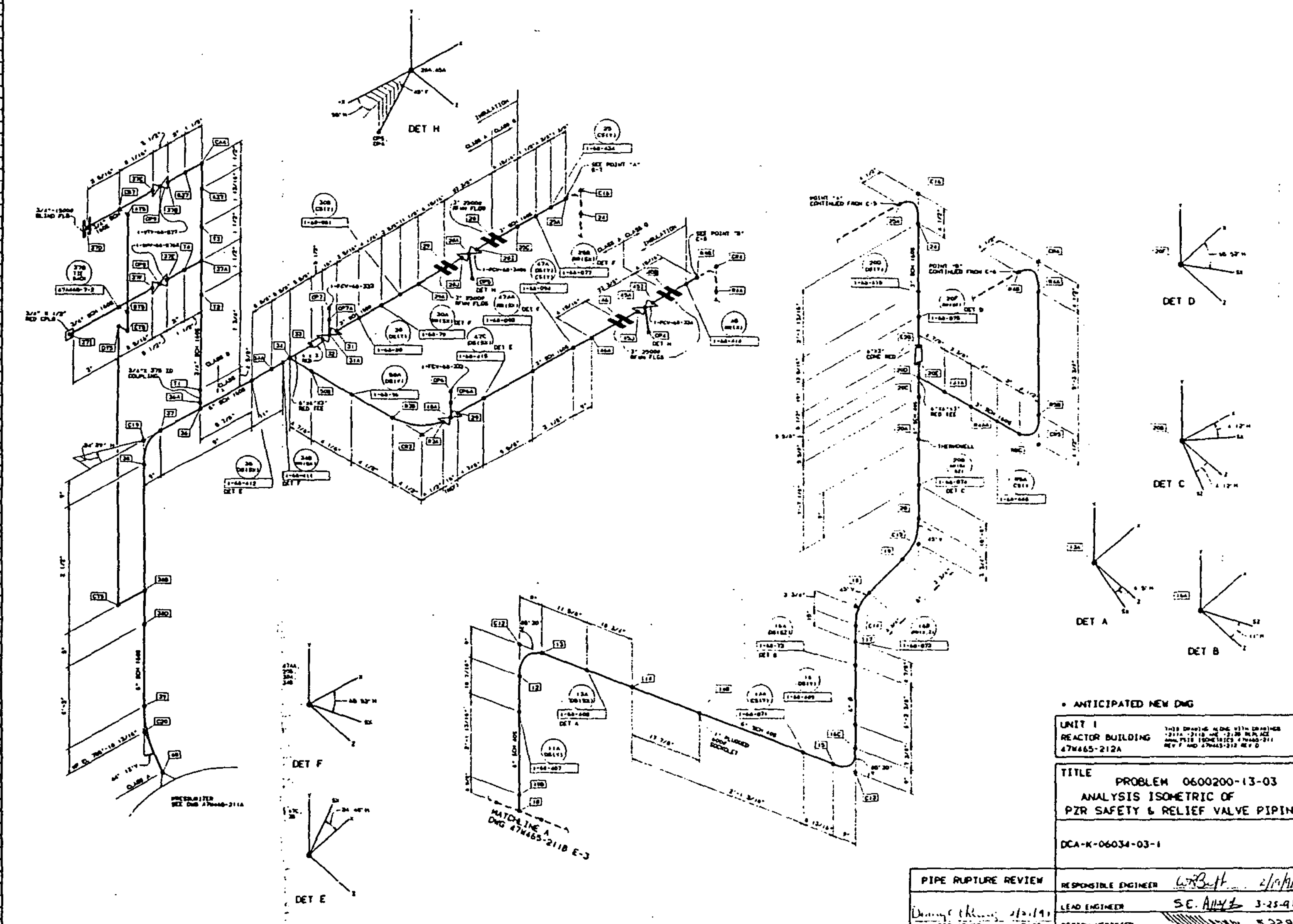
SCALE NTS

EXCEPT AS NOTED

WATTS BAR NUCLEAR PLANT

TENNESSEE VALLEY AUTHORITY

PIPE RUPTURE REVIEW		
Doug C Rising 2/21/91 (SIGNATURE / DATE)		
RESPONSIBLE ENGINEER	WABull	2-19-91
LEAD ENGINEER	S.E. Allgood	2-25-91
DESIGN VERIFIED		3.22.91



NOTES

1. DESIGN INPUT DOCUMENTS ARE DOCUMENTED IN WPAID-00 AND IN THE ANALYSIS CALCULATIONS PACKAGE FOR THIS PIPING. THE COMPUTER MATH MODEL AND THE COMPUTER PIPING ANALYSIS ARE CURRENT TO REVISION 2 OF WPAID-00 AND REVISION 15 OF THE ANALYSIS CALCULATIONS PACKAGE. LATER CHANGES IN DESIGN INPUT DOCUMENTS HAVE NOT REQUIRED A PIPING REANALYSIS. THESE CHANGES ARE EVALUATED IN WPAID-00 AND IN WPAID-[illegible] AND WILL BE INCORPORATED WHEN REANALYSIS ARE REQUIRED BY WPAID-00 OR WPAID-[illegible]
2. THE STRESS ANALYSIS CALCULATION FOR THIS PIPING CAN BE RETRIEVED BY CALCULATION NO 0600200-13-03
THE CLASS 1 DESIGN REPORT FOR THIS STRESS ANALYSIS CAN BE RETRIEVED BY CALCULATION NO CL1-0600200-13-03
3. THE PIPING ANALYZED IN THIS STRESS CALCULATION IS HIGH ENERGY
THE PIPE RUPTURE INFORMATION FOR THIS STRESS ANALYSIS CAN BE RETRIEVED BY THE CALCULATION NO PR-0600200-13-03
4. ALL SUPPORTS ARE ATTACHED TO THE ICS
5. DIMENSIONS ARE FOR SUPPORT LOCATION ONLY. ADDITIONAL DIMENSIONS ARE PROVIDED FOR USE IN THE MATH MODEL
6. CONSTRUCTION SPECIFICATIONS N3C-912 AND G-43 MUST BE USED TO PROVIDE CLEARANCES FOR PIPING AND TOLERANCES FOR SUPPORT LOCATIONS
7. ALL PIPING IS TVA CLASS [illegible] UNLESS OTHERWISE NOTED
8. WHERE INDICATED WELDING ELBOWS HAVE BEEN TRIMMED FOR NOTED DEGREES/ANGLES LESS THAN 90°

4-4-91

DCN K-06034 B
PAGE 167

• ANTICIPATED NEW DWG

UNIT 1
REACTOR BUILDING
47W465-212A

THIS DRAWING ALONG WITH DRAWINGS -211A -211B AND -212B REPLACE ANALYSIS ISOMETRICS 47W465-211 REV F AND 47W465-212 REV D

TITLE
PROBLEM 0600200-13-03
ANALYSIS ISOMETRIC OF
PZR SAFETY & RELIEF VALVE PIPING

DCA-K-06034-03-1

WATTS BAR NUCLEAR PLANT

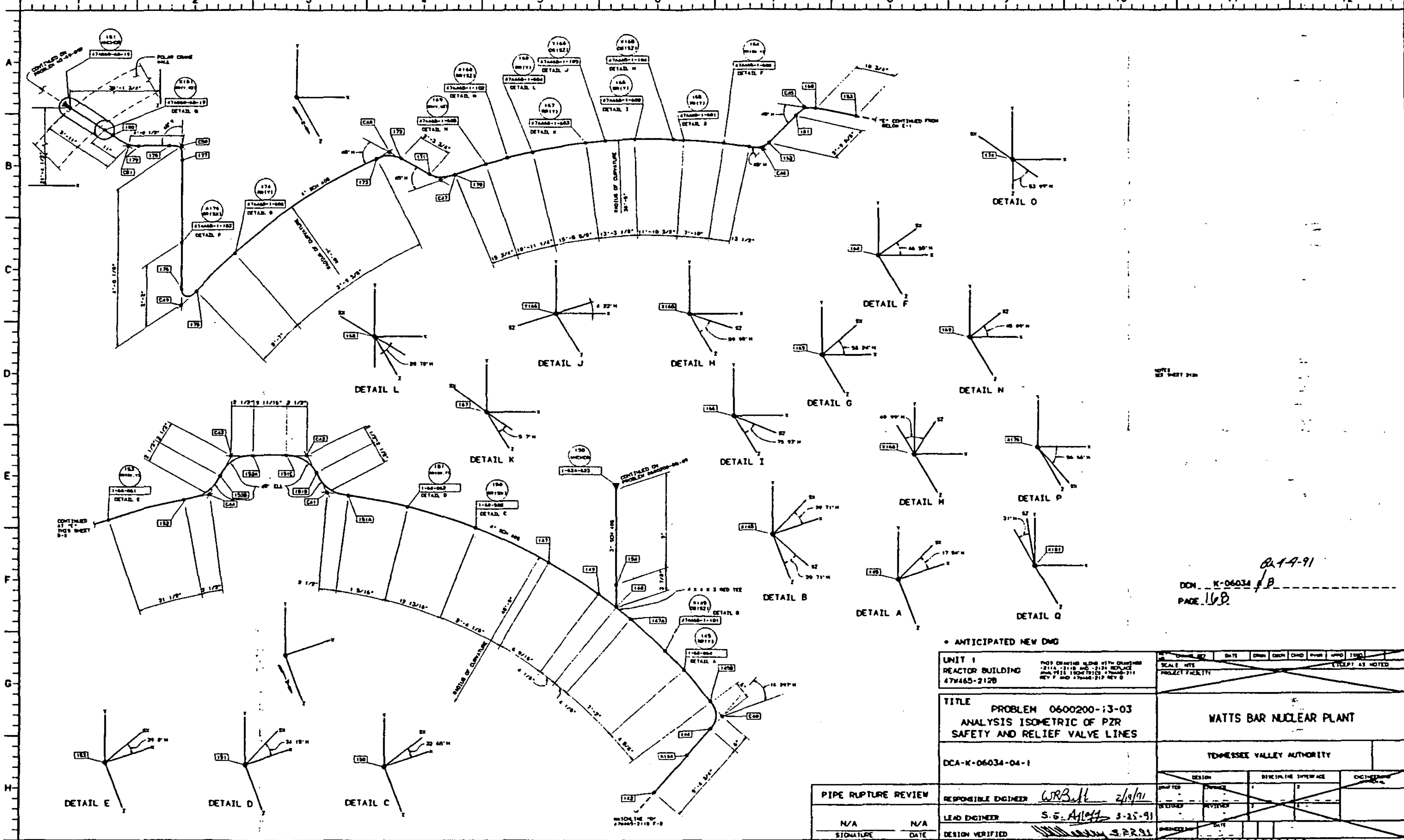
TENNESSEE VALLEY AUTHORITY

SCALE NTS EXCEPT AS NOTED

PIPE RUPTURE REVIEW	
[signature] 2/21/91	
SIGNATURE	DATE

RESPONSIBLE ENGINEER	[signature]	2/19/91
LEAD ENGINEER	S.C. [signature]	3-25-91
DESIGN VERIFIED	[signature]	3.22.91
ISSUED BY		

CAD DRAWING
DO NOT REVISE MANUALLY
THIS DRAWING WAS BEEN CAD GENERATED



DCN K-06034 B
PAGE 16B
8-4-91

• ANTICIPATED NEW DWG

UNIT 1
REACTOR BUILDING
47W465-212B

TITLE
PROBLEM 0600200-13-03
ANALYSIS ISOMETRIC OF PZR
SAFETY AND RELIEF VALVE LINES

DCA-K-06034-04-1

WATTS BAR NUCLEAR PLANT

TENNESSEE VALLEY AUTHORITY

PIPE RUPTURE REVIEW

SIGNATURE	DATE
N/A	N/A

RESPONSIBLE ENGINEER WRB 2/19/91
LEAD ENGINEER S.S. A 3-25-91
DESIGN VERIFIED 3.22.91

SCALE NTS EXCEPT AS NOTED