CONNECTICUT YANKEE ATOMIC POWER COMPANY

BERLIN, CONNECTICUT
P.O. BOX 270 • HARTFORD, CONNECTICUT 06141-0270

TELEPHONE
203-665-5000

July 9, 1987

Docket No. 50-213
B12590
Re: TMI Action Item II.D.1

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D. C. 20555

Reference: (1) F. M. Akstulewicz letter to E. J. Mroczka, "Review of NUREG-0737, Item II.D.1, Performance Testing of Relief and Safety Valves for Haddam Neck," dated December 12, 1986.

Gentlemen:

Haddam Neck Plant
Relief Valve and Safety Valve Testing

In Reference (1), the NRC Staff requested that Connecticut Yankee Atomic Power Company (CYAPCO) provide additional information regarding NUREG 0737, Item II.D.1, the testing of pressurizer power operated relief valves (PORVs) and safety valves at the Haddam Neck Plant.

This additional information is provided in the attachment. A response to Question No. 5 is not yet available since supporting information must be obtained from a contractor in order for CYAPCO to fully address the question. As such, the response to Question No. 5 is scheduled to be submitted by September 1, 1987.

Please contact us if you have any questions.

Very truly yours,

CONNECTICUT YANKEE ATOMIC POWER COMPANY

EJMroczka

E. J. Mroczka
Senior Vice President

Attachment

cc: W. T. Russell, Region I Administrator
F. M. Akstulewicz, NRC Project Manager, Haddam Neck Plant
P. D. Swetland, Resident Inspector, Haddam Neck Plant

A046
1/1

Docket No. 50-213
B12590

Attachment

Haddam Neck Plant
Additional Information
Relief Valve and Safety Valve Testing

July, 1987

Haddam Neck Plant
Additional Information on SV/RV Testing

Question 1:

The submittal (Reference 1) did not include a discussion of the consideration of the single failures after the initial events that challenge the PORVs and/or safety valves. NUREG 0737 requires selection of single failures that produce maximum loads on the PORVs and safety valves. Provide a discussion describing how the single failure considerations are met.

CYAPCO Response:

In accordance with NUREG 0737, test conditions were verified to bound the worst case fluid conditions assuming the worst case single failure that might occur during a design basis accident. Thus, the application of additional failures beyond those considered is not necessary.

Question 2:

The Haddam Neck PORV block valves were not tested by EPRI. The licensee indicated that they had conducted an independent plant specific evaluation of the 2 in., 1500 lb., Crane gate valve with the Crane-Teledyne Model No. T4-5 motor operator (Reference 1, response to Question 8). However, no details were provided of their independent evaluation. Therefore, provide evidence supported by test to demonstrate that the block valve can be operated, closed, and opened for fluid conditions expected under operating and accident conditions and that the valve operator is capable of delivering sufficient thrust to effect full closure of the valve within the required stroke time.

CYAPCO Response:

Reference (1) stated that CYAPCO had conducted an independent plant specific evaluation of the Haddam Neck PORV block valve motor operator arrangement. This evaluation involved a review of the EPRI block valve information package for applicability to the Haddam Neck Plant. The applicable results were discussed with the valve/operator vendor (Crane-Teledyne).

Crane-Teledyne recalculated the torque requirements for the Haddam Neck valves. The new calculated torque values verified the adequacy of those values originally specified and maintained at Haddam Neck. Thus, it was concluded that the block valve/motor operator arrangements were adequate to ensure proper valve operation.

However, CYAPCO has since replaced the PORV block valve operators due to environmental equipment qualification (EEQ) concerns. The new operators are Limitorque SMB-00-10 operators with 10 ft. lb. motors. The operators develop a seating torque of 50 ft. lb. and a running torque of 30ft. lb. The valves remain the same (Crane, 2" 1500 lb., Model 87-1/2U). As part of the motor operator replacement, Limitorque recalculated the torque requirements for the Haddam Neck PORV block valves.

The Limitorque SMB-00-10 operator was successfully tested by EPRI, however, the tests utilized 3" gate valves compared to the Haddam Neck PORV block valves, which are 2". Torque requirements for the 2" valves are less than the valves tested. Based on this information, it was concluded that the Haddam Neck PORV block valve/motor operator arrangement is adequate to ensure proper valve operation.

To further demonstrate the operability of the PORV block valves, CYAPCO is including the block valves in the IE Bulletin 85-03 (Reference 3) program. Under this program, actual valve stem thrusts will be measured and compared to the stem thrusts calculated by the vendor. These tests will be performed during the 1987 refueling outage (Reference 4).

CYAPCO believes the above commitment goes beyond what was mutually agreed upon between the participating utilities and the NRC (as detailed in Reference 5). However, CYAPCO is anxious to close out this long standing issue.

Question 3:

In response to the question on the maximum bending moments induced on the safety valves and PORVs by pressure and thermal expansion loads during valve discharge (Reference 1, Question 7), the licensee stated that the safety valves were subjected to loads two times higher in the EPRI tests than those predicted for the effects associated with dead weight, thermal expansion, SSE and valve discharge for the in-plant valves. But the magnitudes of the predicted moments were not given. Provide a comparison of the predicted maximum moments and the maximum moments sustained during the EPRI tests for the safety valves and PORVs.

CYAPCO Response:

The as-tested valve discharge bending moments for the Crosby Type 3K6 safety valves were measured during the EPRI/CE PWR Safety Valve Testing. The maximum induced discharge moment was 13,458 ft. lbf (Reference 5). Induced discharge bending moments were not measured during EPRI PORV testing. The bounding expected discharge bending moments for the safety and relief valves are tabulated in Appendix A.

Question 4:

In the EPRI tests on the Copes-Vulcan PORVs, the valve opening and closing times were recorded. The longest opening time was 1.01 sec and the longest closing time was 1.44 sec. The required opening and closing time for the PORVs at the Haddam Neck Plant was not given by the licensee. Give the required PORV opening and closing time for the Haddam Neck Plant so that the valve operability evaluation can be completed.

CYAPCO Response:

The Haddam Neck safety analysis assumes a PORV block valve opening time of 20 sec. and a closing time of 20 sec. The PORV is assumed to open and close within these time intervals.

Question 5

The discussion on the thermal hydraulic analysis of the PORV and safety valve piping system presented in Reference (1) (response to Question 9) has been reviewed. Additional information is still required in order to complete the evaluation of the analysis. Provide the following information:

a. Explain in detail how the thermal-hydraulic analysis program "STEHAM" was verified to ensure that it was adequate for the safety valve/PORV piping application. Provide a comparison of the calculated results using the STEHAM program for an EPRI test condition with the EPRI test results for the same test.

b. Discuss the piping model used for the thermal-hydraulic analysis. Identify the important parameters used in the analysis such as node spacing, valve flow area, pressure ramp rate, choked flow locations and discuss the rational for their selection.

CYAPCO Response:

(To be provided)

Question 6

For piping and support stress analysis discussed in Reference (1) (response to Question 11), the following additional information is required.

a. Appendix B of Reference (1) lists the cut-off frequency and cut-off mode as 1337 Hz/21 modes for time history analysis and 50 Hz/50 modes for pipe stress analysis. However, no description of the time history and pipe stress analysis was provided. It is not clear whether the safety valve and PORV discharge analysis is considered as the time history analysis and loading conditions analyzed in the time history analysis and the loading conditions considered in the pipe stress analysis. Justify the adequacy of the cut-off frequency and cut-off mode number used in each case. Also explain, why a lower number of modes (21) was specified in conjunction with a higher cut-off frequency (1337 Hz) and a high number of modes (50) was specified with a much lower cut-off frequency (50 Hz).

b. Identify the governing codes used for the piping and support stress analysis and indicate which portions of the piping is considered as Class 1 and Class 2 or 3.

c. One set of load combination equations is given in Appendix C of Reference (1). Are these load combination equations and stress limits applicable to the entire piping system from the pressurizer to the discharge tank or was a distinction made between the Class 1 portion and the rest of the piping. Also, explain why the Operating Basis Earthquake (OBE) is excluded from the load combinations.

d. References (1) and (2) did not provide any evaluation of the stress results of the piping and support analysis. Provide a comparison between the maximum and allowable stresses in the piping upstream and downstream of the safety valves and PORVs and in the piping supports. Identify overstressed locations and describe the structural modification required, if any.

e. Provide a clear readable sketch of the structural model showing lumped mass locations, pipe size and application points of fluid forces.

f. Submit a copy of the structural analysis report.

CYAPCO Response:

a. The time history analysis was performed to evaluate the effects of the fluid dynamic forcing functions, developed in the "STEHAM" thermal hydraulic analysis, on the piping, supports and equipment. The time history forcing functions were applied to the piping structural model and displacements and stresses were generated for the piping, as well as support and equipment loadings. These results were stored on tape and used in the final pipe stress analysis and combined as detailed in Appendix B.

The cutoff frequency and mode for the time history analysis was 256 Hz and 141, respectively. Free vibration analyses were run to form the basis for these values. The integration time step was then selected to ensure at least 2-1/2 time steps per cycle at the cutoff frequency. The cutoff frequency and mode for the pipe stress analysis, was 50 Hz and 50, respectively. For seismic response spectra analysis NRC Regulatory Guide 1.60 represents the design response spectra by the maximum ground acceleration at frequencies greater than 33 Hz. Consequently, the resulting floor response spectra converges to that of the particular building location rigid range response above 33 Hz and a cutoff frequency of 50 Hz is conservative.

b. All Pressurizer Safety/Relief Valve Piping from the pressurizer to the pressurizer relief tank was qualified to ASME Section III Subsection NC, 1974 Edition, including addenda through the Summer of 1976, for Class 2 piping. Subsequently, in conjunction with the systematic evaluation program (SEP) for the Haddam Neck Plant and NUREG 0737 all of the pressurizer relief piping was requalified in accordance with the 1973 ANSI B31.1 Power Piping Code. This is consistent with the SEP treatment of the remainder of the Reactor Coolant System (RCS).

The supports for all of the pressurizer relief piping were qualified in accordance with the Seventh Edition of the AISC Code.

c. The load combination equations and stress limits previously transmitted and reiterated in Appendix A are applicable to the entire piping system from the pressurizer to the relief tank. ASME Class 1 rules were not applied to any of the pressurizer relief piping. An operational basis earthquake was not included in the load combinations since it was neither postulated in the plant design basis nor included in the SEP.

d. The pressurizer relief piping was within applicable code stresses allowable in all locations. A comparison of maximum and allowable stresses is provided in Appendix D.

   The supports were qualified in accordance with the AISC Code. To assure qualification, minor structural modifications were required. These modifications included the replacement of U-bolts with box frames.

e. Piping work sketches of the structural model illustrating analytic information and the application of fluid forces is provided in Appendix C.

f. The Structural Analysis Report is readily available for inspection in our offices upon your request.

References:

1. W. G. Counsil letter to J. A. Zwolinski, "Haddam Neck Plant, Response to Requests for Additional Information on Performance Testing of Relief and Safety Valves," dated April 15, 1985.

2. W. G. Counsil letter to D. W. Eisenhut, "Haddam Neck Plant, Millstone Nuclear Power Station, Unit No. 2, NUREG-0737 Item II.D.1, Performance Testing of PWR Relief and Safety Valves," dated December 15, 1982.

3. IE Bulletin 85-03, "Motor-Operated Valve Common Mode Failures During Plant Transients Due to Improper Switch Settings", dated November 15, 1985.

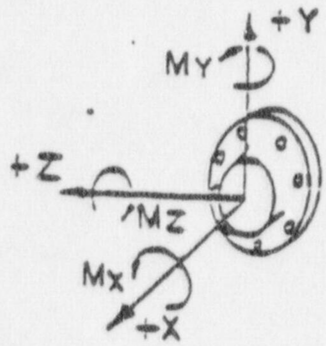
4. J. F. Opeka letter to T. E. Murley, "IE Bulletin Common Mode Failures", dated June 11, 1986.

5. R. C. Youngdahl (EPRI, RAC) letter to H. Denton, "Status of EPRI PWR RV/SV Test Program," dated July 24, 1981.

6. EPRI/CE PWR Safety Valve Test Report, Volume 10: Piping Structural Response Results, EPRI NP-2770-LD, March 1983.

APPENDIX "A"

Bounding Expected Discharge Bending Moments
for Safety Valves and PORVs



Safety Valves	Resultant Bending Moment (ft-lbf)
Normal and Upset (sustained loadings)*	6545
Faulted (occasional loadings)	6818
PORVs	
Normal and Upset (sustained loadings)*	1909
Faulted (occasional loadings)	2326

* Including safety/relief valve fluid transients.

APPENDIX "B"

PIPE STRESS CRITERIA

Loading Combinations	Stress Limits
Design Pressure + Deadweight	S_h
Design Pressure + Deadweight + SRSS (SOT_R & SOT_S)	$1.2\ S_h$
Operating Pressure + Deadweight + SRSS (Potential Earthquake Loads (SSE), SOT_R and SOT_S)	$2.4\ S_h$
Thermal	S_A

SA	Allowable stress range - $1.25\ S_c + 0.25\ S_h$.
S_c	Material allowable stress at minimum temperature from ANSI B31.1, 1973 Edition, Summer 1973 Addenda.
S_h	Material allowable stress at the maximum operating temperature from ANSI B31.1, 1973 Edition, Summer 1973 Addenda.
SOT	System Operating Transient
SOT_R	Relief Valve Discharge Transient
SOT_S	Safety Valve Discharge Transient
SSE	Safe Shutdown Earthquake

APPENDIX "C"

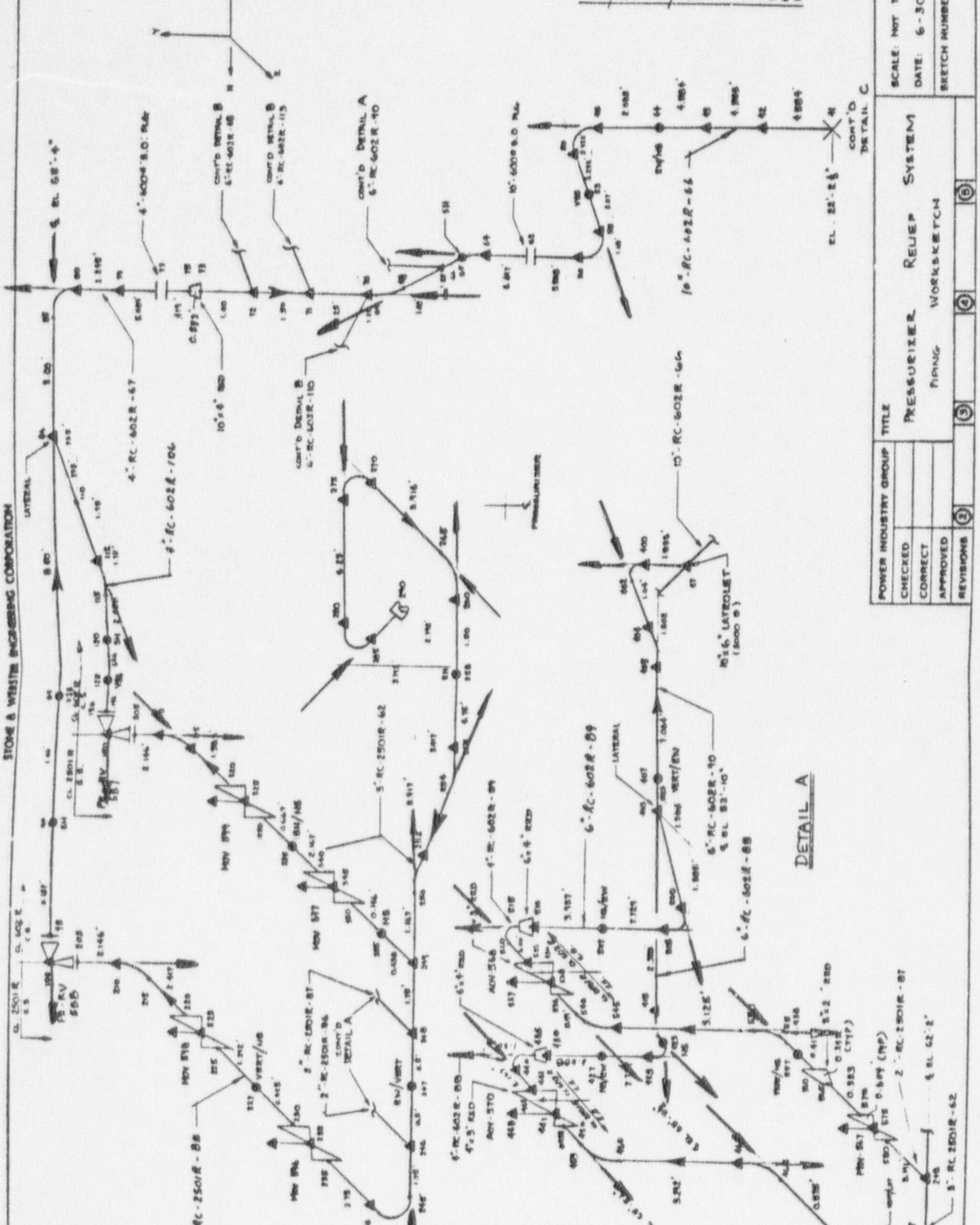
Structural Model

Illustrating the Application of Fluid Forces

CALC # 14096-NP(B)-002-XE

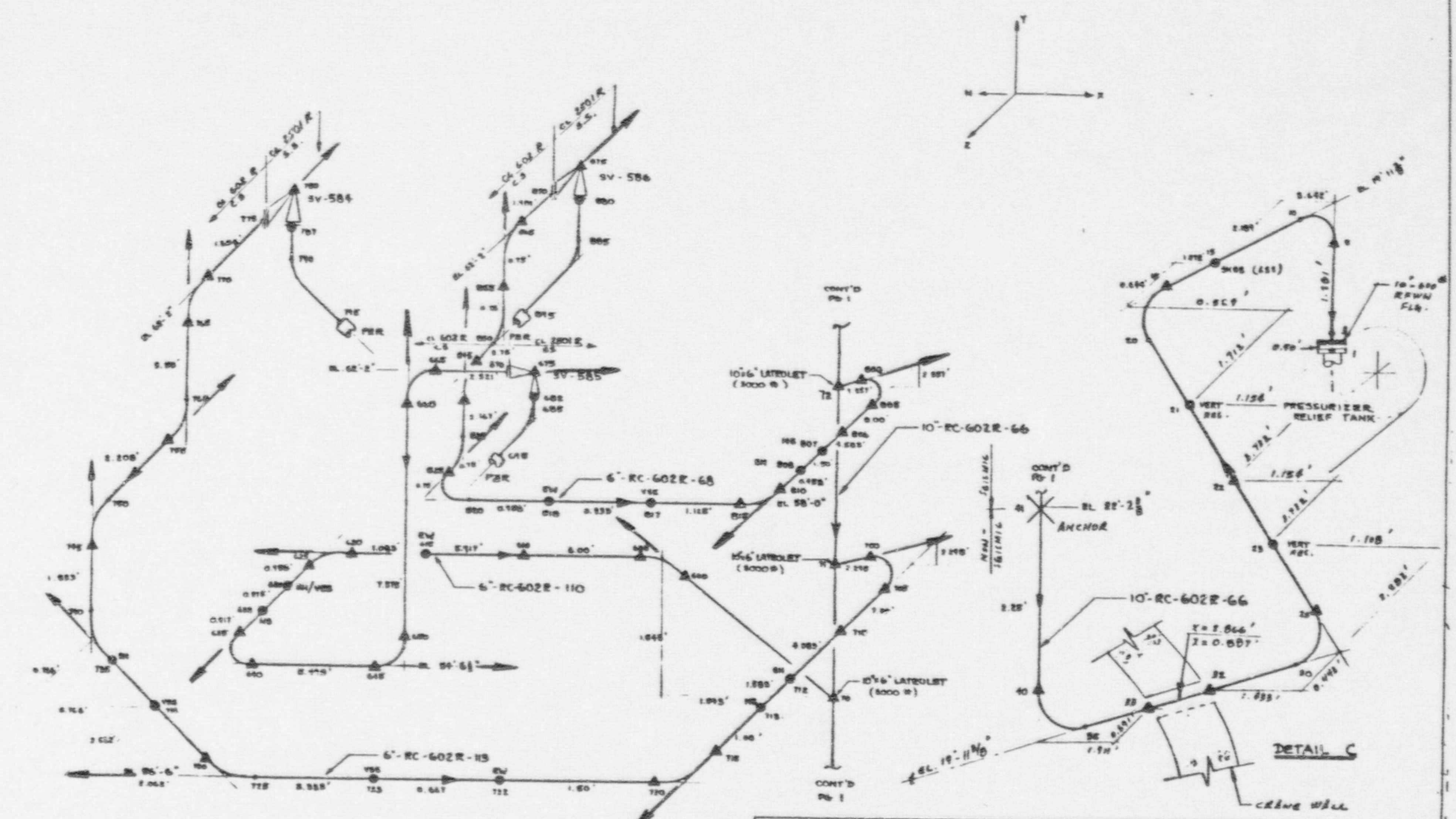
6.0 <u>DESIGN INPUT</u> (CONT.)

<u>A. MATHEMATICAL MODEL</u>



CALC # 14096-NP(B)-002-XE

STONE & WEBSTER ENGINEERING CORPORATION

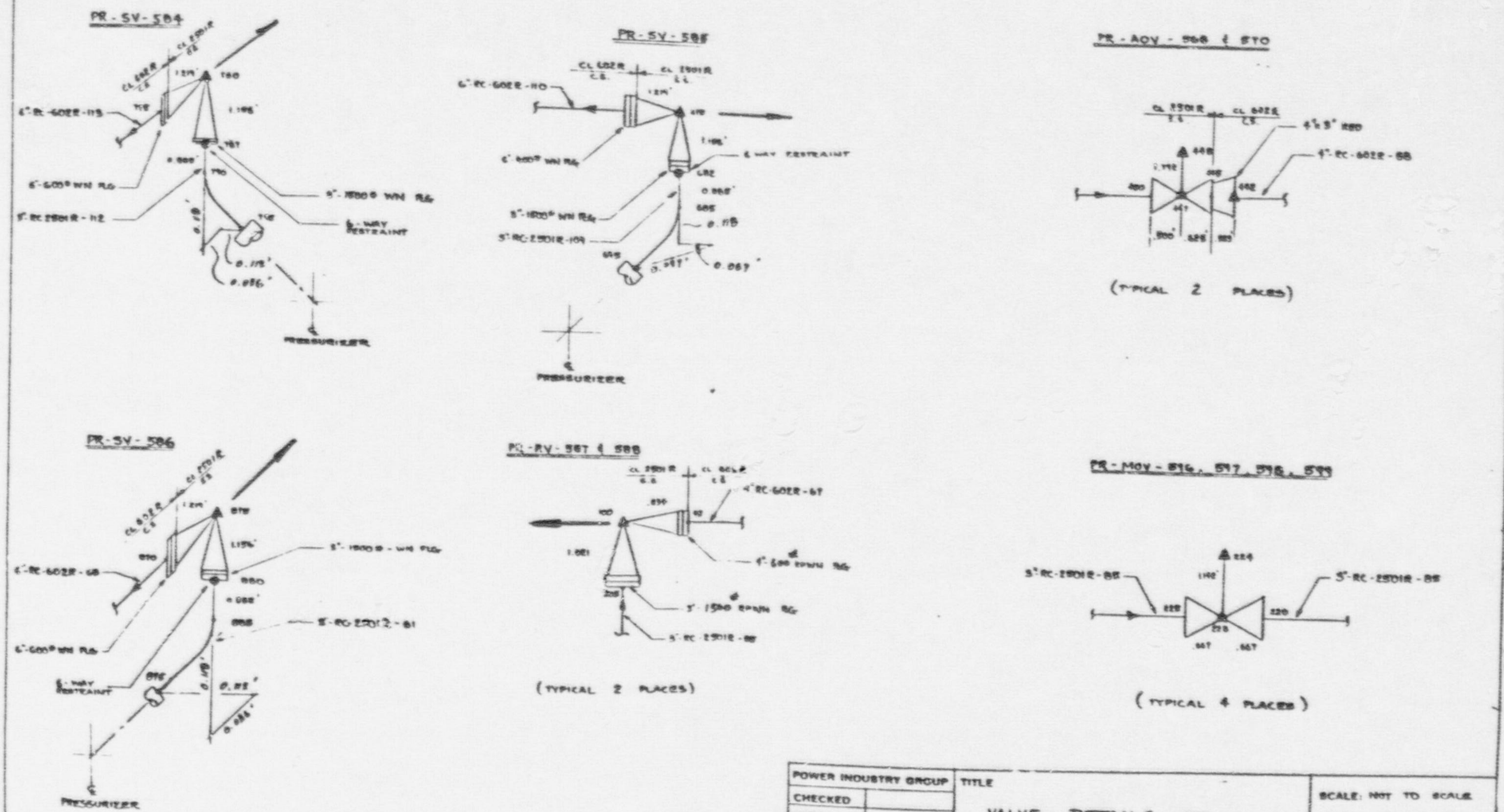


POWER INDUSTRY GROUP		TITLE	SCALE: NOT TO SCALE
CHECKED			DATE: 6-29-82
CORRECT			SKETCH NUMBER
APPROVED			
REVISIONS	② ③ ④ ⑤		

STONE & WEBSTER ENGINEERING CORPORATION

CALL # 14096-NP(B)-002-XE

VALVE DETAILS



POWER INDUSTRY GROUP	TITLE	
CHECKED	VALVE DETAILS FOR	SCALE: NOT TO SCALE
CORRECT	PRESSURIZER RELIEF PIPING	DATE: 6-30-82
APPROVED		SKETCH NUMBER
REVISIONS	② ③ ④ ⑤	

APPENDIX "D"

MAXIMUM STRESS LEVELS FOR CARBON STEEL PIPING

	Point No.	Member Type	Max. Calc. Stress (PSI)	Allowable Stress (PSI)
Sustained Stress (Equation 8)	410	TEE	4631	15000
Occasional Stress (Equation 9)	86	TEE	17128	36000
Expansion Stress (Equation 10)	410	TEE	25237	22500
Sustained Plus Expansion Stress (Equation 11)	410	TEE	29868	37500
Equation 9	71	TEE	14059	18000

S(C) = Basic material allowable stress at minimum (cold) temperature = 15000 (PSI).

S(H) = Basic material allowble stress at maximum (hot) temperature = 15000 (PSI).

APPENDIX "D" (Cont)

MAXIMUM STRESS LEVELS FOR STAINLESS STEEL PIPING

	Point No.	Member Type	Max. Calc. Stress (PSI)	Allowable Stress (PSI)
Sustained Stress (Equation 8)	335	RUN	8158	16600
Occasional Stress (Equation 9)A	249	TEE	19260	39840
Expansion Stress (Equation 10)	560	REDUCER	22117	27525
Sustained Plus Expansion Stress (Equation 11)	560	REDUCER	29191	44125
Equation 9	682	RUN	18462	19920

S(C) = Basic material allowable stress at minimum (cold) temperature = 18700.

S(H) = Basic material allowable stress at maximum (hot) temperature = 16600.