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SUBJECT: Provides final piping & restraint stresses as compared to stress allowables & explanation of why proposed mod required two rupture disc/baffleplate assemblies rather than one,per NRC request re NUREG-0737,Item II.D.1.Tables & figures encl.

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WISCONSIN PUBLIC SERVICE CORPORATION Public Service

P.O. Box 1200, Green Bay, Wisconsin 54305

December 14, 1984

Director of Nuclear Reactor Regulation
Attention: Mr. S. A. Varga, Chief
Operating Reactors Branch No. 1
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Varga:

Docket 50-305
Operating License DPR-43
Kewaunee Nuclear Power Plant
TAC #44590
NUREG-0737, Item II.D.1 "Performance Testing of Relief and Safety Valves"
Request for Additional Information

References: 1) Letter to C. W. Giesler of WPSC from S. A. Varga of the NRC dated December 5, 1983
2) Letter to S. A. Varga of the NRC from C. W. Giesler of WPSC dated March 23, 1984

Reference 1, requested additional information concerning our earlier responses to Item II.D.1 of NUREG-0737 "Performance Testing of Relief and Safety Valves." In our letter of March 23, 1984 (Reference 2), we forwarded the requested information to your office. The NRC has recently requested that we describe our analyses, provide the final piping and restraint stresses as compared to stress allowables and explain why the proposed modification required two rupture disc/baffleplate assemblies rather than one. This letter responds to this request and provides the additional information.

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All of our responses in Reference 2 assumed that the double rupture disc/baffleplate assembly modification was installed in the pressurizer safety and relief valve (S/RV) discharge piping. In that response, we provided a description of the proposed modification (Question No. 23) along with several plan views of the upper portion of the S/RV discharge piping showing the rupture disc/baffleplate assemblies installed and a comparison to the as-built discharge piping (Figures A23-1, A23-2a and A23-2b, Reference 2). A copy of these plan views is provided in the attachment to this letter as Figures 1, 2a, and 2b for your convenience.

Appendices A and B of Reference 2, contained a microfilm copy of the RELAP5 and ADLPIPE computer analyses (inputs and outputs) for a two-safety valve actuation resulting from the KNPP postulated Locked Rotor Accident. This transient produces the limiting stresses in the discharge piping for the plant faulted condition. Detailed information regarding the modeling of the discharge piping and the limiting transient was also provided in Reference 2.

It should be noted that the original analyses of the as-built S/RV discharge piping were conducted with the RELAP5/REPIPE/ADLPIPIE computer codes. Subsequent analyses, assuming the double rupture disc/baffleplate assembly modification was installed, utilized the RELAP5/FORCE/ADLPIPE computer codes. The difference between the computer codes is the post-processor used to calculate the resultant thermohydraulic forces.

During the initial design stage of the project it was originally believed that the installation of one rupture disc/baffleplate assembly at the discharge of safety valve PR-3A would be adequate to relieve the overstress situation experienced in the as-built piping. However, as the design and analysis of this modification progressed, sensitivity studies showed that with one rupture disc/baffleplate assembly installed the stress allowables of the discharge piping would be exceeded under certain conditions. Several factors contributed to this problem.

1) Due to space limitations inside the pressurizer vault, the rupture disc/baffleplate assembly(s) had to be installed at a 45 degree angle to the discharge of the safety valve(s) rather than in line with the discharge (Figure 1). This increased peak loads over those from the previous analyses which assumed an inline configuration.

2) With only one rupture disc/baffleplate assembly installed (PR-3A), part of the discharge flow from safety valve PR-3B would merge with the discharge flow from safety valve PR-3A resulting in a water hammer effect. The resulting pressure spikes caused additional peak loads at high frequencies in the discharge piping.

To reduce these effects, two rupture disc/baffleplate assemblies will be installed; one at the discharge of each safety valve (PR-3A and PR-3B). Both rupture disc/baffleplate assemblies will be orientated at a 45 degree angle to the discharge of the safety valves in the same plane but opposite directions (Figure 1). In addition, a 10-inch piping segment will replace the 6-inch piping run between the first 90 degree elbow at the discharge of safety valve PR-3A and the as-built 10-inch by 6-inch reducer. This was necessary to decrease the pressure spikes caused by a two-safety valve actuation (Figures 2a and 2b).

The pressurizer S/RV discharge piping was originally designed to the USA Standard Code for Pressure Piping, USAS B31.1.0-1967 Edition and code cases to ASA B31.1-1955. Modified portions of the discharge piping conform to the ANSI/ASME B31.1-1980 Edition of Power Piping up to and including the Winter - 1980 Addenda. Tables 1 and 2 in the attachment to this letter list the specific piping and support loading combinations used in the stress analyses for the discharge piping. The load combinations found in Table-1, are consistent with those found in the KNPP Updated Safety Analysis Report (USAR), Appendix B, Table B.7-1. A list of abbreviations and definitions is also provided in Table-3 of the attachment for your convenience.

The piping downstream of the S/RV's is Class II piping while that upstream of the valves is Class I, in accordance with the USAR. It was recognized that the downstream Class II piping would affect the upstream Class I piping during plant normal, upset and faulted conditions. To ensure the integrity of the upstream piping, all downstream Class II piping was subjected to Class I loading conditions for the plant normal, upset and faulted conditions.

The ADLPIPE computer code calculated the piping stresses and provided the restraint loadings (static, siesmic and dynamic time-dependent). Figures 3, 4, and 5 in the attachment to this letter provide piping isometrics for the S/RV discharge piping, from the pressurizer to the pressurizer relief tank, which show the ADLPIPE node numbers and anchor points.

Four S/RV actuations were considered for the design basis.

Valve Actuation	Condition
1) Two Safety Valves	Faulted
2) One Safety Valve (PR-3A)	Faulted
3) One Safety Valve (PR-3B)	Faulted
4) Two Relief Valves	Upset

The KNPP postulated Locked Rotor Accident was considered the upper bound transient for safety valve actuation while the worst case PORV actuation was determined to be the postulated Loss of Load Accident at the beginning of core life.

Tables 4 and 5 in the attachment to this letter provide the maximum stress values calculated in the S/RV discharge piping, for the thermal range, normal, upset and faulted conditions, and a comparison to the stress allowables. The locations of these maximum stresses are identified by ADLPIPE node numbers which can be located on the piping isometrics in Figures 3, 4, and 5. All piping, both upstream and downstream of the S/RV's, has been evaluated according to the load combinations for Class I piping and components. In all cases, the resultant stresses are within the stress allowables.

The supports for the S/RV discharge piping were also evaluated for the plant normal, upset and faulted conditions. The largest load, regardless of plant condition, was used as the design load for these supports. Table 6 in the attachment to this letter provides the largest support loading for each plant condition, the maximum and minimum loads experienced and the rated loads. As shown, the support rated loads are equal to or greater than the maximum and minimum loads experienced.

The results of the stress analyses presented in this submittal are based on the implementation of the double rupture disc/baffleplate assembly modification and its associated piping and restraint changes. It was concluded that in all cases, the piping stresses and restraint loadings would be within acceptable limits. It should be noted, that it is still our intention to implement this design change during the KNPP 1985 refueling/maintenance outage.

Very truly yours,

D. C. Hintz
Manager - Nuclear Power

JGT/js

Attach.

cc - Mr. Robert Nelson, US NRC

Attachment

To

Letter to S. A. Varga of the NRC from D. C. Hintz of WPSC

Dated December 14, 1984

S/RV Discharge Piping Double Rupture Disc/Baffleplate Assembly

Modification - Figures and Tables

List of Figures

List of Tables

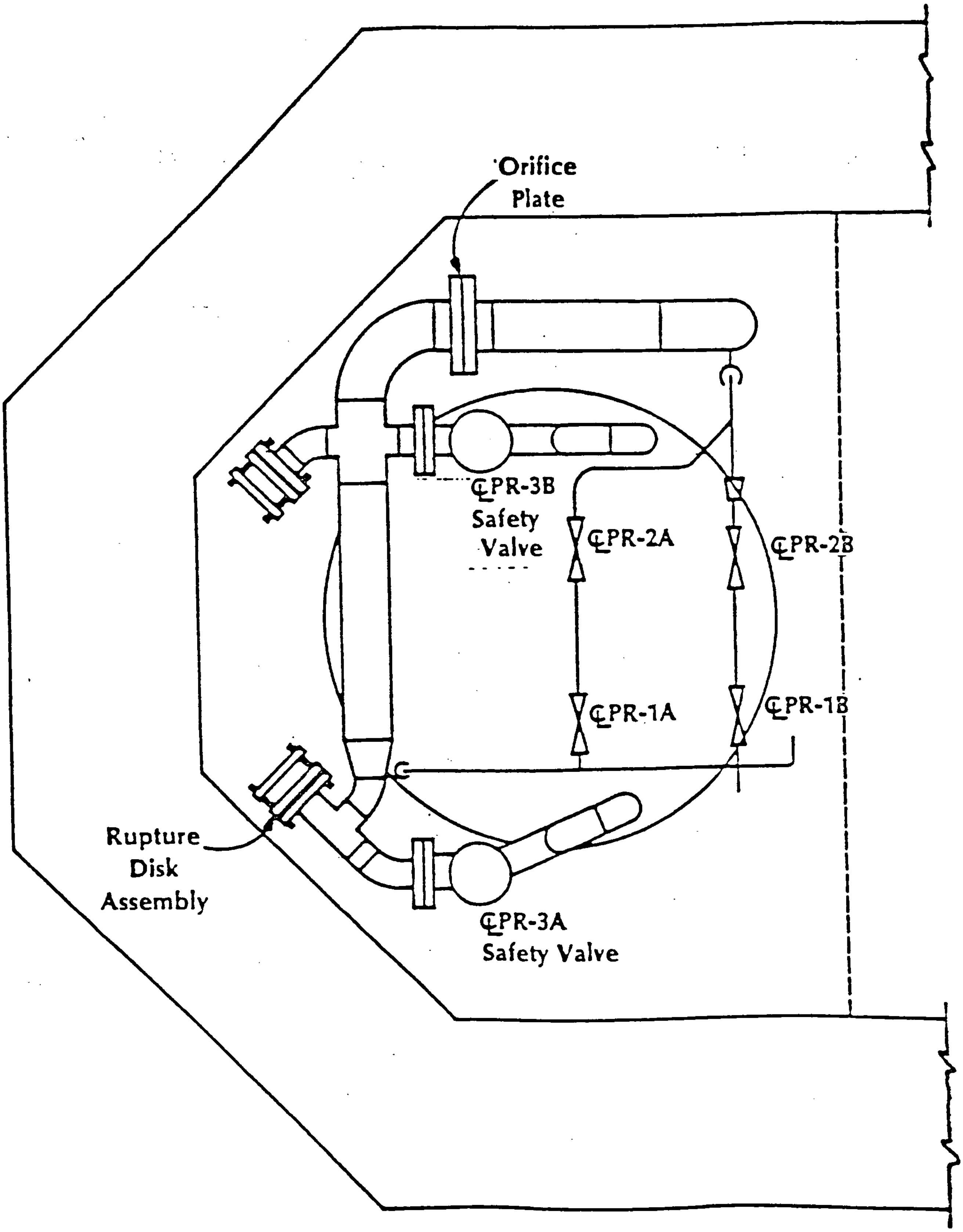

FIGURE -1: "PLAN VIEW OF KEWAUNEE RUPTURE DISC/BAFFLEPLATE ASSEMBLY CONFIGURATION"
(Figure A23-1, Reference 2)

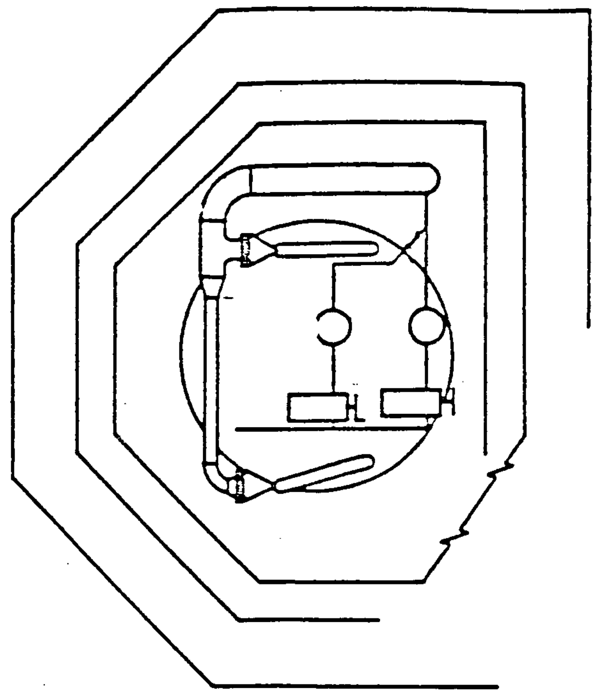

FIGURE-2a: "KEWAUNEE AS-BUILT--PLAN VIEW"
(Figure A23-2a, Reference 2)

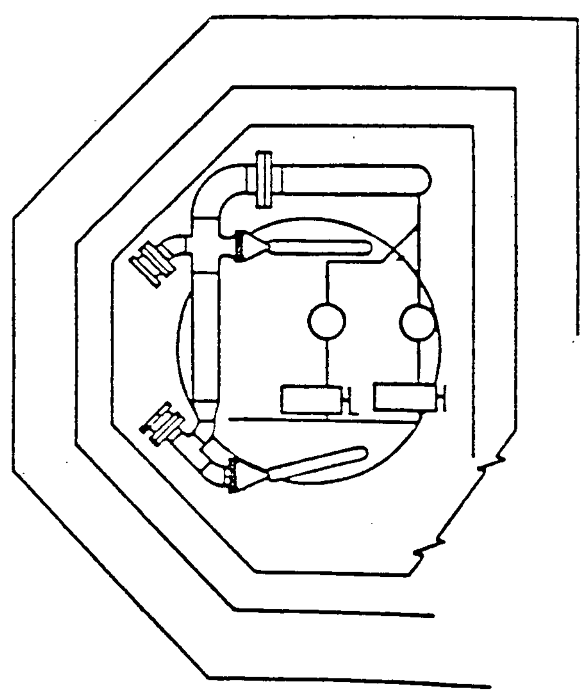

FIGURE -2b: "KEWAUNEE RUPTURE DISC/BAFFLEPLATE ASSEMBLY MODIFICATION--PLAN VIEW"
(Figure A23-2b, Reference 2)

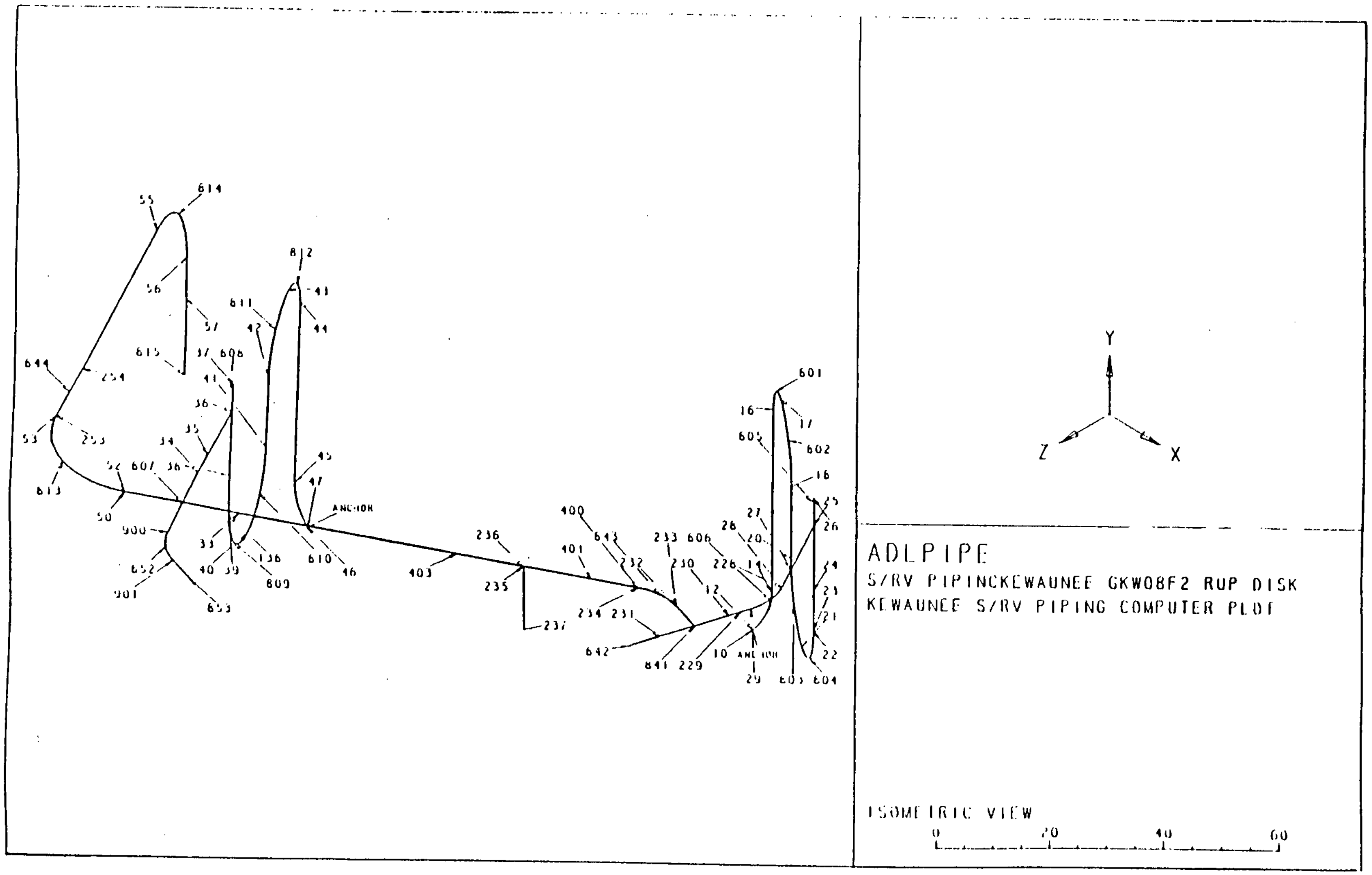

FIGURE-3: "PIPING ISOMETRIC OF THE KEWAUNEE S/RV DISCHARGE PIPING FROM SAFETY VALVES TO FIRST VERTICAL 10-INCH ELBOW"

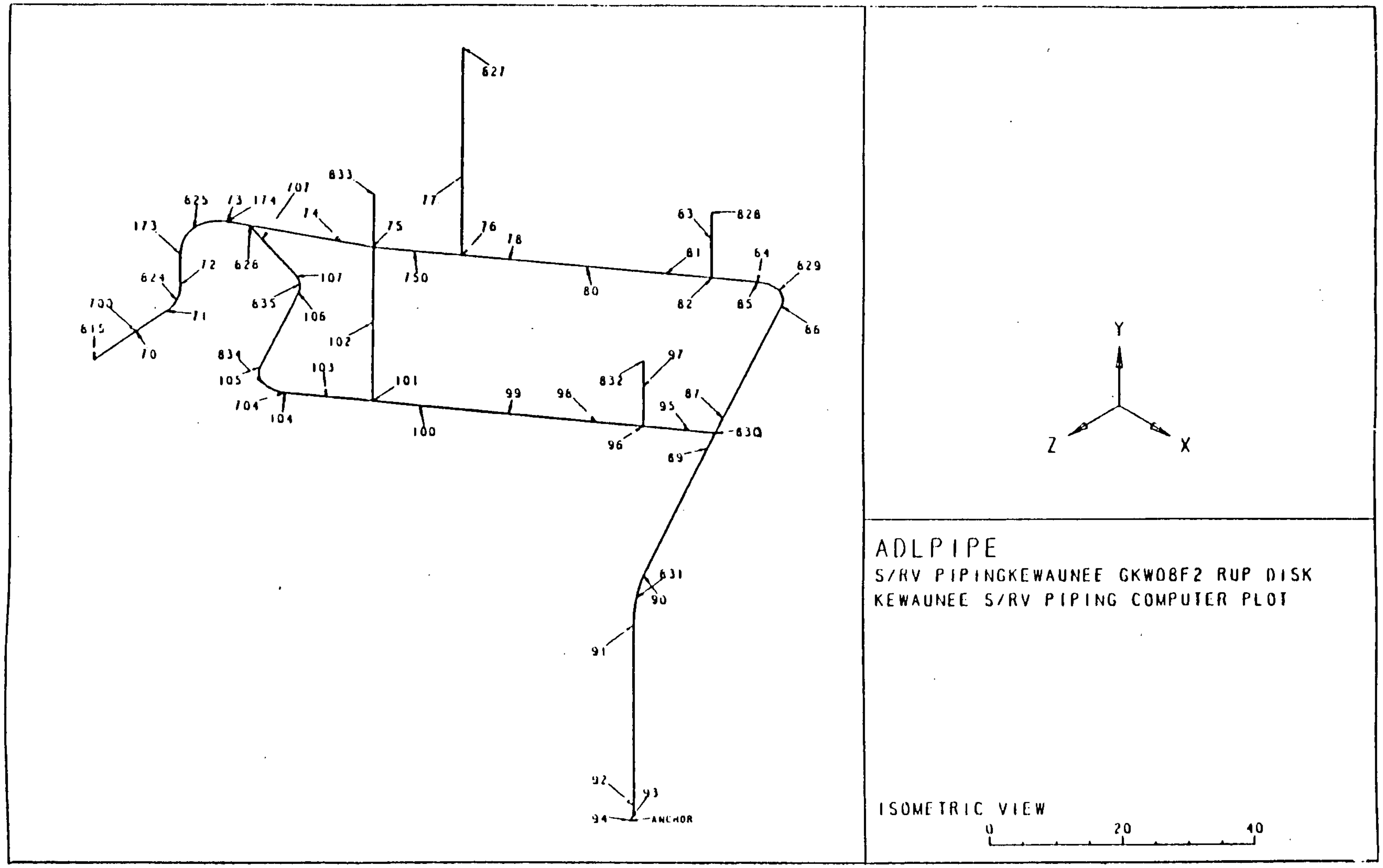

FIGURE-4: "PIPING ISOMETRIC OF THE KEWAUNEE S/RV DISCHARGE PIPING FROM PRESSURIZER THROUGH PORV'S"

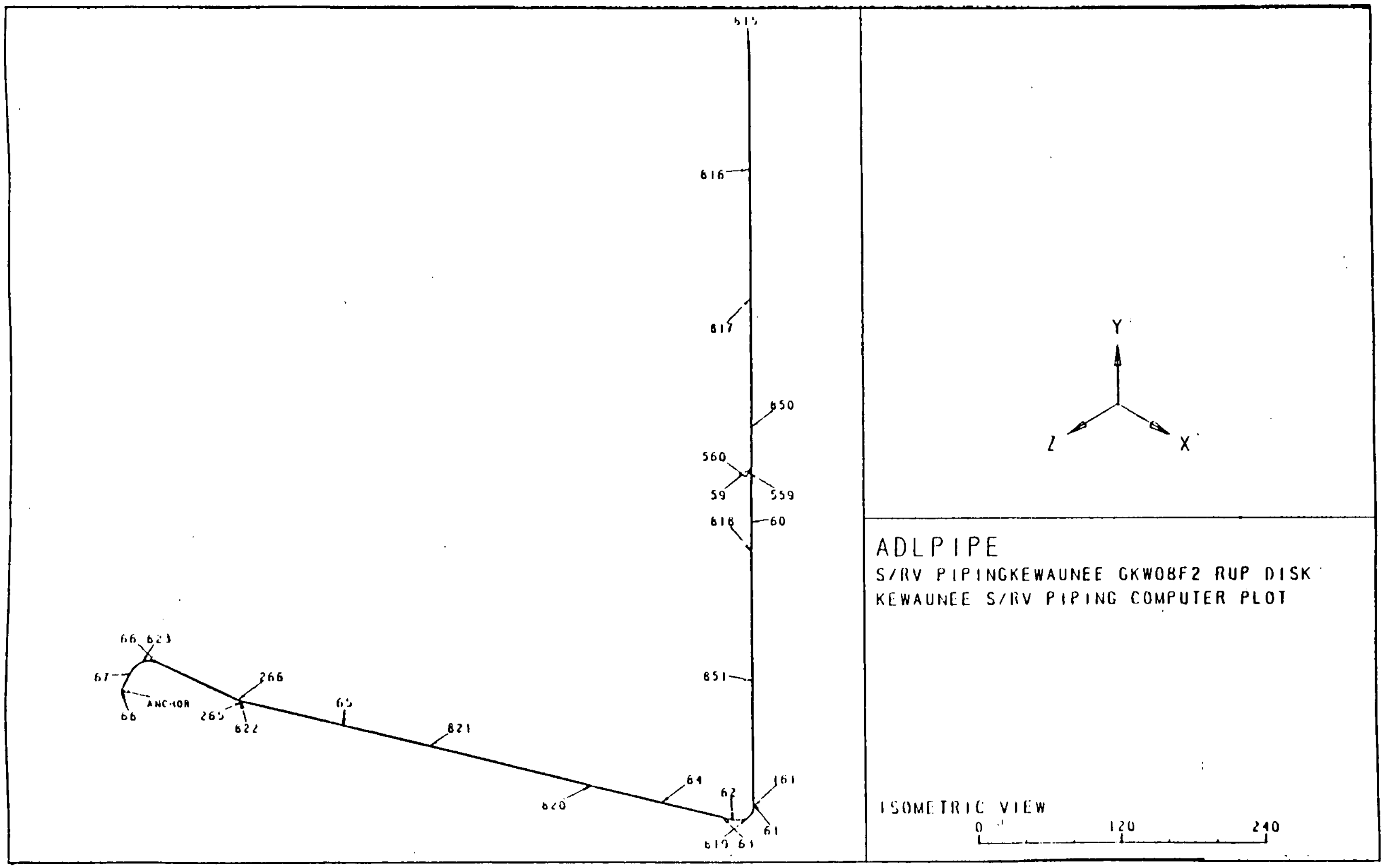

FIGURE -5: "PIPING ISOMETRIC OF THE KEWAUNEE S/RV DISCHARGE PIPING FROM 10-INCH BY 4-INCH TEE TO PRESSURIZER RELIEF TANK"

TABLE-1: "LOAD COMBINATIONS FOR FSAR CLASS I PIPING AND COMPONENTS"

Condition	Load Combination	B31.1 Equation	Stress Allowable	Remarks
Normal	DL + PI	11	Sh	Primary and normal loads
Upset	DL + PI ± $[SO^2 + SA^2 + ST1^2]^{1/2}$	12	1.2 Sh	Primary and occasional loads
	TE + TA	13	Sa	Secondary loads
	TE + TA + DL + PI	14	Sa + Sh	Secondary and primary loads to be evaluated only if equation 13 is exceeded
Faulted	DL + PI ± $[SS^2 + SA^2 + STn^2]^{1/2}$	12	2.4 Sh	Primary loads

TABLE-2: "SUPPORT LOAD COMBINATIONS"

Condition	Load Combination	Remarks
Normal	DL + TE1 DL	Largest of 2 cases
Upset	$DL + TE2 \pm (SO^2 + SA^2 + ST1^2)^{1/2}$ $DL \pm (SO^2 + SA^2 + ST1^2)$	Largest of 4 cases
Faulted	$DL + TE3 \pm (SS^2 + SA^2 + STn^2)^{1/2}$ $DL \pm (SS^2 + SA^2 + STn^2)^{1/2}$	Largest of 4 cases

TABLE 3: "DEFINITIONS AND LOAD ABBREVIATIONS"

Abbreviation or Symbol		Definition
DL	=	Dead loads consisting of the weight of piping and other superimposed permanent loads.
PI	=	Design pressure, psi.
SA	=	Loading due to Seismic Anchor Displacements.
Sa	=	Allowable stress range as defined by ANSI/ASME B31.1, psi
Sh	=	Hot allowable stress as defined by ANSI/ASME B31.1, psi.
SO	=	Loading due to Operational Basis Earthquake.
SS	=	Loading due to Design Basis Earthquake.
ST1	=	System Transient Loading (2 relief valves).
ST2	=	System Transient Loading (1 safety PR-3B).
ST3	=	System Transient Loading (2 safety simultaneous).
ST4	=	System Transient Loading (1 safety PR-3A).
STn	=	Largest of ST2, ST3, or ST4.
TA	=	Loading due to thermal anchor movements.
TE_n	=	Loading due to thermal expansion for mode n.

TABLE-4: "MAXIMUM STRESS VALUES FOR THE KEWAUNEE S/RV PIPING BASED ON CLASS I* LOAD COMBINATION FOR FAULTED CONDITIONS"

Node	Stress psi	Allowable psi	Comment
104	17,703	35,880	3-Inch Existing Outlet Piping
76	24,164	34,320	3-Inch Existing Inlet Piping
75	20,105	35,880	4-Inch Existing Outlet Piping
234	29,468	38,880	6-Inch Modified Outlet Piping
10	26,859	38,400	6-Inch Existing Inlet Piping
265	15,169	39,120	10-Inch Existing Outlet Piping
807	34,663	43,440	10-Inch Modified Outlet Piping

*Faulted Condition with two safety valve actuation.

Node	Stress psi	Allowable psi	Comment
104	19,345	35,880	3-Inch Existing Outlet Piping
94	22,326	34,320	3-Inch Existing Inlet Piping
71	18,665	35,880	4-Inch Existing Outlet Piping
400	22,854	38,880	6-Inch Modified Outlet Piping
10	21,542	38,400	6-Inch Existing Inlet Piping
56	15,717	39,120	10-Inch Existing Outlet Piping
807	28,901	43,440	10-Inch Modified Outlet Piping

*Faulted Condition with safety valve PR-3A actuation.

Node	Stress psi	Allowable psi	Comment
750	20,355	35,880	3-Inch Existing Outlet Piping
76	24,116	34,320	3-Inch Existing Inlet Piping
75	19,659	35,880	4-Inch Existing Outlet Piping
233	20,411	38,880	6-Inch Modified Outlet Piping
138	17,070	38,400	6-Inch Existing Inlet Piping
265	17,716	39,120	10-Inch Existing Outlet Piping
807	22,574	43,440	10-Inch Modified Outlet Piping

*Faulted Condition with safety valve PR-3B actuation.

TABLE-5: "MAXIMUM STRESS VALUES FOR THE KEWAUNEE S/RV PIPING BASED ON CLASS I* LOAD COMBINATION FOR NORMAL, UPSET, AND THERMAL RANGE CONDITIONS"

Node	Stress psi	Allowable psi	Comment
750	5,247	14,950	3-Inch Existing Outlet Piping
80	8,004	14,300	3-Inch Existing Inlet Piping
70	5,183	14,950	4-Inch Existing Outlet Piping
400	6,530	16,200	6-Inch Modified Outlet Piping
22	6,250	16,000	6-Inch Existing Inlet Piping
65	6,909	16,300	10-Inch Existing Outlet Piping
53	6,900	18,100	10-Inch Modified Outlet Piping

*Normal Condition.

Node	Stress psi	Allowable psi	Comment
104	8,022	17,940	3-Inch Existing Outlet Piping
94	13,272	17,160	3-Inch Existing Inlet Piping
71	9,823	17,940	4-Inch Existing Outlet Piping
400	8,905	19,440	6-Inch Modified Outlet Piping
10	8,373	19,200	6-Inch Existing Inlet Piping
265	8,368	19,560	10-Inch Existing Outlet Piping
52	8,382	21,720	10-Inch Modified Outlet Piping

*Upset Condition with two PORV actuation.

Node	Stress psi	Allowable psi	Comment
707	10,009	27,175	3-Inch Existing Outlet Piping
94	7,637	27,013	3-Inch Existing Inlet Piping
71	4,311	27,175	4-Inch Existing Outlet Piping
843	10,500	27,550	6-Inch Modified Outlet Piping
17	15,734	27,438	6-Inch Existing Inlet Piping
819	13,065	27,513	10-Inch Existing Outlet Piping
807	11,075	28,025	10-Inch Modified Outlet Piping

*Thermal Range Condition.

TABLE-6 "RESTRAINT DESIGN LOAD SUMMARY"

Restraint	Load: Normal lb	Load: Upset lb	Load: Faulted lb	Maximum Load lb	Minimum Load lb	Rated* Load lb	Notes
RC-H8	7,816	8,714	20,421	12,152	-20,421	12,152 -20,421	1, 3
RC-H7	941	941	941	941	--	941	1, 3
RC-H40	--	2,374	23,812	23,812	-23,812	±23,812	1, 3
RC-H6	1,709	1,709	1,709	1,709	--	1,709	1, 3
RC-H9	4,308	5,329	22,716	18,335	-22,716	18,335 -22,716	1, 3
RC-H5	1,232	1,232	1,232	1,235	--	1,835	2, 3
RC-H37	--	1,003	11,706	11,706	-11,706	±11,706	1, 3
RC-H73	--	1,711	15,183	15,183	-15,183	±15,183	4, 3
RC-H3	1,352	1,352	1,352	1,352	--	1,462	2, 3
RC-H4(X)	374	1,547	4,089	4,089	-2,037	±4,089	1, 3
RC-H4(Z)	108	1,030	3,465	3,013	-3,465	±3,465	1, 3
RC-H39	--	928	9,073	9,073	-9,073	±9,073	1, 3
RC-H38	--	999	9,222	9,222	-9,222	±9,222	1, 3
RC-H2	731	731	731	731	--	1,216	2, 3
RC-H1	745	745	745	745	--	924	2, 3
RC-H11	1,110	1,110	1,110	1,110	--	1,237	2, 3
RC-H12	899	899	899	899	--	977	2, 3

*Rated load for total support assembly includes standard components and/or structural items. It should be noted that the restraint may be rated for a higher load, but the structural supports (baseplate, anchors, etc.) are rated for the load calculated.

NOTES:
1. Restraint has been modified.
2. Restraint is as built before the S/RV piping modification design.
3. Positive (+) loads put the restraint in tension, negative (-) loads put the restraint in compression.
4. Restraint has been added.