SEABROOK STATION

RESOLUTION OF IDI FINDING 2-20

BASIS FOR ANALYSIS

Revised: April 21, 1986

Finding 2-20, Basis for Analysis

In conjunction with the Integrated Design Inspection (IDI) conducted for the Seabrook facility, a follow-up inspection at United Engineers & Constructors (UE&C) identified an open item regarding the screening criterion used to evaluate jet impingement effects on target piping and supports.

Branch Technical Position ASB 3-1, Appendix B states, "the energy level in a whipping pipe may be considered as insufficient to rupture an impacted pipe of equal or greater nomial pipe size and equal or heavier wall thickness." UE&C considers the loads induced in larger size target piping and supports by jet impingement effects to be less severe than the loads induced by a whipping pipe and, thus provide a greater margin against failure. The following is the staff's position on the use of the above screening criterion for jet impingement effects.

The SRP NUREG-0800 Section 3.6.1 Branch Technical Position ASB 3-1, paragraph I.(d) (footnote 1) and Section 3.6.2, paragraph III.2 state that the energy level associated with an unrestrained whipping pipe is considered capable of causing breaks in impacted pipes of smaller nominal pipe size and developing through-wall leakage cracks in impacted piping of equal or larger nominal pipe size with thinner wall thickness. Because of the fundamental difference between the nature of the loading caused by an unrestrained whipping pipe (dynamic impact) and a jet flow from a restrained pipe break or crack (static pressure), the staff has not permitted the above guidelines for whipping pipes to be extended to jet impingement even though the equivalent static load from a jet is generally less than that from a whipping pipe. The staff further recognizes, for high impact velocities associated with a whipping pipe, the strain rate effects can significantly increase the yield strength in the impacted pipe.

As a result, the staff does not find the use of the screening criterion to be acceptable for jet impingement effects. The staff requests that the applicant provide the following information for resolution of this item.

1) Identify the piping and supports in the Seabrook facility which are affected by this item. Include system description and plant location.

2) Demonstrate that safe shutdown of the Seabrook facility can be accomplished when the jet impingement loads are included in the evaluation of target piping systems.

3) Address the significance of including jet impingement loadings in the faulted load combination with respect to the ability of the target piping and supports to withstand the effects of the jet impingement load in combination with an SSE.

4) The jet impingement loading on the target pipe may be calculated using the methodology presented in ANSI/ANS-58.2 (1980), "Design Basis for Protection of Light Water Nuclear Power Plants Against Effects of Postulated Pipe Rupture" in addition to the guidelines in SRP Section 3.6.2, paragraph III.3.

Response: (Revised: April 21, 1986)

This submittal was revised as a result of several discussions with the NRC Staff and provides resolution of their concerns.

In a pipe rupture situation, the internal energy of the piping system is converted through fluid mass acceleration into a blowdown thrust force.

For the pipe-on-pipe impact scenario, virtually all of this blowdown thrust force is available to accelerate the severed pipe section into the target piping. In the time interval between pipe severance and impact into the target pipe, the broken pipe section will accumulate energy by virtue of the blowdown thrust force acting through a distance (i.e., the separation between the broken and target pipes). At the moment of impact, the target piping experiences both the energy of the whipping pipe (an equivalent mass striking it at a velocity) and the blowdown thrust force. Both of these components are dynamic in nature. After the impact energy has been dissipated by the target piping and its supporting system, a sustained reaction force equal to the blowdown thrust force must still be resisted by the target pipe.

For the jet impingement case, the target pipe does not experience the impact loading of the whipping pipe, but need only resist the blowdown thrust force, a suddenly applied dynamic load. In the jet impingement case for equal size pipe, however, the target pipe does not intercept the entire jet, and thus does not experience the full blowdown thrust load. In addition, the consideration of a shape factor, based upon the drag coefficient of an object in a stream, further reduces load on the target pipe. ANSI/ANS-58.2 (1980) provides a shape factor for pipe of 0.576.

Based upon these considerations, it is felt that the loads induced in equal or larger size target piping and its supporting system would be less severe and provide a greater margin against failure than the criteria provided in BTP ASB 3-1 regarding the pipe-upon-pipe impact loading cases. UE&C has utilized this as part of their screening criteria when considering the jet impingement effects on such piping.

To support our position, an extensive review was made of the piping failure modes and effects analysis (FMEA) study to determine the worst case jet-target interactions. The objective of the review was to select several jet-target interactions that represented worst-case situations, so that when analyzed, they could be considered bounding of all jet-target interactions at Seabrook Station.

Breaks in the reactor coolant, residual heat removal, safty injection, CVCS charging, letdown and seal injection systems, as well as main steam, feedwater and steam generator blowdown systems, were reviewed. These systems represent all of the major high energy systems in safety related areas and consist of both safety related and non-safety related portions. In addition, jet-target interactions were reviewed for non-nuclear safety (NNS) process systems located in safety related areas, such as the auxiliary steam and hot water heating systems.

The goal of the review was to select a large bore and a small bore case for analysis, with the target pipe the same size as the source. Attention was concentrated on selecting cases where the jet source was of high pressure and where the target was as close as possible to the jet source and was centered in the jet cone. The type of fluid was also considered, whether steam, flashing water, or non-flashing liquid. The target pipe supporting system was not considered in the review and no effort was made to select a case with any particular support configuration, so as to provide cases representative of typical ASME systems.

This review provided the 3" RTD Bypass Line Case (Reactor Coolant System) and the 6" Atmospheric Relief Valve Line Case (Main Steam System) discussed below.

To maximize the jet load, no credit was taken for friction losses in the broken pipe. To maximize the fraction of the jet affecting the target, the jet was considered to originate normal to the target pipe. Actual line supports were utilized and support loading developed and reviewed for acceptability. The loading was treated as a point force rather than a distributed load, and a DLF of 2.0 was applied to the full jet impingement force.

Example 1:

This example considered the effect on Loop 1 RTD Bypass Line (Line RC-15-06-2501-3") due to a rupture in Loop 4 RTD Bypass. Both lines are 3 inch, Schedule 160, Type 316 Stainless Steel, ASME Section III, Class 1. For conservatism, the jet source was considered to originate normal to the target pipe surface, rather than at the 20 degree skew angle. Jet loading was calculated following the methodology of ANSI/ANS-58.2 (1980). A dynamic load factor of 2.0 was applied to the full impingement jet force to account for the dynamic nature of the loading.

The target piping geometry is shown in Figure 1 of Appendix A.

For pipe stress evaluation, the amplified jet impingement loading (including the DLF of 2.0) was directly summed with the faulted condition maximum equation of stress calculated by Westinghouse in WCAP 9936, "ASME Section III Class 1 Piping Stress Analysis for the Seabrook Nuclear Generating Station Unit 1", which included Deadweight, Pressure, DBE, DBA and Faulted Transients. A-square-root-of-the-sum-of-the-squares (SRSS) method of stress combination was not used since Westinghouse provided only the total faulted stress in their stress reports. The resultant stresses were below the Code allowable stress limit of $3.0S_m$.

Support loads were evaluated in combination with faulted condition deadweight, thermal and seismic loads. All support member stresses were below the faulted allowable limits, adjusted for temperature.

Details of the analysis may be found in Appendix A.

Example 2:

This example considered the effect on Loop 4 Main Steam Atmospheric Relief Valve (ARV) line due to a rupture in Loop 1 ARV Line. Both lines are 6 inch, Schedule 80, Carbon Steel, ASME Section III, Class 2. Jet loading was calculated following the methodology of ANSI/ANS-58.2 (1980). A dynamic load factor of 2.0 was applied to the full jet impingement force to account for the dynamic nature of the loading.

The target piping geometry is shown in Figure 2 of Appendix A.

The impingement loading was treated as a concentrated load and input into an ADLPIPE model to calculate forces, moments and stresses. For pipe stress evaluation, the jet impingement stresses based upon the amplified jet impingement load, which included a DLF of 2.0, were conservatively combined with SSE-Seismic and SSE-Seismic Anchor Displacement Stresses by the square-root-of-the-sum-of-the-squares (SRSS) method. These stresses were then directly summed with faulted deadweight, pressure and thermal stresses. The resultant total stresses were below the Code allowable limit of 2.4 S_h.

Support loads were evaluated in combination with faulted condition deadweight, thermal and seismic loads. All support member stresses were below the faulted allowable limits adjusted for temperature.

Details of the analysis may be found in Appendix A.

Conclusion:

The above two examples have shown that jet impingement loads or equal size pipe targets yield acceptable pipe stress and support loads even when calculated conservatively. The examples evaluated utilized existing support designs and hardware and represented both ASME Section III, Class 1 and 2 categories.

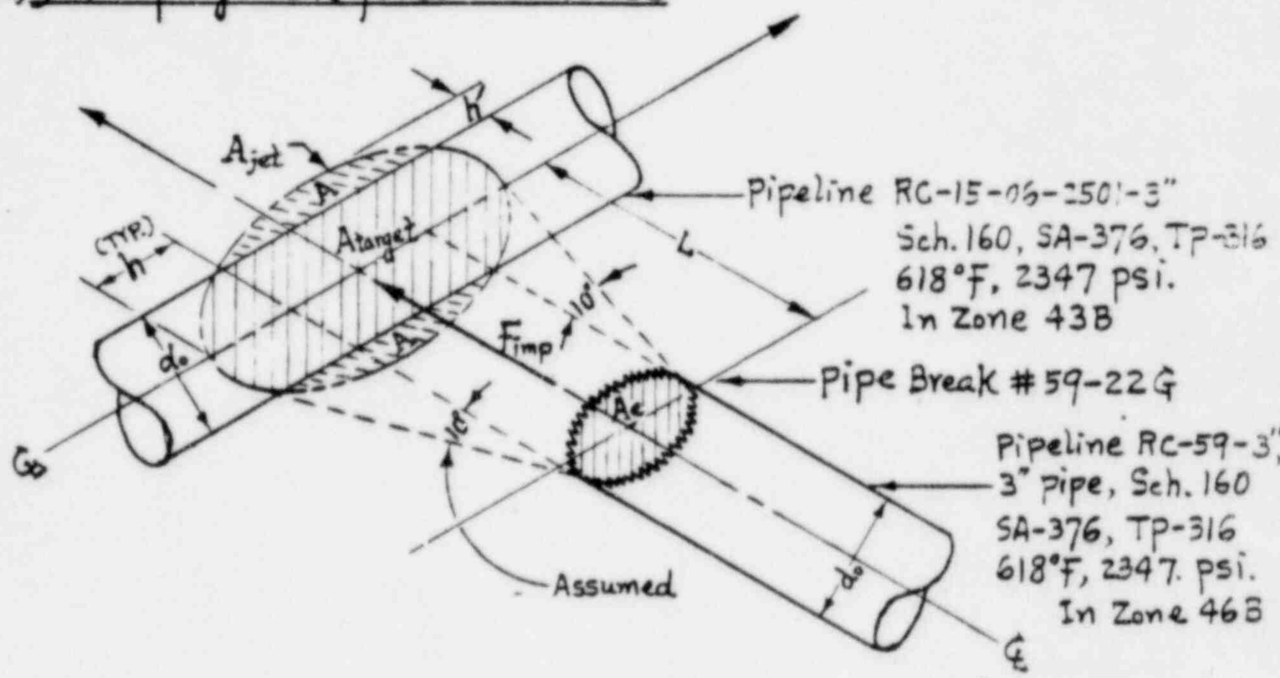
We conclude that we have selected worst case jet-target interactions with added conservatism to assure that the safe shutdown of the Seabrook Station can be accomplished when the jet impingement loads in question are included in the evaluation of all safety related target piping systems.

We feel that these examples show that the effect of jet impingement on targets of like size or larger are less severe than pipe whip effects and that the use of such a screening criteria is justified. We, therefore, consider this item closed.

Appendix A

I) For Break # 59-22G:

A) Jet Impingement Force Occurrence



From ANSI-ANS-58.2-1980, Pages 56~57, ———— Ref.(1)

$$F_{imp} = K_\phi F_{jet}\left(\frac{A_{target}}{A_{jet}}\right) \text{ ------------------ Eq.(D-1)}$$

$$F_{jet} = C_T P_o A_e \text{ ------------------ Eq.(D-3)}$$

$$\therefore \; F_{imp} = K_\phi C_T P_o A_e\left(\frac{A_{target}}{A_{jet}}\right) \text{ ------------------ (1)}$$

From Page 58 In Ref.(1), The Shape Factor, $K_\phi = 0.576$, For Circular Jet Impinging On Pipe With Jet Diameter Greater Than Target pipe Diameter.

Assume The Thrust Coefficient, $C_T \approx 1.26$, For A Steam-Water Mixed Fluid Through The Pipe With Friction Coeffient ≈ 0.

$P_o = 2{,}347$ psi.

$A_e = \frac{\pi D_i^2}{4} = \frac{\pi \times 2.626^2}{4} = 5.416 \text{ In}^2$, For 3", Sch.160 pipe

From The Figure On Sheet 1,

$L = 28''$

$h = L \tan 10^\circ = 28 \tan 10^\circ = 4.937''$

r = Radius Of Jet Circle $= \frac{1}{2} D_i + h = \frac{1}{2} \times 2.626 + 4.937''$
$= 6.250''$

$\therefore A_{jet} = \pi r^2 = \pi \times 6.25^2 = 122.725 \text{ in}^2$

$h' = h - t = 4.937 - 0.437 = 4.5''$

The Segment Area, A, Can Be Found From The Equation On The Top Of Page 17 In "The Engineers' Manual - Hudson (2nd Ed.)", - Ref. (2) Then

$$A = r^2 \cos^{-1}\frac{r-h'}{r} - (r-h')\sqrt{2rh' - h'^2}$$

$$= 6.25^2 \cos^{-1}\frac{1.75}{6.25} - (1.75)\sqrt{2 \times 6.25 \times 4.5 - 4.5^2}$$

$$= 39.774 \text{ in}^2$$

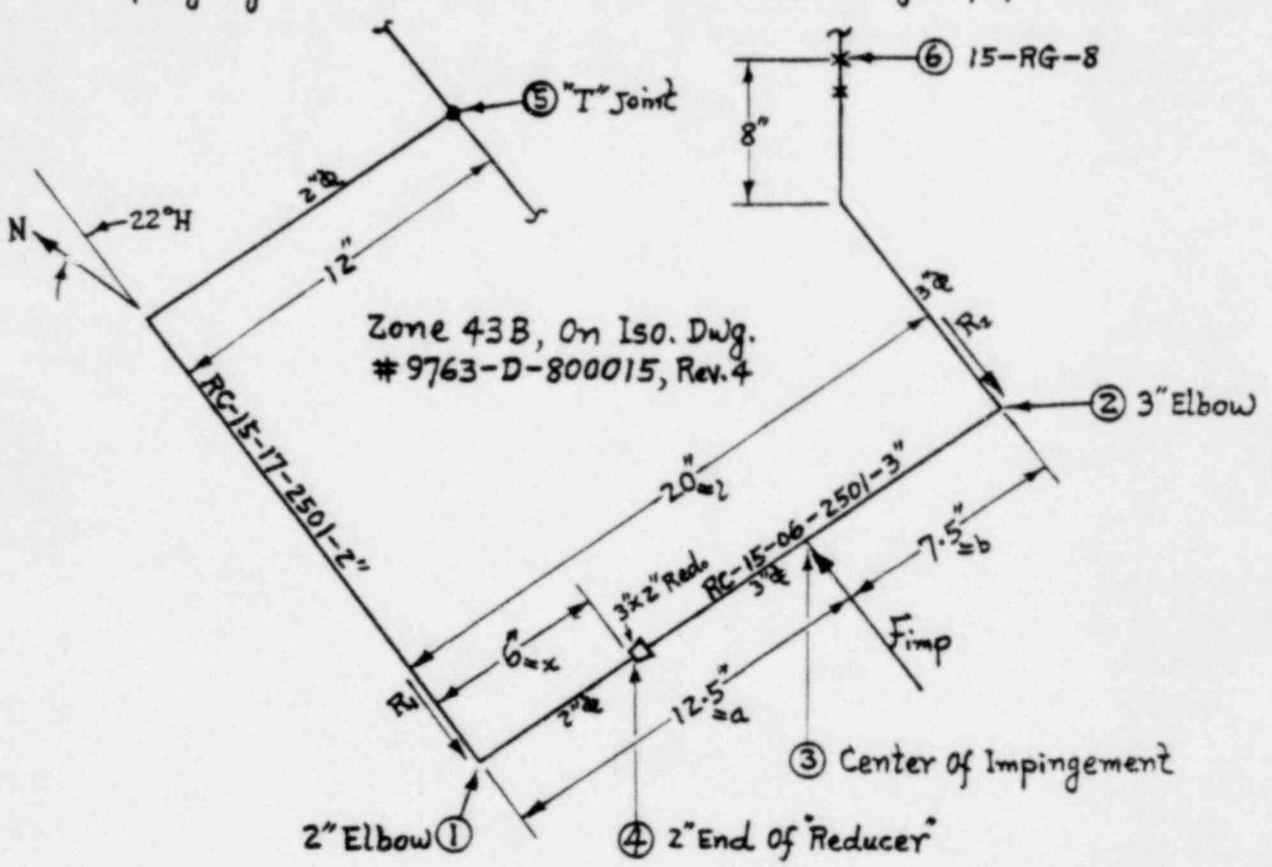
$\therefore A_{target} = A_{jet} - 2A = 122.725 - 2(39.774) = 43.178 \text{ in}^2$

Substituting All The Above Data Into Equation (1) On Sheet 1,

$$F_{imp} = 0.576 \times 1.26 \times 2{,}347. \times 5.416 \times \frac{43.178}{122.73} = 3246 \text{ lbs.}$$

Apply a dynamic load factor of 2.0. Then the amplified $F_{imp} = 2(3246) = 6492$ lbs. This amplified F_{imp} of 6492 lbs, will be used as static load to compute loading on piping systems as follows

B) Impinging Loads To Various Points On The Target Pipeline



For Conservative Purpose, Treat Beam ①-② As A Simply-Supported Beam To Take A Conc. Load. From The Formulae For The "Sample Beam, No. 8," On page 2-116, In "AISC" Manual Of Steel Construction, 8th Ed. ——Ref.(3), The Reactions At points ① And ② Are:

$$R_1 = \frac{F_{imp} b}{l} = \frac{6492 \times 7.5}{20.} = 2434 \text{ Lbs.}$$

$$R_2 = F_{imp} - R_1 = 6492 - 2434 = 4058 \text{ Lbs.}$$

The Moments At Points, ③, ④, ⑤ & ⑥ Are:

$$M_3 = \frac{F_{imp}\, a b}{l} = \frac{6492 \times 12.5 \times 7.5}{20.} = 30430 \text{ In.-Lbs.}$$

$$M_4 = \frac{F_{imp} b x}{l} = \frac{6492 \times 7.5 \times 6}{20.} = 14607 \text{ In.-Lbs.}$$

$$M_5 = R_1 \times 12'' = 2434 \times 12 = 29213 \text{ In.-Lbs.}$$

$$M_6 = R_2 \times 8'' = 4058 \times 8 = 32459 \text{ In.-Lbs.}$$

The Moments Of Inertia For 2" And 3" Pipes Of Sch. 160,

$$I_2 = \frac{\pi}{64}(d_o^4 - d_i^4) = \frac{\pi}{64}(2.375^4 - 1.689^4) = 1.162 \text{ In.}^4, \quad \text{For 2" Pipe}$$

$$I_3 = \frac{\pi}{64}(d_o'^4 - d_i'^4) = \frac{\pi}{64}(3.5^4 - 2.626^4) = 5.032 \text{ In.}^4. \quad \text{For 3" Pipe}$$

The Bending Stresses At Points ③, ④, ⑤ & ⑥ Are:

$$S_3 = \frac{M_3 d_o'}{2 I_3} = \frac{30430 \times 3.5}{2 \times 5.032} = 10583 \text{ psi.}$$

$$S_4 = \frac{M_4 d_o}{2 I_2} = \frac{14607 \times 2.375}{2 \times 1.162} = 14923 \text{ psi.}$$

$$S_5 = \frac{M_5 d_o}{2 I_o} = \frac{29213 \times 2.375}{2 \times 1.162} = 29846 \text{ psi.}$$

$$S_6 = \frac{M_6 d_o'}{2 I_3} = \frac{32459 \times 3.5}{2 \times 5.032} = 11288 \text{ psi.}$$

For Finding The Maximum Possible Stresses At The Two Ends Of Beam ①-②, Use Another Approach To Treat It As A Fixed-End Beam With The Same Concentrated Load. From The "Sample Beam, No. 17," On page 2-119 Of Ref. (3),

$$M_1 = \frac{F_{imp} a b^2}{l^2} = \frac{6492 \times 12.5 \times 7.5^2}{20^2} = 11412 \text{ In.-Lbs.}$$

$$M_2 = \frac{F_{imp} a^2 b}{l^2} = \frac{6492 \times 12.5^2 \times 7.5}{20^2} = 19019 \text{ In.-Lbs.}$$

Then, At points, ① And ②,

$$S_1 = \frac{M_1 d_o}{2I_2} = \frac{11412 \times 2.375}{2\times1.162} = 11{,}658 \text{ psi.}$$

$$S_2 = \frac{M_2 d_o'}{2I_3} = \frac{19019 \times 3.5}{2\times5.032} = 6{,}615 \text{ psi.}$$

C) Total Other Stresses At Some Key Points In "Westinghouse's Analysis"

From Table 6-8 In "Westinghouse's Analysis"—Full Tittle As Ref. (4), Faulted Condition, Primary Stress Summary Are Listed At Different Node points. The Corresponding Node points To This Calculation Are Determined From Fig. 6-6 of Ref. (4). Then The Maximum Stresses In Faulted Condition At points, ④ And ⑤, Of This Calculation Are:

$S_4' = 16{,}940.$ psi., At Node point, 2270, In Ref. (4)

$S_5' = 17{,}770.$ psi., " " " , 2000, " "

The Allowable Stress For Both points,

$3S_m = 49{,}800.$ psi.

D) Qualification Of The Overall Maximum Stress At The Main Concerned Points

On The Same Branch Directly Taking Fimp, The Higher Stress Is At point ④, Then

$$S_{max} = S_4 + S_4' = 14923 + 16{,}940.$$

$$= 31{,}863 \text{ psi.} < 3S_m = 49{,}800. \text{ psi.}$$

∴ This Branch Of pipe Is Qualified To Take The Jet Imping. Load.

Due To That No Support Can Take The Axial Load In Either Side Of The Reaction Forces Produced From The Jet Impingement Force, The Reaction Forces, R_1 And R_2, Will Directly Transfer To points ⑤ And ⑥. Then The Maximum Stress At point ⑤ Is:

$$S'_{max} = S_5 + S'_5 = 29{,}846 + 17{,}770. \quad \left(B_{2b} \text{ stress index} = 0.4\left(\frac{R_m}{T_r}\right)^{2/3} = 0.8231, \text{ Use } 1.0\right)$$

$$= 47{,}616 \text{ psi.} < 3S_m = 49{,}800. \text{ psi.}$$

∴ All The Left Hand Side Branches To Take partial Jet Impingement Force Thru R_1 Are Qualified.

At point ⑥, There Is Not A Corresponding Data In "Westinghouse's Analysis"; But, However, $S_6 = 11{,}681.$ psi. Is Averagely Lower Than Those In Other Points, So The Right Hand Side Branches To Take partial Jet Impingement Force Thru R_2 Can Be Seen As Qualified Also.

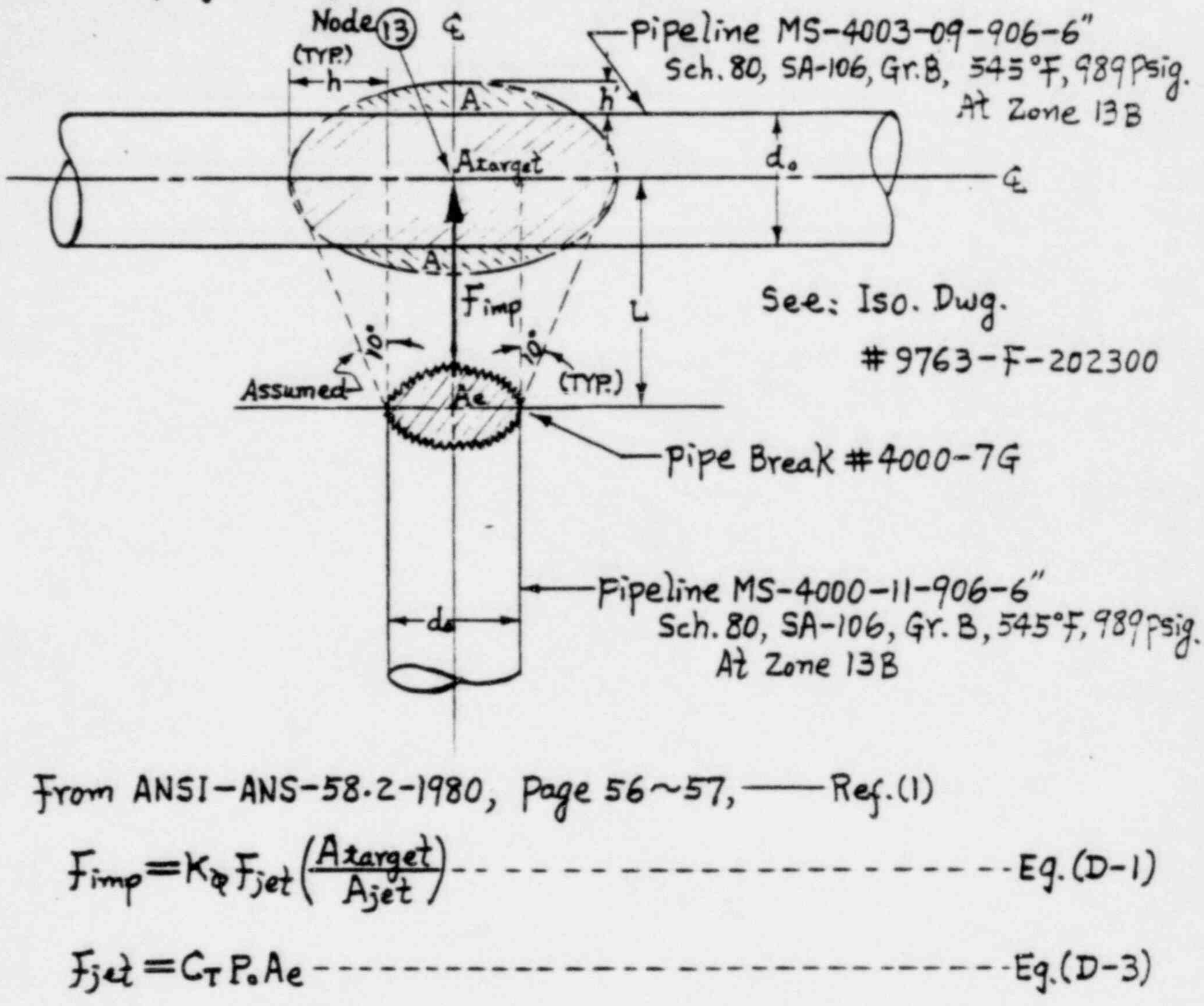
E) Conclusion

All The Pipeline, RC-15, Is Qualified To Take The Jet Impingement Load Created By "Break #59-22G."

The Partial Jet Impingement Load Taken By The Only "Pipe Support, 15-RG-8." $= R_2 = 4{,}058$ Lbs., While The Other Partial Jet Impingement Load, $R_1 = 2434$ Lbs., Will Go To The "T" Joint Shown By ⑤. These Loads Create Bending Moments, M_5 & M_6, On The Two points As Indicated On Sheet 4.

II) For Break #4000-7G:

A) Jet Impingement Force Occurrence



From ANSI-ANS-58.2-1980, Page 56~57, —— Ref. (1)

$$F_{imp} = K_\phi F_{jet}\left(\frac{A_{target}}{A_{jet}}\right) \text{ ------------------- Eq. (D-1)}$$

$$F_{jet} = C_T P_o A_e \text{ ------------------------- Eq. (D-3)}$$

$$\therefore \; F_{imp} = K_\phi C_T P_o A_e \left(\frac{A_{target}}{A_{jet}}\right) \text{ ------------------- (1)}$$

From Page 58 In Ref. (1), the Shape Factor, $K_\phi = 0.576$, For Circular Jet Impinging On Pipe With Jet Diameter Greater Than Target pipe Diameter.

From Page 36 Of Ref.(1), The "Thrust Coefficient" For Saturated Or Superheated Steam,

$C_T = 1.26 - P_a/P_o$ Eq. (B-3)

Assume: $P_a = 14.7$ psi.

$P_o = 989 + 14.7 \doteq 1{,}004.$ psi.

$\therefore\ C_T = 1.26 - 14.7/1{,}004. \doteq 1.25$

$A_e = \frac{\pi D_i^2}{4} = \frac{\pi \times 5.761^2}{4} = 26.067$ In.^{2}, For 6", Sch. 80 pipe

From The Figure On Sheet 7,

$L = 39.3''$

$h = L \tan 10° = 39.3 \tan 10° = 6.93''$

r = Radius Of Jet Circle $= \frac{1}{2} D_i + h = \frac{1}{2} \times 5.761 + 6.93$

$= 9.81''$; $h' = h - 0.432 = 6.93 - 0.432 = 6.5$

$\therefore\ A_{jet} = \pi r^2 = \pi \times 9.81^2 = 302.33$ In.^{2}

The "Segment Area", A, Can Be Found From The Equation On The Top Of Page 17 In "The Engineers' Manual—Hudson (2nd Ed)"—Ref.(2); Then

$A = r^2 \cos^{-1}\frac{r-h'}{r} - (r-h')\sqrt{2rh' - h'^2}$

$= 9.81^2 \cos^{-1}\frac{3.3125}{9.81} - (3.3125)\sqrt{2(9.81)(6.5) - 6.5^2}$

$= 118.02 - 30.59 = 87.43$ In^2

$\therefore A_{target} = A_{jet} - 2A = 302.33 - 2 \times 87.43 = 127.47 \text{ In}^2$

Substituting All The Above Data Into Equation (1),

$$F_{imp} = 0.576 \times 1.25 \times 1{,}004. \times 26.067 \left(\frac{127.47}{302.33}\right)$$

$$= 7945. \text{ Lbs.}$$

Apply a dynamic load factor of 2.0; Then the amplified $F_{imp} = 2 \times 7945. \rightarrow 15{,}890.$ lbs This amplified value of F_{imp} of 15,890. lbs. is used to compute loading on piping system, as follows:

B) Stresses And Support Loads Of Line 4003

1) Using The Ratio, 15,890/10,000, Multiplying The Results Of $F_{imp} = 10{,}000.$ Lbs., As An "External Force", put Into "ADL-Pipe Model", The Forces, Moments And Stresses At Various Node points On The Pipeline, MS-4003-06-906-6", As Shown On The Iso. Dwg. No. 9763-F-202300 (Fig. 2), Are Obtained From The "Computer Output".

2) The Pipe Stresses Due To Deadweight, Thermal Expansion, Seismic, Etc., Were Provided By "FMEA".

3) Combine All The Stresses Obtained Above Into The Tables As Shown On Sheets 10 And 11. The Jet Impingement, SSE

and SAD-SSE Loads are combined using the S.R.S.S. method.

4) The pipe Support Loads Due To Jet Impingement Only Are Listed On Sheet 12.

C) Stress Profile Tabulation

Node No.	Dead Weight	Internal Pressure	Thermal	SSE ≈2×OBE	SAD-SSE ≈ 2×SAD-OBE	Jet Impingement	Total
5	2.	5,145.	49.	132.	66.	126.	5,390.
7	160.	"	3,069.	7,306.	5,166.	14,357.	25,291.
9	168.	"	2,292.	1,122.	4,074.	12,655.	20,945.
10	56.	"	2,901.	1,550.	3,610.	8,112.	17,115.
12	42.	"	1,702.	1,278.	2,808.	4,148.	12,059.
13	101.	"	2,942.	1,984.	1,434.	25,601.	33,906.
14	114.	"	3,228.	2,146.	1,118.	9,059.	17,864.
16	188.	"	5,476.	2,596.	1,522.	10,645.	21,871.
17	375.	"	4,950.	2,576.	1,904.	9,941.	20,914.
20	397.	"	2,380.	2,182.	1,498.	14,107.	22,275.
22	295.	"	1,490.	4,638.	1062.	6,930.	15,337.
24	394.	"	4,888.	3,448.	704.	2,766.	14,903.
26	353.	"	8,174.	3,312.	840.	4,574.	19,376.
27	260.	"	7,796.	2,904.	1,200.	4,393.	18,602.
29	223.	"	4,428.	3,026.	1,306.	2,540.	13,951.

Node No.	Dead Weight	Internal Pressure	Thermal	SSE ≈2×OBE	SAD-SSE ≈ 2× SAD-OBE	Jet Impingement	Total
31	770.	5,145.	2,755.	9,196.	890.	1,809.	18,084.
33	811.	"	1,142.	8,978.	450.	1,064.	16,150.
35	203.	"	1,566.	2,556.	126.	501.	9,522.
37	349.	"	2,585.	3,756.	176.	853.	11,760.
38	530.	"	2,486.	4,462.	214.	1,155.	12,775.
40	467.	"	1,469.	3,696.	184.	787.	10,864.
42	692.	"	2,342.	4,986.	240.	1,435.	13,373.
43	818.	"	2,131.	5,626.	240.	1,510.	13,924.
45	258.	"	926.	2,118.	118.	221.	8,462.
47	479.	"	910.	2,184.	144.	53.	8,723.
49	636.	"	1,496.	2,508.	186.	47.	9,792.
51	524.	"	1,635.	1,668.	190.	129.	8,988.
53	368.	"	1,310.	1,944.	170.	162.	9,281.
54	248.	"	1,991.	2,848.	152.	94.	10,238.
56	25[illegible].	"	1,261.	2,934.	114.	126.	9,602.
60	483.	"	981.	3,656.	80.	98.	10,267.
63	576.	"	1,344.	1,782.	42.	116.	8,851.
65	308.	"	786.	1,412.	42.	20.	7,652.
67	775.	"	1,673.	3,100.	80.	142.	10,697.
71	2,939.	"	2,151.	8,172.	122.	183.	18,410.

D) Support Loads Due To Jet Impingement Loading

Node No.	Support No.	F_x (Lbs.)	F_y (Lbs.)	F_z (Lbs.)	M_x (Ft-Lbs.)	M_y (Ft-Lbs.)	M_z (Ft-Lbs.)
20	4003-SG-22	0.	13,149.	0.	0.	0.	0.
24	" -SG-23	-23.	1,485.	0.	0.	0.	0.
29	" -RM-24	0.	0.	-42.	0.	0.	0.
35	" -RG-25	0.	0.	-89.	0.	0.	0.
45	" -SG-26	0.	-196.	0.	0.	0.	0.
56	" -RG-27	0.	0.	127.	0.	0.	0.
79	" -RG-29	0.	0.	0.	0.	0.	0.
5	"T"-Anchor	57.	4,414.	18.	-3,027.	-465.	6,961.
76	4003-A-28	-33.	6.	-15.	-60.	80.	93.

E) Conclusion

The Maximum Total Stress Is At Node point, #13, Right On The Jet Impinging Center, Where

$S_{max} = 33,906.$ psi. $< 2.4\,S_h = 36,000.$ psi.

While $S_h = S_c = 15,000$ psi. For SA-106, GR.B, Carbon Steel. Thus, This Target Pipeline, MS-4003-09-906-6", Is Qualified To Take The Jet Impingement Load From "Break #4000-7G."

III) <u>References</u>:

1) ANSI-ANS-58.2-1980

2) The Engineers' Manual — Hudson (2nd Edition)

3) AISC Manual Of Steel Construction (8th Edition)

4) WCAP-9936, ASME Section III Class 1 pipe Stress Analysis for The Seabrook Nuclear Generating Station, Unit 1, By: Westinghouse Electric Corporation, Nuclear Energy Systems.

Figure 1

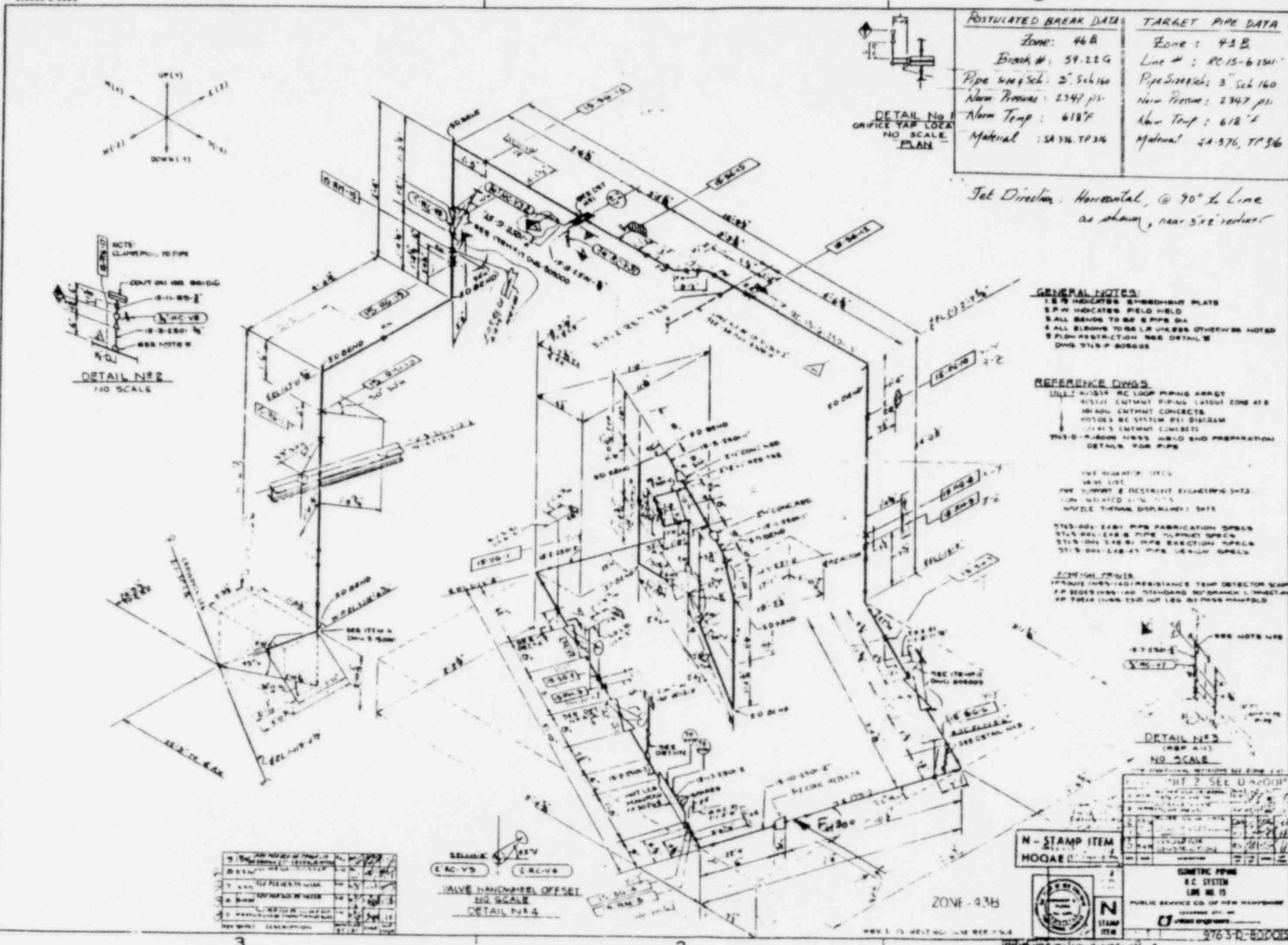
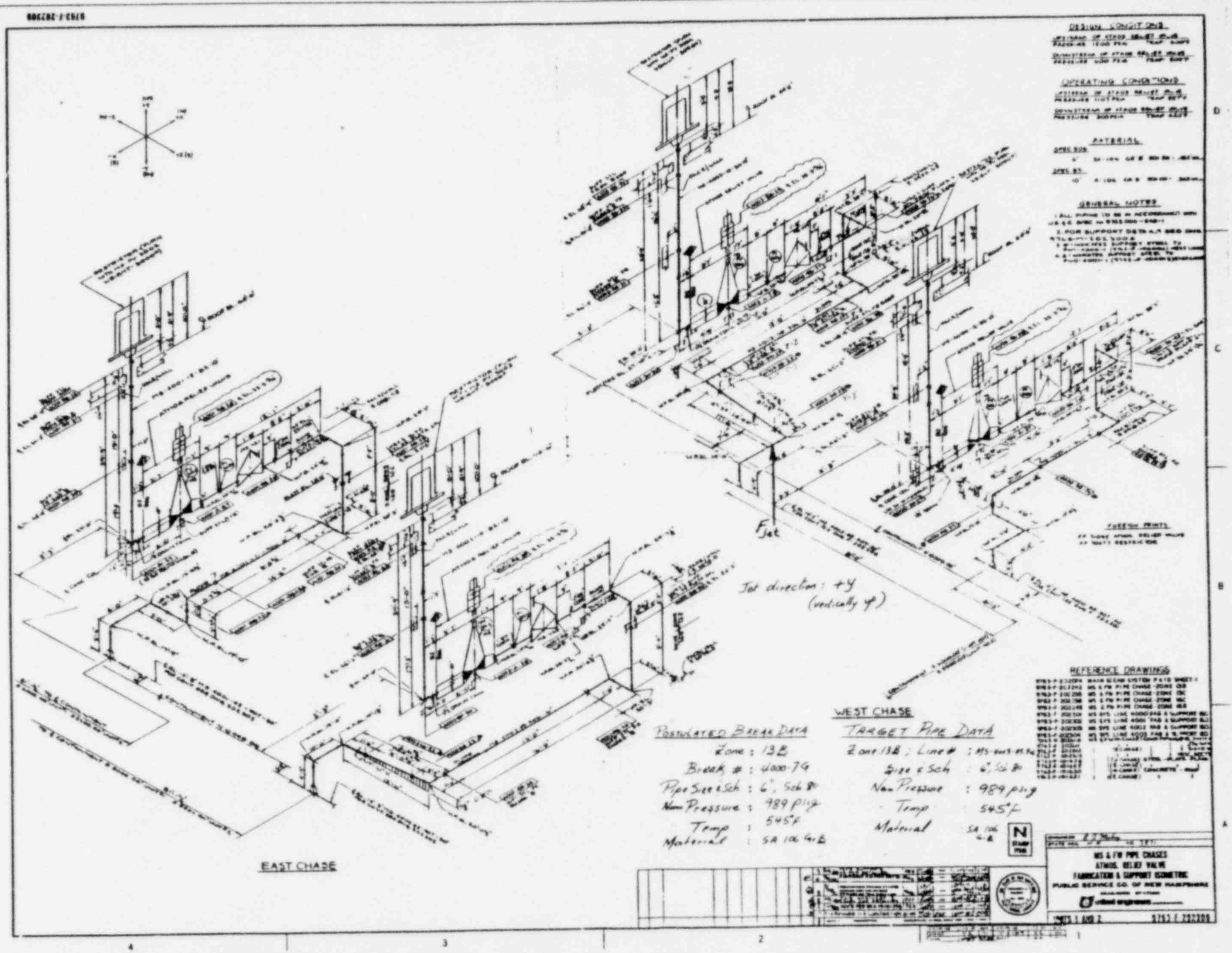

POSTULATED BREAK DATA
Zone: 46B
Break #: 59.22G
Pipe size & Sch: 2" Sch 160
Nom Pressure: 2347 psi
Nom Temp: 618°F
Material: SA 376, TP 316
TARGET PIPE DATA
Zone: 43B
Line #: RC-15-6-2501
Pipe Size & Sch: 3" Sch 160
Nom Pressure: 2347 psi
Nom Temp: 618°F
Material: SA-376, TP 316
Jet Direction: Horizontal, @ 90° to Line as shown, near 3"x2" reducer
DETAIL No 1
ORIFICE TAP LOCA
NO SCALE
PLAN
GENERAL NOTES:
REFERENCE DWGS
DETAIL No 2
NO SCALE
DETAIL No 3
NO SCALE
VALVE HANDWHEEL OFFSET
NO SCALE
DETAIL No 4
N-STAMP ITEM
ZONE-43B
ISOMETRIC PIPING
R.C. SYSTEM
PUBLIC SERVICE CO. OF NEW HAMPSHIRE
9763-D-802015
A
B
C
1
2
3

Figure 2



EAST CHASE
WEST CHASE
Jet direction: +y
(vertically up)
FJet
POSTULATED BREAK DATA
Zone : 13B
Break # : 4000-79
Pipe Size & Sch : 6", Sch 80
Nom Pressure : 989 psig
Temp : 545°F
Material : SA 106 Gr B
TARGET PIPE DATA
Zone 13B ; Line #
Size & Sch : 6", Sch 80
Nom Pressure : 989 psig
Temp : 545°F
Material : SA 106 Gr B
DESIGN CONDITIONS
OPERATING CONDITIONS
MATERIAL
GENERAL NOTES
REFERENCE DRAWINGS
MS & FW PIPE CHASES
ATMOS. RELIEF VALVE
FABRICATION & SUPPORT ISOMETRIC
PUBLIC SERVICE CO. OF NEW HAMPSHIRE