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SCHWENCER,A. Licensing Branch 2

SUBJECT: Forwards revised FSAR pages describing jet area based on target location to replace Page 3.6-46.

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February 19, 1982
G02-82-239

Docket No. 50-397

Mr. A. Schwencer, Chief
Licensing Branch No. 2
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Schwencer:

Subject: NUCLEAR PROJECT NO. 2
WNP-2 JET IMPINGEMENT ANALYSIS METHODOLOGY

As discussed in a phone conversation between the NRC staff (Mr. R. Auluck and Ms. R. Li) and Supply System representatives on February 12, 1982, the following information is provided.

Revised FSAR pages describing the jet area based on target location are attached. These pages will replace the current page 3.6-46 of the FSAR. The jet area description follows the guidance of paragraph C2 of Appendix C, ANSI 58.2-1980. Please note that for non-flashing subcooled jets Equation 3.6.2.3.1-12 now specifies the jet area to be taken equal to the break area. As discussed in our phone conversation of February 12, 1982, subcooled jets have been first considered to expand at a 10° half-angle and any target within this cone is assumed to fail. Similarly for steam-water (i.e., flashing) jets any target within the theoretical jet envelop (see Appendix C of ANSI 58.2) is postulated to fail, regardless of the fact that the asymptotic plane location may exceed five (5) pipe diameters from the jet exit (see SRP 3.6.2, Section III, 3.(f)).

Although the pipe rupture assessment of the WNP-2 plant is not complete, this conservative approach has resulted in no postulated pipe break which precluded reactor safe shutdown or necessitated a specific jet impingement barrier to be installed in-plant. We plan to continue with the conservative jet loading philosophy described above and will retain the details of each break location analysis in auditable files.

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Should you have any further concern in this matter, please contact Mr. Pat Powell, (509) 377-2501 Extension 2909. Thank you.

Very truly yours,

G D Bouchey

G. D. Bouchey
Deputy Director, Safety and Security

DMB/jca

cc: R Auluck - NRC
WS Chin - BPA
R Feil - NRC Site
R Li - NRC

(T/A_E) yields the thrust reaction load on the piping system subject to the assumption that the vapor to liquid velocity ratio is unity. By conservation of forward momentum, the jet force per unit area (F_j/A_E) equals the thruse force per unit area (T/A_E). To determine the effect of the fluid jet on targets located some distance L_T, from the break, the following procedure is used.

Classify target distance L_T, as less than, equal to, or greater than the distance required for full jet expansion L_∞.
REFER TO FIGURE 3.6-3.
Where:

$$L_\infty = \frac{D_E}{2}\left[\left(\frac{A_\infty}{A_E}\right)^{1/2} - 1\right] \qquad \text{Eq. 3.6.2.3.1-2}$$

$$\frac{A_\infty}{A_E} = \left[\frac{G_E^2}{g_c}\right]\left[\frac{\bar{v}_\infty}{T/A_E}\right] \qquad \text{Eq. 3.6.2.3.1-3}$$

$$\bar{v}_\infty = f\,(P_\infty, h_E) \qquad \text{Eq. 3.6.2.3.1-4}$$

where:

A_∞	-	area of jet at full expansion	ft^2
A_E	-	area of exit	ft^2
D_E	-	diameter of exit	ft
G_E	-	mass flux	$lb_m/sec.\ ft^2$
g_c	-	Newton's Constant	$32.174\ \frac{ft\text{-}lb_m}{lb_f\ sec^2}$
h_E	-	exit plane enthalpy	BTU/lb
L_∞	-	distance to full expansion	ft
P_∞	-	receiver pressure	lb_f/ft^2

For $L_T < L_\infty$, property variations are assumed linear from A_E to A_∞ for area and from P_E to P_∞ for pressure.

The jet impingement load F_j, is as follows with F_j, a constant:

$$F_{jT} = F_j \times \frac{A_T}{A_L} \qquad \text{Eq. 3.6.2.3.1-8}$$

where:

A_T - is the area of target which is intercepted by the jet.

A_L - is the jet area at the target distance calculated as:

In Region 1: for $0 < L_T \leq L_\infty$

$$A_L = (A_\infty - A_E) \frac{L_T}{L_\infty} + A_E \qquad \text{Eq. 3.6.2.3.1-9}$$

For $L_T < L_\infty$ Add Attachment As shown

$$D_j = \frac{L_T}{L_\infty} D_\infty \quad \text{for } L_\infty \leq L_T$$

where:

D_j - diameter of jet at L_T, ft.

L_T - distance to target, ft.

D_∞ - diameter at full expansion, ft.

The jet force on the target is:

$$F_{jT} = \frac{4F_j A_T}{\pi D_j^2} \qquad \text{Eq. 3.6.2.3.1-10}$$

where A_T, is the area target which is intercepted by the jet.

Attachment to P. 3.6-46

In Region 2: for $L_{\infty} \leq L_T \leq \frac{1}{2}\left[\sqrt{\frac{4A_{\infty}}{\pi}} - D_E\right] \cot 10°$,

$A_L = A_{\infty}$

where:

$$L_3 = 1/2\left[\left(\frac{4A_{\infty}}{\pi}\right)^{1/2} - D_E\right] \text{Cot } 10°$$

(Eq. 3.6.2.3.1-10

In Region 3: for $\frac{1}{2}\left[\sqrt{\frac{4A_{\infty}}{\pi}} - D_E\right] \cot 10° < L_T < \infty$

$A_L = A_E(1 + \frac{2L}{D_E}\tan 10°)^2$ (Eq. 3.6.2.3.1-11)

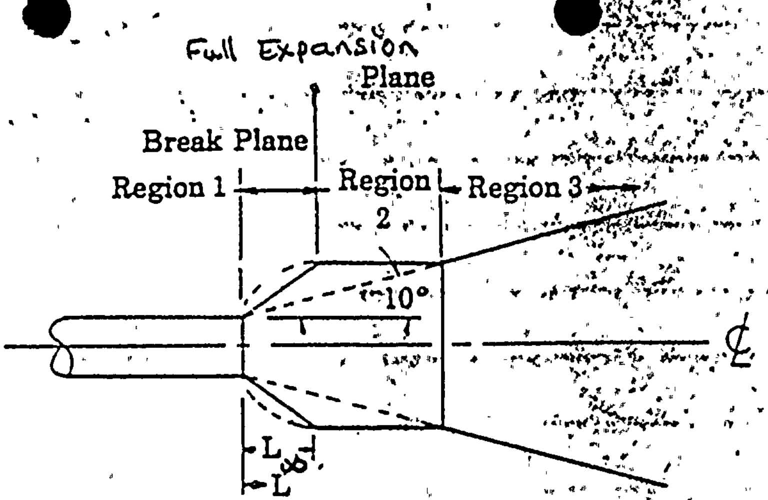
For non-flashing / non-expanding fluids:

$A_L = A_E$ (Eq. 3.6.2.3.1-12)

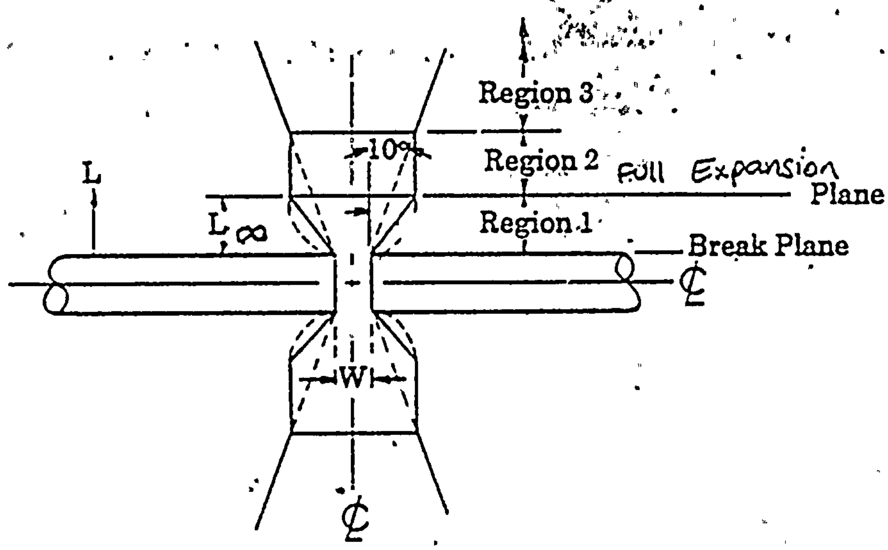
~~(NOT USED)~~

Replace with
Attached Figure 3.6-3

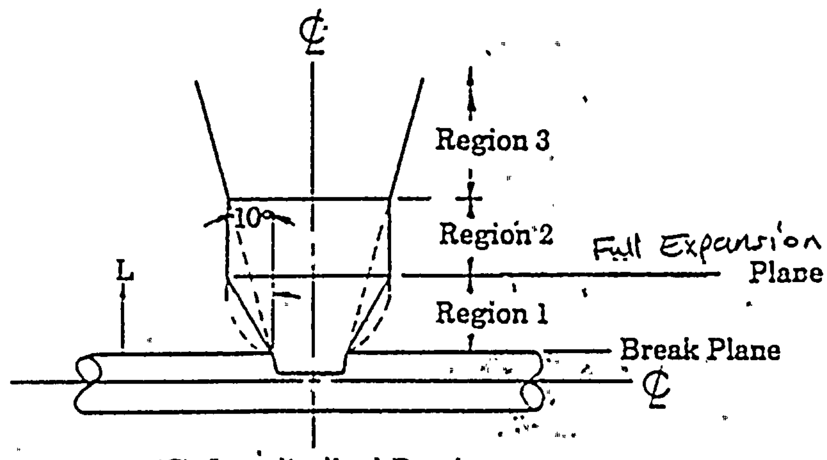
WASHINGTON PUBLIC POWER SUPPLY SYSTEM	FLUID JET GEOMETRY	FIGURE



(A) Circumferential Break With Full Separation



(B) Circumferential Break With Partial Separation



(C) Longitudinal Break

Figure 3.6-3