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Document Control Desk
U. S. Nuclear Regulatory Commission
Washington, DC 20555

ATTENTION: T. R. QUAY

SUBJECT: PIPING FUNCTIONAL CAPABILITY

Dear Mr. Quay:

As promised during the meeting with the NRC staff on December 6, 1996 Westinghouse is revising the criteria for piping functional capability to be included in the AP600 SSAR. A draft mark-up of Table 3.9-11 is attached. Also, the following two references will be added to the SSAR.

19. "Functional Capability Criteria for Essential Mark II Piping," General Electric Company, NEDO-21985, 78NED174, E. C. Rodabaugh, September, 1978.

20. "Functional Capability of ASME Class 2/3 Stainless Steel Bends and Elbows," ASME 83-PVP-66, T. H. Liu, E. R. Johnson, K. C Chang.

The seventh paragraph of subsection 3.9.3.1.5 will be revised as follows:

> The functional capability requirements for ASME piping systems that must maintain an adequate fluid flow path to mitigate a Level C or Level D plant event are shown in Table 3.9-11. These requirements are based on references 19 and 20.

These changes will be included in Revision 10 of the SSAR.

If you have any changes please contact Donald A. Lindgren at (412) 374-4856 if you have any questions.

D. A. Lindgren /for

Brian A. McIntyre, Manager
Advanced Plant Safety and Licensing

/jml

attachment

cc: D. Jackson, NRC, (attachment)

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Table 3.9-11 (sheet 1 of 3)

PIPING FUNCTIONAL CAPABILITY - ASME CLASS 1, 2, AND 3[1]

Wall Thickness:	Do/t ≤ 50, where Do, t are per ASME III
Service Level D Conditions	Equation 9 ≤ smaller of 2.0 S_y and 3.0 S_m [2, 4] Equation 9 ≤ smaller of 2.0 S_y and 3.0 S_h [3, 4]
External Pressure:	$P_{external} \leq P_{internal}$
TE + SCVE	$C2*M*D_0/2I \leq 6.0\ S_m$ [2] (NB-3650) Equation 10a (NC3653.2) ≤ 3.0 S_c [3]
TF + SCVF	$C2*M*D_0/2I \leq 6.0\ S_m$ [2] (NB-3650) Equation 10a (NC 3653.2) ≤ 3.0 S_c [3]
~~DW~~	~~$\frac{B2 * M}{Z} \leq 0.25\ S_Y$~~

Notes:

1. Applicable to Level C or Level D plant events for which the piping system must maintain an adequate fluid flow path

2. Applicable to ASME Code Class 1 piping for all loading conditions and analysis methods

3. Applicable to ASME Code Class 2 and 3 piping when the following limitations are met:

   3.1 Dynamic loads are reversing (slug-flow water hammer loads are non-reversing)

   3.2 Dynamic moments are calculated using an elastic response spectrum analysis with 15 % peak broadening and not more than 5 % damping

   3.3 Steady-state bending stress does not exceed:

$$\frac{B2 * M}{Z} \leq 0.25\ S_Y$$

4. ~~Applicable to reversing dynamic loads and to fluid hammer - slug flow loads~~ For ASME Class 2 and 3 piping that does not satisfy the limitations in note 3 above, functional capability is assured when the equations on sheets 2 and 3 are met.

Table 3.9-11 (sheet 2 of 3)

PIPING FUNCTIONAL CAPABILITY - ASME CLASS 1, 2, AND 3

Component	Stress Calculation	Stress Limit
Straight Pipe[5]	PDo/4t + M/Z	1.5 Sy
Branch [6]	31[6]*PDo/2t + B2b[6]*Mb/Zb + B2r[6]*Mr/Zr	2.0 Sy
Stainless Steel Elbow [7]	B1[7]*PDo/2t + B2[7]*M/Z	1.8 Sy
Non-stainless Steel Elbow [8]	B1[8]*PDo/2t + B2[8]*M/Z	1.5 Sy
Reducer [9]	PDo/4t + FCI[9]*M/Z	1.5 Sy
Butt Welding Tee [10]	B1[10]*PDo/2t + B2b[10]*Mb/Zb + B2r[10]*Mr/Zr	2.0 Sy
Fabricated Tee [11]	PDo/4t + FCI[11]*M/Z	1.5 Sy

Notes:

5 Includes butt-welded joint, 30 degree tapered transition, fillet-welded joint, socket-welded flange, single-welded slip-on flange, and brazed joint.

6 B1 = 0.5, except if either B2b or B2r is 4/3, then B1 = 2/3

$B2b = 1.5(R_m/T_r)^{2/3}(r_m'/R_m)^{1/2}(T_b'/T_r)(r_m'/r_p)$, but not less than 4/3

$B2r = 0.6(R_m/T_r)^{2/3}(r_m'/R_m)$, but not less than 4/3

R_m, T_r, r_m', T_b', T_r, and r_p based on ASME III, NB3600

Table 3.9-11 (sheet 3 of 3)

PIPING FUNCTIONAL CAPABILITY - ASME CLASS 1, 2, AND 3

Notes:

7 B1 = -0.1 + 0.4h, but not less than 0.0 nor greater than 0.5. Also, for B2 = 1.0, B1 = 0.5

B2 = $1.3/h^{2/3}$, for alpha > 90 degrees,
$0.895/h^{0.912}$, for alpha = 90 degrees,
1.0, for alpha = 0 degrees

h, and alpha based on ASME III, NB-3600

interpolate linearly for values of alpha < 90 degrees, B2 not less than 1.0

8 B1 = -0.1 + 0.4h, but not less than 0.0 nor greater than 0.5. Also, for B2 = 1.0, B1 = 0.5

B2 = $1.3/h^{2/3}$, for alpha > or = 90 degrees,
$1.17/h^{0.56}$, for alpha = 45 degrees
1.0, for alpha = 0 degrees

h, and alpha based on ASME III, NB-3600

interpolate linearly for values of alpha < 90 degrees, B2 not less than 1.0

9 FCI = 0.75i, but less than 1.0

$i = 0.5 + 0.01\text{alpha}(D_2/t_2)^{1/2}$, but not greater than 2.0

D_2, t_2, and alpha based on ASME III, NC-3600

10 B1 = 0.5, except if either B2b or B2r is 4/3, then B1 = 2/3

$B2b = 0.4(R_m/T_r)^{2/3}$, but not less than 4/3

$B2r = 0.5(R_m/T_r)^{2/3}$, but not less than 4/3

R_m, and T_r based on ASME III, NB3600

11 FCI = 0.75i, but not less than 1.0

$i = 0.9/h^{2/3}$, h based on ASME III, NC-3600