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SUBJECT: Forwards addl info re safety relief valve methodology,in response to NRC 810528 request.Info will be incorporated into FSAR within 4 months.

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Director, Nuclear Reactor Regulation
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U.S. NUCLEAR REGULATORY COMMISSION

Attention: Mr. A. Schwencer, Chief
Licensing Branch No. 2
Division of Licensing

Gentlemen:

Subject: SUPPLY SYSTEM NUCLEAR PROJECT NO. 2
RESPONSES TO ROUND TWO QUESTIONS
SRV METHODOLOGY

Reference: Letter, R. L. Tedesco (NRC) to R. L. Ferguson, "Request for Additional Information - SRV Methodology", May 28, 1981.

Enclosed are sixty (60) copies of the responses to the SRV Methodology questions which were transmitted to us by the reference letter. These responses are to be incorporated formally into the FSAR in an amendment within four months.

Very truly yours,

G. D. Bouchey

G. D. BOUCHEY
Director, Nuclear Safety

GDB:CDT:ct

Enclosure

cc: WS Chin, BPA
V. Stello, NRC
AD Toth, NRC, Resident Inspector
J. Plunkett, NUS Corporation
WNP-2 Files
R. Auluck, NRC
OK Earle, B&R

B001
S/1

Q. 022.107

Provide detailed calculations of the wall pressure amplitude multiplier to account for the difference between WNP-2 design conditions and Caorso test conditions.

Response:

Provided below are detailed calculations of the pressure amplitude multiplier developed to convert from Caorso test conditions to WNP-2 design conditions. Table 6.1 of the SRV report defines key plant parameters for single valve actuations important in defining pressure amplitudes for both Caorso and WNP-2 facilities. Test conditions chosen for Caorso were conditions which were typical of subsequent actuations of a single valve.

WALL PRESSURE AMPLITUDE MULTIPLIER
(DFFR Methodology)

I. WNP-2 pressure prediction: (single valve, subsequent actuation).

$VA = 2.423\ m^3$

$AQ = 6.93\ m^2$

$AW = 419\ m^2$

$WCL = 5.3\ m$

$TW = 200^\circ F$

$VOT = 20\ ms$

MN = 412 metric tons/hr.

Ref: (See Table 6.1, SRV Report)

$$VAAQ = \frac{VA}{AQ} = \frac{2.423}{6.93} = 0.3496$$

$$MNAQ = \frac{(MN)}{AQ}^{0.7} = \frac{412}{6.93}^{(0.7)} = 9.766$$

$$AWAQ = \frac{AW}{AQ(NN)}$$ Where NN = number of quenchers

$$= \frac{419}{(6.93)(1.0)} = 60.46$$

Since VAAQ > 0.255, VAAQ is redefined as 0.255

Since MNAQ > 6.89,

COF = 0.01
MNQJ = MNAQ = 9.766
MNAQ is redefined as 6.89
MNQ1 = MNAQ = 6.89
$MNQ2 = (MNAQ)^2 = 47.47$

Since AWAQ > 20,

AWAQ = 20

$$C = \frac{5\ (F-32)}{9} = \frac{5\ (200-32)}{9} = 93.33$$

LNTW = ln c = 4.536

$WCL2 = (WCL)^2 = (5.3)^2 = 28.09$

$AWQ2 = (AWAQ)^2 = 400.0$

$A1 = (VAAQ - 0.1706)\ (2.58) = (0.255-0.1706)(2.58) = 0.2178$

$A2 = 0.$

$A3 = (MNQ2-52.7)\ (0.0089) = (47.47-52.7)\ (0.0089) = -0.04655$

$A4 = (MNQJ-6.89) * COF = (9.766-6.89)(0.01) = 0.02876$

$A5 = (LNTW-3.83)(0.1377) = (4.536-3.83)(0.1377) = 0.09722$

$A6 = (WCL-4.0)(0.206) = (5.3-4.0)(0.206) = 0.2678$

$A7 = (WCL2-16.0)(0.0176) = (28.09-16.0)(0.0176) = 0.2128$

$A8 = (VOT-532.0)(0.000148) = (20-532.0)(0.000148) = -0.07578$

$A9 = 0.$

$A10 = 0.$

$PRD\ 1 = A1 + A2 - A3 + A4 + A5 + A6 - A7 - A8 - A9 + A10 + 0.253$

$PRD\ 1 = 0.7741 = AA$

For subsequent actuations,

$CMSA = 1.744$

$VVPM = 0.012$

$PROR = 0.229$

$CONF = 2.065$

$VVP1 = 0.006$

$$AB = (CMSA)^2\ (VVP1) + \left|(VVPM) + \frac{(PROR)^2 (CMSA)^2}{(NN)}\right| (AA)^2$$

$$= (1.744)^2 (0.006) + \left|(0.012) + \frac{(0.229)^2 (1.744)^2}{(1)}\right| (0.7741)^2$$

$$= 0.1210$$

AB is redefined as $\sqrt{AB}$ * (CONF)

$$= \sqrt{0.1210} \quad (2.065) = 0.7183$$

$$\begin{aligned} MPPDV &= (CMSA)\ (AA) + (AB) \\ &= (1.744)\ (0.7741) + (0.7183) \\ &= 2.068 \text{ bar} \end{aligned}$$

The predicted peak positive pressure amplitude for single valve, subsequent actuation is

$$2.068 \frac{(14.7)}{(1.014)} = \underline{29.98 \text{ psid}}$$

II. Caorso Pressure Prediction:
(Single valve, subsequent actuations)

VA = 1.781 m^3

AQ = 6.93 m^2

AW = 370 m^2

WCL = 5.09 m

TW = $90^{\circ}F$ VOT = 45 ms MN = 390 metric tons/hr.	Found typical for single valve, subsequent actuation tests at Caorso.

Ref: (Table 6.1, SRV Report)

$$VAAQ = \frac{VA}{AQ} = \frac{1.781}{6.93} = 0.2570$$

$$MNAQ = \frac{MN}{AQ}^{(0.7)} = \frac{(390)}{6.93}^{0.7} = 9.397$$

$$AWAQ = \frac{AW}{AQ(NN)}$$ Where NN = Number of quenchers

$$= \frac{370}{(6.93)(1.0)} = 53.39$$

Since VAAQ > 0.255, VAAQ is redefined as 0.255

Since MNAQ > 6.89,

COF = 0.01

MNQJ = MNAQ = 9.397

MNAQ is redefined as 6.89

MNQ1 = MNAQ = 6.89

MNQ2 = $(MNAQ)^2$ = 47.47

Since AWAQ > 20,

AWAQ = 20

$$C = \frac{5}{9}(F-32) = \frac{5}{9}(90-32) = 32.22$$

LNTW = ln c = 3.473

WCL2 = $(WCL)^2$ = $(5.09)^2$ = 25.91

AWQ2 = $(AWAQ)^2$ = 400.0

A1 = (VAAQ-0.1706)(2.58) = 0.2178

A2 = 0.

A3 = (MNQ2-52.7)(0.0089) = -0.04655

A4 = (MNQJ-6.89)(COF) = 0.02507

A5 = (LNTW-3.83)(0.1377) = -0.04916

A6 = (WCL-4.0)(0.206) = 0.2245

A7 = (WCL2-16.0)(0.0176) = 0.1744

A8 = (VOT-532.0)(0.000148) = -0.07208

A9 = 0.

A10 = 0.

PRD1 = A1 + A2 - A3 + A4 + A5 + A6 - A7 - A8 - A9 + A10 +0.253

PRD1 = AA = 0.6154

For subsequent actuations,

CMSA = 1.744
VVPM = 0.012
PROR = 0.229
CONF = 2.065
VVP1 = 0.006

$$AB = (CMSA)^2 (VVP1) + \left| (VVPM) + \frac{(PROR)^2 (CMSA)^2}{(NN)} \right| (AA)^2$$

AB ≐ 0.08320

AB is redefined as $\sqrt{AB}$ * CONF

AB = 0.5956

MPPDV = (CMSA)(AA) + (AB)
= 1.669 bar

The predicted peak positive pressure amplitude for single valve, subsequent actuation at Caorso is:

$$1.669 \frac{(14.7)}{(1.014)} = \underline{24.20 \text{ psid}}$$

PRESSURE AMPLITUDE MULTIPLIER

Conversion from Caorso test conditions to WNP-2 design conditions

$$C_f = \frac{29.98}{24.20} \approx 1.2$$

REFERENCES:

1. Letter, D. L. Renberger to B. J. Youngblood, "Submittal of SRV Report", dated August 8, 1980, G02-80-172, transmitting report titled "SRV Loads - Improved Definition and Application Methodology for Mark II Containments".

Q. 022.109

Provide the quencher submergence and SRV line volumes for all WNP-2 discharge lines.

Detailed quencher design and vacuum breaker characteristics are important in the determination of SRV air clearing load. Due to the difference in detailed quencher design and vacuum breaker characteristics between Caorso and WNP-2, we require further justification of the applicability of Caorso data to WNP-2 or require in-plant test.

Response:

Table 022.109-1 provides the quencher submergence and SRV line volumes for all 18 SRV discharge lines at WNP-2. The comparison between the quenchers at Caorso and WNP-2 is discussed in the response to Question 022.053 and the vacuum breaker comparison is addressed in Question 022.054. In both comparisons there appear to be no significant differences that would substantially affect the SRV air clearing load. For the details of the responses refer to the above referenced questions. Based on these comparisons, an in-plant SRV test at WNP-2 does not appear to be required.

TABLE 022.109-1

QUENCHER SUBMERGENCE AND SRV DISCHARGE LINE AIR VOLUMES

Valve No.	Length (ft.) 10"Ø	12"Ø	Total (ft.) (1)	Submergence (ft.) (2)	Air Volume (ft.³) (3)
1A	104.5	31.96	136.48	17.3	65.1
2A	106.81	34.96	141.77	17.3	68.3
3A	109.20	42.97	152.17	17.3	75.2
4A*	127.98	29.95	157.93	17.3	75.4
1B	91.53	30.00	121.53	17.3	57.2
2B	108.11	35.67	143.77	17.3	69.5
3B	131.04	34.96	166.01	17.3	80.4
4B*	118.54	51.19	169.74	17.3	85.6
5B*	109.28	38.67	147.96	17.3	72.2
1C	101.92	30.00	131.92	17.3	62.4
2C	129.31	34.05	163.36	17.3	78.9
3C	141.79	30.67	172.46	17.3	82.8
4C*	136.72	29.96	166.67	17.3	79.7
5C*	126.47	49.04	175.53	17.3	88.1
1D	84.36	43.17	127.53	17.3	62.9
2D	118.57	45.27	163.84	17.3	81.5
3D*	110.44	34.95	145.39	17.3	70.1
4D*	106.38	44.17	150.55	17.3	74.6

*ADS Valves

NOTES: 1. SRV line to the top of quencher.

2. High water level (El. 466.40 ft.) to the ℄ of a quencher arm. (Top of quencher to the ℄ of arm = 3.75 ft.)

3. 10" and 12" - Sch. 80.

Q. 022.110

Our evaluation of the Caorso data reveals that higher wall pressure amplitudes are observed for consecutive SRV actuation tests for lines with two 10" vacuum breakers than those with only one vacuum breaker. Since the WNP-2 design utilizes two 10" vacuum breakers on each SRV line, it is our position that pressure amplitude multipliers which will account for this difference should be provided.

Response:

Please refer to the response to Question 022.057.

Q. 022.111

Our evaluation of the Caorso data indicates that higher pressure amplitudes are observed for multiple SRV actuation tests than single SRV first actuation tests. Since WNP-2 specifications are based on single SRV actuation test results, it is our position that a pressure amplitude multiplier for the all-valve case based on the DFFR correlation (assuming WNP-2 surface area) should be used.

Response:

Please refer to the response to Question 022.055.

Q. 022.112

The vertical wall pressure distribution in the WNP-2 specification does not bound Caorso test results. Since the accuracy of sensors used to obtain test data is questionable, it is our position that the staff generic acceptance criteria set forth in NUREG-0487, Supplement 2, Item II.B.4.d should be used.

Response:

As indicated in the response to Question 022.059 and illustrated in Figure 022.059-1, the vertical wall pressure distribution in the WNP-2 specification does bound Caorso test results. Furthermore, the vertical wall pressure distribution in the WNP-2 specification was also verified by TOKAI 2 test results, as shown in Figure 3.8b of the Reference 1 report. Plant assessments are being performed using the vertical wall pressure distribution defined in the SRV report. A major effort would be involved in adopting an alternative vertical wall pressure distribution which does not appear to be warranted based on existing test data.

REFERENCES:

1. Burns and Roe, Inc., "SRV Loads - Improved Definition and Application Methodology to Mark II Containments - Technical Report", dated July 29, 1980 (proprietary), submitted to NRC by WPPSS to NRC letter G02-80-172, "Submittal of SRV Report", August 8, 1980.

Q. 022.113

The method used in the calculation of the circumferential pressure distribution in the WNP-2 asymmetric case may not be conservative because of an over-prediction of pressure on the opposite side of the pool of the discharging quencher(s).

It is our recommendation that zero dynamic pressure be specified for the 180^{o} circumference on the opposite side of operating quenchers to assure a maximum overturning moment.

Response:

Please refer to the response to Question 022.061.

Q. 022.114

The use of the DFFR correlation in the calculation of pressure multipliers to account for differences in parameter values between the WNP-2 design condition and Caorso test conditions is not necessarily conservative.

Over-prediction of pressure amplitude corresponding to the Caorso test conditions by the DFFR correlation may lead to under-prediction of the pressure multiplier. Furthermore, despite the overall conservatism in the DFFR correlation, trends with respect to individual parameters may not be conservative, e.g., trend with respect to SRV steam flow.

It is, therefore, our position that trends obtainable from Caorso test results, if more conservative than the DFFR correlation should be used in the pressure multiplier calculations or incorporation of the Caorso data in the DFFR model should be provided for our review.

Response:

Please refer to the response to Question 022.058.