ENTERGY

Entergy Operations, Inc.
1448 S.R. 333
Russellville, AR 72801
Tel 501 858-5000

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Subject: Arkansas Nuclear One - Units 1 and 2
Docket Nos. 50-313 and 50-368
License Nos. DPR-51 and NPF-6
Response to Generic Letter 95-07
Request for Additional Information
(TAC Nos. M93427 and M93428)

Gentlemen:

Entergy Operations provided responses to Generic Letter 95-07, "Pressure Locking and Thermal Binding of Safety-Related Power-Operated Gate Valves," in submittals dated October 16, 1995 (0CAN109509), and February 13, 1996 (0CAN029605). By letter dated June 14, 1996, the NRC requested additional information regarding our responses to the generic letter.

The requested information is attached in accordance with your request. Should you have any questions, please contact me.

Very truly yours,

Dwight C. Mims

Dwight C. Mims
Director, Nuclear Safety

DCM/dwb

Attachment

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P PDR

cc: Mr. Leonard J. Callan
Regional Administrator
U. S. Nuclear Regulatory Commission
Region IV
611 Ryan Plaza Drive, Suite 400
Arlington, TX 76011-8064

NRC Senior Resident Inspector
Arkansas Nuclear One
P.O. Box 310
London, AR 72847

Mr. George Kalman
NRR Project Manager Region IV/ANO-1 & 2
U. S. Nuclear Regulatory Commission
NRR Mail Stop 13-H-3
One White Flint North
11555 Rockville Pike
Rockville, MD 20852

ATTACHMENT 1
RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION REGARDING GENERIC LETTER 95-07

NRC Question 1

The licensee's IST program states that valves CV-1400, CV-1401, LPI/DH Loop Isolation Valves, are normally closed with a safety function to open. The licensee's submittal in response to GL 95-07 states that operating procedures have been revised to add a caution stating that the valves should remain open above 200 degrees F, because they are potentially susceptible to thermal binding. Has the licensee changed the normal position of these valves from normally closed to normally open during power operation, when reactor coolant system (RCS) average temperature is above 200 degrees F? Please provide clarifying information regarding this procedure change. In addition, if these valves are flexible wedge, double disk or split wedge gate valves, they may be potentially susceptible to pressure locking during a design basis event. Please address this issue.

Question 1 Response

During power operations, LPI/DH loop isolation valves CV-1400 and CV-1401, are normally closed with a safety function to open. The normal closed position of the valves during power operation has not been changed. Since system fluid temperature can exceed 200 °F during decay heat removal operation, it is possible that the valve temperature could exceed 200 °F when securing a decay heat removal loop from operation. As a precaution against thermal binding, procedure 1104.004, "Decay Heat Removal Operating Procedure," was revised to caution against thermal binding and note that if the <u>valve body temperature</u> of CV-1400 or CV-1401 was above 200 °F at the time of securing the loop from decay heat removal operation, then the remainder of the realignment of the train could take place while waiting on the valve to cool below 200 °F. The valve will be closed once the valve body temperature drops below 200 °F. The procedure also has provisions for closing the valve if the valve temperature is above 200 °F depending on plant conditions. Should that occur, design engineering is required to be contacted for contingency actions (i.e., cycle intervals) to maintain the valves operable. The intent of this procedure change is to assure that opening and closing operations are conducted at relatively the same conditions.

The LPI/DH loop isolation valves CV-1400 and CV-1401 were also evaluated for susceptibility to pressure locking. A maximum design basis RCS pressure of 2525 psig was assumed to be trapped in the bonnets of the valves. Conservative values for packing loads, friction factors, and degraded voltage were combined with torque and weak link capability obtained from the motor operated valve program and used as inputs into the Entergy Operations' pressure locking analysis method. The total required thrust to open the valve under these conditions was determined to be less than the valve's weak link rating and the operator capability. The valves were thus determined to have sufficient margin to open under design basis conditions.

NRC Question 2

In Table 2, the licensee's submittal states that valve CV-1000, Pressurizer ERV Isolation Valve, may be susceptible to boiler effect pressure locking. In addition, the NRC staff believes that this valve may be potentially susceptible to hydraulic pressure locking during a steam generator tube rupture event. The staff believes that further information is needed regarding the technical basis for the acceptability of this valve. For the purposes of closure of GL 95-07, has the licensee completed analytical calculations to demonstrate the capability of this valve to open under both boiler effect and hydraulic pressure locked conditions? If so, please provide these calculations for our review.

As part of its justification that pressure locking is not a concern for this valve, the licensee's submittal states that operability of this valve is not required as part of the ANO-1 licensing basis, because the valve has no active credited safety function. Also, the licensee's submittal states that the valve is part of a redundant RCS vent path as described in ANO-1 Technical Specification (TS) 3.1.1.7. TS 3.1.1.7 states that, with one RCS vent path inoperable, the inoperable vent path must be restored to operable status within 30 days. Further, TS 3.1.1.7 states that, with two or more vent paths inoperable, at least two vent paths must be restored to operable status within 72 hours. In that this valve may be required to move from the closed to open position to create an RCS vent path as described in TS 3.1.1.7, please describe why this valve has no active credited safety function.

Question 2 Response

The Pressurizer Electromatic Relief Valve (ERV) Isolation Valve, CV-1000, is not required to stroke during a steam generator tube rupture event since ANO does not credit the use of the ERV to depressurize during this scenario. As part of ANO's pressure locking and thermal binding review, CV-1000 was evaluated for susceptibility to both hydraulic and boiler effect pressure locking. Results of this screening indicated that the valve was potentially susceptible to hydraulic pressure locking as well as boiler effect locking. The valve was evaluated with the Entergy Operations' pressure locking analysis method and was determined to have adequate margin to open against hydraulic pressure from the RCS (Reference Appendix 1, which contains portions of ANO Engineering Report 93-R-0010-01, Appendices III and IV regarding CV-1000). Because of the range of temperatures to which the valve is exposed during operation, an analytical approach to demonstrate operability during potential boiler effect locking situations was not considered feasible. In lieu of analysis, procedure modifications requiring CV-1000 to be open during heatup were implemented to eliminate the potential for boiler effect pressure locking.

Recommended actions identified in the attached excerpts from ANO Engineering Report 93-R-0010-01 have been included in the ANO corrective action program. Each item identified has either been completed or scheduled for action.

Valve CV-1000, Pressurizer ERV Isolation Valve, has no active credited safety function. Technical Specification 3.1.1.7 requires one reactor coolant system vent path from the pressurizer steam space to be operable when RCS temperature is above 280 °F except that such path may be inoperable for up to 30 days. The vent path normally used to meet this requirement is through valves SV-1079 and SV-1077. This vent path was designed specifically for the purpose of venting noncondensible gases and/or steam from the RCS that could inhibit natural circulation core cooling. Though the path through CV-1000 was not designed for this purpose, it can be used to satisfy the technical specification requirement in the event that the path designed for this purpose is unavailable. There are no safety analyses that credit operation of either path. If neither path were available, all safety analyses would remain valid. Therefore, valve CV-1000, pressurizer ERV isolation valve, has no active credited safety function.

NRC Question 3

In Table 2, the licensee's submittal states that valves 2CV-4698-1, Pressurizer Vent, and 2CV-4740-2, Low Temperature Over Pressure Isolation, are not susceptible to pressure locking or thermal binding. The NRC staff believes that these valves may be potentially susceptible to pressure locking or thermal binding during a design basis event. Please provide a detailed description of your evaluation of the susceptibility of these valves to pressure locking or thermal binding.

Question 3 Response

Valves 2CV-4698-1, pressurizer vent, and 2CV-4740-2, low temperature overpressure isolation, were evaluated for susceptibility to pressure locking and thermal binding (Reference Appendix 2, which contains portions of ANO Engineering Report 93-R-0010-01, Appendix III regarding valves 2CV-4698-1 and 2CV-4740-2). Based on this evaluation, the valves were determined not to be susceptible to pressure locking and thermal binding.

NRC Question 4

Through review of operational experience feedback, the staff is aware of instances where licensees have completed design or procedural modifications to preclude pressure locking or thermal binding which may have had an adverse impact on plant safety due to incomplete or incorrect evaluation of the potential effects of these modifications. Please describe evaluations and training for plant personnel that have been conducted for each design or procedural modification completed to address potential pressure locking or thermal binding concerns.

Question 4 Response

The modifications to susceptible valves, including those already modified and those planned, involve providing a vent path from the bonnet area. Existing modifications installed pressure relief valves and vented the bonnets to appropriate drains to prevent pressure locking. Future modifications may involve venting the bonnet area back to system piping. These modifications may result in one side of the double disk performing the isolation function for the valve.

ANO is aware of concerns regarding pressure locking modifications to valves (e.g., valves may become unidirectional when a hole is drilled in the disk). To ensure that the modifications did not, or will not, have an adverse impact on plant safety, evaluations are performed for each of the changes in accordance with our rigorous design process. Post modification inspection and/or testing is another means used, where appropriate, to confirm the acceptability of the change.

Design changes, including valve modifications, are evaluated to determine whether or not the change should be included in the training for plant personnel. Training (required reading/information packages, etc.) on the procedure changes regarding valves modified to preclude pressure locking or thermal binding have been provided to licensed operators. Consistent with established ANO procedures, future modifications will also be reviewed for appropriateness for training.

Valve ID: CV-1000 PZR ERV Isolation Valve

System: RCS

Valve Size: 2.500

Valve/Disk Type: GATE (FW)

Evaluation

Thermal Binding

This valve is potentially susceptible to thermal binding, since the RCS temperature is greater than 200 °F during normal plant operation. NUREG-1275 lists an example where a PORV block valve failed due to stem/disk separation. The valve had been closed while the RCS was hot. The plant subsequently cooled down for a valve replacement. The valve failed to open because of thermal binding at the lower temperature. If CV-1000 is closed to isolate leakage from the ERV while the RCS is at normal operating temperature, and the plant is then subsequently cooled down with the valve in the closed position, the valve may fail to open at the lower temperature. If it does open, it is possible that internal parts may have been overstressed during the stroke. Damage to the disk ears or other valve parts may occur and not be noticed. To eliminate thermal binding as a concern, when CV-1000 has been isolated at normal operating temperatures, plant cooldown procedures should require cycling CV-1000 approximately every 100 °F during the cooldown. As an alternative to cycling, the valve could be opened at the start of the cooldown and left open. This valve is considered susceptible to thermal binding. This valve has been closed during portions of plant cooldowns in the past. It is important to assure that the valve has not been unknowingly overstressed by stroking it cold, following such a cooldown, with the valve in the closed position. Maintenance records should be reviewed, or a visual inspection performed for evidence that the valve has not sustained damage from such a scenario. Since the valve is currently open, it is considered operable with respect to thermal binding, however to assure that it remains operable in the future, the recommended procedure changes should be implemented.

Hydraulic Locking

The valve is potentially susceptible to hydraulic locking, since steam could become trapped in the bonnet of the valve from flex wedge/seat leakage. For conservatism in analyzing the potential for hydraulic locking, the maximum trapped bonnet pressure is assumed to be equal to the maximum RCS pressure (2525 psig.)(ref. 5). The upstream pressure is also conservatively assumed to be 2525 psig. at the time of opening. An evaluation using the Entergy "Hub" analysis method was done for this valve. The "Hub" analysis predicts that the maximum required opening thrust occurs when bonnet pressure is at a maximum and the high side pressure equals the bonnet pressure. Maximum opening thrust under these conditions also occurs when the lower pressure side is zero. The valve was therefore evaluated against these conservative conditions, and demonstrated to be capable of performing its safety function.. The valve is also set to open against a delta-P of not less than 2525 psig under the ANO GL 89-10 program and is capable of opening under these conditions. Since this valve is capable of opening under these design basis conditions, it is not considered susceptible to hydraulic pressure locking.

Environmental Boiler Effect

This valve is susceptible to environmental boiler effect. The valve is directly on the pressurizer. Heat from plant heatup will be transmitted to the bonnet of this valve. The valve is in steam service, however because of the vertical valve orientation, condensate could be trapped in the bonnet. If the plant is heated up with the valve in the closed position, pressure could build up in the bonnet and possibly lock or over stress the valve. Procedural guidance should be established to require that CV-1000 remain open following steam bubble formation. The valve can be opened and closed while the plant is at normal operating temperature without declaring it inoperable.

Proximity Boiler Effect

This valve is susceptible to proximity boiler effect. The valve is directly on top of the pressurizer. Because of the valve orientation, condensate could be trapped in the bonnet. If the plant is heated up with the valve in the closed position, pressure could build up in the bonnet and possibly lock or over stress the valve. Procedural guidance should be established to require that CV-1000 remain open following steam bubble formation. The valve can be opened and closed while the plant is at normal operating temperature without declaring it inoperable.

Recommendations and Conclusions:

This valve is considered **"Susceptible-Operable"** at this time. Should the valve be closed hot and subsequently cooled down, the valve could bind, thus rendering it "Inoperable". The plant should also not be heated up with the valve in the closed position. Procedures should be revised, as described above, to preclude the potential for thermal binding and pressure locking. It should be noted that "Operability" of the valve is not required as part of the ANO-1 licensing basis, since the valve has no active credited safety function. The valve is however, part of a required RCS vent path as described in Technical Specification section 3.1.1.7.

References:

1. 91-E-0091-01 R2
2. 91-E-0091-02 R0
3. NES 13 R1
4. ISO 16-RC-6 Sht. 1 Rev. 7
5. CALC V-1031-00 Rev. 2
6. CALC V-CV-1000-10 Rev. 2
7. OP 1102.002 R58- Plant Startup
8. OP 1103.005 R26- Pressurizer Operations
9. OP 1102.010 R44- Plant Shutdown and Cooldown
10. OP 1015.035 R1- Valve Operations
11. OP 1015.002 R17- Decay Heat Removal and LTOP System Operation

APPENDIX 1

PRESSURE LOCKING ANALYSIS FOR CV-1000

VARIABLES	REFERENCES
a = Mean Seat Radius = 1/2 * Mean Seat Diameter = 2.25 / 2 = 1.125 inches	V-CV-1000-10/2
b = Disc Post Radius = 1/2 * Post Diameter = 1.625 / 2 = 0.813 inches	95-R-1022-01/0
θ = Seat Angle = 5 Degrees	95-R-1022-01/0
q_{bon} = Pressure Trapped in Bonnet = 2525 psig	V-1031-00/2
q_{hi} = High Side Pressure = 2525 psig	" "
q_{low} = Low Side Pressure = 0 psig	" "
μ = Coefficient of Friction Between Disc and Seat Ring = 0.4	EPRI TEST DATA
TCF = Torque Correction Factor for VOTES Data = 0	N/A See Notes
MUT = Measured Unseating Thrust at last Static Test = 8466 lb	JO-920108 *
USinac = Open Cal Inaccuracy Associated with Unseating Value = 0.04	*See Notes Below
MAOT = Maximum Allowable Open Thrust - Weak Member = 22680 lb (ACT. TT LIMIT)	V-CV-1000-10/2
MPT = Motor Pullout Torque Capability for Open Direction	
MPT = Start Torque * OAR * Pullout Efficiency * DGF * App. Factor * Temp. Factor	MES-01
DGF = AC voltage % squared or DC %. % voltage and Tempature Factor Reference :	92-E-0009-01/6
MPT 10 * 77 * 0.4 * 0.64 * 1 * 0.823 = 162.23 ft-lb	Latest Setpoint Calculation
SF = Valve Stem Factor, used for Conversion of Actuator Torque to Thrust	
COF = Coefficient of Friction Assumed for Calculation of SF = 0.17	JO-920108
SF = 0.01309 ft-lb per lb, using COF above.	Latest Setpoint Calculation
MPOT = Motor Pullout Thrust Capability = MPT * SF lb	MES-01
MPOT = 12,393 lb	

THE FOLLOWING VALUES ARE PER ROARK'S FORMULAS FOR STRESS AND STRAIN, TABLE 2

C_2 = 1/4 [1-((b/a)^2 * (1+2*ln(a/b))] $\qquad C_2 = 0.034623$

C_3 = b/(4a) [((b/a)^2 + 1) * ln(a/b) + (b/a)^2 - 1)] $\qquad C_3 = 0.003014$

NOTE: In the following equations, v = .3 = Poisson's Ratio for the disc material.

C_8 = 1/2(1 + v + (1 - v)(b/a)^2) $\qquad C_8 = 0.832786$

C_9 = b/a[((1+v)/2 * ln(a/b)) + ((1-v)/4 * (1 - (b/a)^2))] $\qquad C_9 = 0.212993$

$$L_{11} = \frac{1}{64}\cdot\left[1+4\left(\frac{r_0}{a}\right)^2 - 5\left(\frac{r_0}{a}\right)^4 - 4\left(\frac{r_0}{a}\right)^2\cdot\left(2+\left(\frac{r_0}{a}\right)^2\right)\cdot\ln\left(\frac{a}{r_0}\right)\right] \qquad L_{17} = \frac{1}{4}\cdot\left[1-\frac{(1-\nu)}{4}\cdot\left(1-\left(\frac{r_0}{a}\right)^4\right)-\left(\frac{r_0}{a}\right)^2\cdot\left(1+(1+\nu)\cdot\ln\left(\frac{a}{r_0}\right)\right)\right]$$

r_0 is set = to b, or post radius

L_{11} = 0.000217 $\qquad L_{17}$ = 0.032491

PRESSURE LOCKING ANALYSIS FOR CV-1000

CALCULATION OF LOADS DUE TO BONNET PRESSURE:

$Q_{bbon} = q_{bon} * a * [(C2 * L17 - C8 * L11)/(C2 * C9 - C3 * C8)]$ = Unit Shear Force at Disc Hub

Q_{bbon} = 551.385 lb/in

$Q_{abon} = Q_{bbon} * (b/a) - q_{bon} + 2a * (a^2 - r^2)$ = Unit Force at Mean Seat Diameter

Q_{abon} = -280.091 lb/in

CALCULATION OF LOADS DUE TO HIGH-SIDE PRESSURE:

$Q_{bhi} = q_{hi} * a * [(C2 * L17 - C8 * L11)/(C2 * C9 - C3 * C8)]$ = Unit Shear Force at Disc Hub

Q_{bhi} = 551.385 lb/in

$Q_{ahi} = q_{bhi} * (b/a) - q_{hi} + 2a * (a^2 - r^2)$ = Unit Force at Mean Seat Diameter

Q_{ahi} = -280.091 lb/in

CALCULATION OF LOADS DUE TO LOW-SIDE PRESSURE:

$Q_{blow} = q_{low} * a * [(C2 * L17 - C8 * L11)/(C2 * C9 - C3 * C8)]$ = Unit Shear Force at Disc Hub

Q_{blow} = 0 lb/in

$Q_{alow} = q_{blow} * (b/a) - q_{low} + 2a * (a^2 - r^2)$ = Unit Force at Mean Seat Diameter

Q_{alow} = 0 lb/in

CALCULATION OF LOADS DUE TO DIFFERENTIAL PRESSURE:

$q_{\delta p} = q_{hi} - q_{low}$ = 2525 psid

$W = (Q_{bhi} - Q_{blow}) + (q_{\delta p} * pi * b^2)/(2*pi*b)$ = 1577.797 lb/in

$Q_{adiff} = -W * b/a$ = -1140.221 lb/in

SEAT RING FORCE CALCULATIONS:

$Q_{tothi} = Q_{abon} - Q_{ahi}$ = 0 lb/in

$F_{rhi} = Q_{tothi} * 2 * pi * a$ = 0 lbf

$Q_{totlow} = Q_{abon} - Q_{alow} + Q_{adiff}$ = -1420.312 lb/in

$F_{rlow} = Q_{tolow} * 2 * pi * a$ = -10039.62 lbf

$F_{rtot} = -1*(F_{rhi} + F_{rlow})$ = 10039.6 lbf

APPENDIX 1

PRESSURE LOCKING ANALYSIS FOR CV-1000

REQUIRED THRUST CALCULATIONS FOR PRESSURE LOCKED CONDITION:

Total Required Thrust = Unseating Force + Pressure Load - Stem Ejection Force

T_{stat} = Adjusted Static Unseating = MUT * (1 + Ina), where Ina = SRSS of Inaccuracies of VOTES open.

$$Ina = \sqrt{(.09 * TCF)^2 + (USinac)^2} = \sqrt{(.09 * 0)^2 + 0.04^2} = 0.04$$

T_{stat} = MUT * (1 + 0.04) = 8805 lbf

Total Pressure Load = Fp = F_{rtot} * Valve Factor, VF

VF = $\mu \div (\cos\theta + \mu \sin\theta)$ = 0.388

Fp = 3895 lbf

SEF = Stem Ejection Force Due to Bonnet Pressure = q_{bon} * Stem Area

SEF = 2525 * 0.994 = 2510 lbf

Total Minimum Required Unwedging Force = T_{stat} + Fp - SEF = 10190 lbf

MARGIN FACTOR CALCULATIONS:

Weak Link Margin Factor = (MAOT - Min. Req'd Unwedging) ÷ Min. Req'd Unwedging = 123%

Capability Margin Factor = (MPOT - Min Req'd Unwedging) ÷ Min. Req'd Unwedging = 22%

NOTES:

Converted unstg torque (89.7) to thrust using static CST SF (.0106) due to poor open cal.

Torque error = (.025^2 + .02^2 + (2/89.7)^2) ^.5 = .04 TCF set to 0; thrust data not used.

Valve ID: 2CV-4698-1 PZR Emergency Core Cooling Vent Valve

System: RCS

Valve Size: 3.000

Vlv/Disk Type: GATE (FW)

Evaluation

Thermal Binding

This valve is not susceptible to thermal binding. During normal operation, the valve is closed. There is steam in the LTOP piping only up to 2CV-4740-2. This valve is several feet downstream. The valve will not be subject to significant thermal gradients from the RCS. The maximum accident temperature in the containment building is 288 °F. Temperatures above 200 °F occur for approximately 17 minutes during a Design Basis LOCA. Information obtained from the valve manufacturer indicates that thermal binding of this valve should not occur under these circumstances.

Hydraulic Locking

This valve is potentially susceptible to hydraulic locking. If 2CV-4740-2 leaks, 2CV-4698-1 may trap full pressurizer pressure in its bonnet through flex wedge leakage. The initial RCS pressure trapped in the valve bonnet could be as high as 2585.3 psig, (Set pressure of the Pressurizer Safety Valves + 1% Tolerance and 3% accumulation). In a feed and bleed scenario, the RCS pressure is assumed to be 2585.3 psig for conservatism. Some backpressure may exist in the Quench Tank due to leakage through the valve, however downstream pressure is assumed to be 0 psig for conservatism. Any backpressure developed will actually assist 2CV-4698-1 to open. An evaluation using the Entergy "Hub" analysis method was done for this valve. The "Hub" analysis predicts that the maximum required opening thrust occurs when bonnet pressure is at a maximum and the high side pressure equals the bonnet pressure. Maximum opening thrust under these conditions also occurs when the lower pressure side is zero. The valve was therefore evaluated against these conservative conditions, and demonstrated to be capable of performing its safety function.. The valve is also set to open against a delta-P of not less than 2585.3 psig under the ANO GL 89-10 program and is capable of opening under these conditions. Since this valve is capable of opening under these design basis conditions, it is not considered susceptible to hydraulic pressure locking.

Environmental Boiler Effect

This valve is not susceptible to environmental boiler effect as its process fluid is steam and its operator is oriented vertically upward (Ref. 4).

Proximity Boiler Effect

This valve is not susceptible to proximity boiler effect as its process fluid is steam and the operator is oriented upward (Ref. 4).

Recommendations and Conclusions:

This valve is considered not susceptible to failure from any PL/TB effects.

References:

1. 91-E-0091-01 R2
2. 91-E-0091-02 R0
3. NES 13 R1
4. 2BCA-14-1/15
5. M2230,SH2,H3/25
6. V-2031-00/1
7. V-2CV-4698-10 R1

Valve ID: 2CV-4740-2 RCS PZR LTOP Relief Isolation Valve

System: RCS

Valve Size: 4.000

Vlv/Disk Type: GATE (FW)

Evaluation

Thermal Binding

During startup, this valve is closed when the RCS temperature exceeds 275 °F. It is opened during cooldown when the RCS temperature is less than 275 °F to enable the LTOP system. Since there is steam in the LTOP piping prior to closing the valve on startup, it is potentially subject to stem elongation binding upon closing. There is no actual flow of steam while the valve is open for LTOP protection because of the closed pressure relief valve and ECCS Vent Valve 2CV-4698-1 downstream. Therefore, the valve body temperature itself should not decrease due to steam flow stoppage when the disk is closed. Because of the continued RCS heatup, the valve body temperature will actually continue to increase. This heating will expand the valve body, disk and stem. Since "Feed and Bleed Cooling" can be credited for core cooling after loss of all FW (though beyond the ANO-2 licensing basis), this valve could be required to open to reduce pressure in the RCS and allow safety injection. The slight possibility exists that the differential expansion of the valve body, disk and stem could cause thermal binding during an attempt to open the valve at high temperature. This however, is considered an extremely unlikely event based on the following: 1.) The valve was designed for high temperature applications and is rated for the parameters postulated , 2.) Information obtained from the valve manufacturer confirms that if the heatup is gradual, the valve should have no problem with thermal binding. The valve has successfully opened many times for normal LTOP operation, and does not present a thermal binding concern for this function. The valve is considered "Not Susceptible" to thermal binding.

Hydraulic Locking

This valve is potentially susceptible to hydraulic locking, as it may trap full pressurizer pressure in its bonnet through flex wedge leakage. The initial RCS pressure trapped in the valve bonnet could be as high as 2585.3 psig, (Set pressure of the Pressurizer Safety Valves + 1% Tolerance and 3% accumulation). In a feed and bleed scenario, the RCS pressure will be equal to or greater than HPSI shutoff head pressure of 1450 psig. Upstream pressure is assumed to be 2585.3 psig for conservatism. Some backpressure may exist due to leakage through the valve, however downstream pressure is assumed to be 0 psig for conservatism. Any backpressure developed will actually assist 2CV-4740-2 to open. An evaluation using the Entergy "Hub" analysis method was done for this valve. The "Hub" analysis predicts that the maximum required opening thrust occurs when bonnet pressure is at a maximum and the high side pressure equals the bonnet pressure. Maximum opening thrust under these conditions also occurs when the lower pressure side is zero. The valve was therefore evaluated against these conservative conditions, and demonstrated to be capable of performing its safety function.. The valve is also set to open against a delta-P of not less than 2585.3 psig under the ANO GL 89-10 program and is capable of opening under these conditions. Since this valve is capable of opening under these design basis conditions, it is not considered susceptible to hydraulic pressure locking.

Environmental Boiler Effect

This valve is not susceptible to environmental boiler effect. Its process fluid is steam and its operator is oriented vertically upward (Ref. 4).

Proximity Boiler Effect

This valve is not susceptible to proximity boiler effect. Its process fluid is steam and the operator is oriented upward (Ref. 4).

Recommendations and Conclusions:

This valve is considered "Not Susceptible" to pressure locking or thermal binding phenomena. It should be noted that "Operability" of the valve is not required as part of the ANO-2 licensing basis, since the valve has no active safety function.

References:

1. 91-E-0091-01 R2
2. 91-E-0091-02 R0
3. NES 13 R1
4. 2BCA-14-1/15
5. M2230,SH2,G3/25
6. V-2041-00/1
7. V-2CV-4740-10 R1