Florida Power
CORPORATION

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Mr. John F. Stolz, Chief
Operating Reactors Branch #4
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Subject: Crystal River Unit 3
Docket No. 50-302
Operating License No. DPR-72
Generic Item B-24, Operability of the Purge Valves

Dear Mr. Stolz:

Florida Power Corporation (FPC) has received and reviewed your letter dated September 20, 1982, on the above subject. Responses to Enclosure 1, Questions 1 and 2 were provided on October 22, 1982. Responses to Enclosure 1, Questions 2 (Part C) 3, 4, 5 and Enclosure 2 Questions 1-9 are stated below.

ENCLOSURE 1

QUESTION 2

The actual piping configurations in which these valves were installed were not identified. Since upstream piping configuration can have a significant effect on the dynamic torques, submit sketches for each of the purge valve installations showing the following detail.

PART C

Disc closure direction with respect to the elbows.

RESPONSE 2, PART C

The inboard valves close top of disc out of reactor building, bottom disc into Reactor Building. The inlet outboard valve closes in the clockwise direction (looking down) and the outlet outboard valve closes counter clockwise (looking down).

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QUESTION 3

Discussions with Pratt on August 5, 1982 indicate Pratt has not tested the R1A valves in other than straight line flow. Please identify and describe what tests have been performed on the 48" purge valves to determine the worst case installation effects.

RESPONSE 3

The 48" purge valves furnished to Crystal River Unit 3 (CR-3), although identified as Model RIA, were actually the design later identified as NRIA, i.e., offset asymmetric disc with anvil style body seats. This design is similar to the Model 1200 in disc structure. The basic difference in design relates to resilient seat configuration and location, which do not affect the analysis.

Pratt's original 5" model tests developed torque and flow coefficients for straight pipe flow. During 1982, Pratt conducted additional model testing to consider alternate valve/piping configurations. The test program included: elbows immediately and two diameters upstream of the valve with valve shaft "out of plane" with respect to elbows, flow from flat and arch side of disc, clockwise and counter clockwise disc closure, and disc diameter to thickness ratios. The torques determined by the model tests were in all cases lower than calculated by the analysis program and existing data base.

QUESTION 4

Calculate the following stresses for a valve closing from a 55° position in the worst case installation,

disc stresses
key way stress
key stress
disc to shaft connection (i.e. pins)

Shear stress, combined stress, and bearing stress should be determined where applicable and the loads applied should be the combination of seismic, aerodynamic torque, pressure, and normal operating loads. Provide the analysis and the results for our review.

RESPONSE 4

The Calculations of Stresses for Purge Valve Disc Blocked at 55° are attached. The shaft to disc is a keyed connection, thus pins are not applicable. The maximum dynamic torque value is determined from the attached Torque Value Table. The seismic loads are not included in this analysis.

QUESTION 5

Provide the minimum available torque for the air operators and state at which angle this minimum occurs.

RESPONSE 5

The minimum torque absorbing capability of the operator (rating) is 125,000 in-lb at 45° according to G. H. Bettis.

ENCLOSURE 2

QUESTION 1

Verification of the delay, lag, and closure times of these valves should be done on a periodic basis not to exceed 6 months. Incorporate this requirement in the Technical Specifications for CR-3 if the time vs. pressure method is to be used to qualify these valves. Technical Specifications presently require these valves to be closed within 60 seconds. If Technical Specifications are not to be changed a closure time of 60 seconds should be assumed in the analysis.

RESPONSE 1

The CR-3 Technical Specifications currently require a verification of response time following maintenance. It also requires verification of closure circuitry at each refueling outage. No increase in frequency of such testing is considered necessary based on experience to date. The required response time is currently 60 seconds. A change to the Technical Specifications is being developed and will be submitted during the first quarter of 1982 requiring the response time to be 5 seconds because of revised dose consequence analysis. Neither the CR-3 Technical Specifications nor Standard Technical Specifications require testing of various allocations of response time (delay, lag and closure) but simply require response time to include time from simulated change in monitored parameter to system activation (valve closure).

QUESTION 2

Two tables of torque values were provided in your submittal. The first table assumed the valve was initially in the full power (90°) position and was fully closed in 5 seconds plus a 1 second delay time. This table indicated a maximum dynamic torque of 465,275 in-lb at 72°. The maximum dynamic torque at 55° was 292,741 in-lb and at 40° was 142,284 in-lb. The second table assumed the valve was initially at 35° from the closed position and closed within 2 seconds. A one second delay time was assumed. The maximum dynamic torque was 34,116 in-lb at seating.

The table indicates the analysis for which these stress levels were calculated and performed for a value with 435,000 in-lb of torque. These valves are blocked to 40° or 55° depending on which operator is used.

The stress analysis submitted includes a summary table of stress levels and stress allowables. The stress tables use ASME allowables for valve body pressure boundaries and a combination of Sm values and 90% of yield for other components of the valve. The stress tables indicate 2 components, the valve shaft and the keyway, to be overstressed. The shaft allowable is .9 Sy = 27,000 psi. The actual stress is 38,937 psi. The keyway allowable bearing stress is .9 Sy = 27,000 psi. The keyway actual bearing stress is 60,870 psi. The valve shaft is ASTM A-479, Type 304 material. The keyway is ASTM A-35, Gr. LF-1.

The purge valve stress analysis report was completed in 1970. It discusses methodology and provides equations used to determine stress levels but did not include the actual calculations. The analysis includes static seismic loads of 5g in 3 directions but neglected the aerodynamic loads. The only torsional loads included in the methodology for shaft analysis were seating loads. Seating torsion is combined with seismic loads and pressure were combined with seismic loads for the shaft analysis, but seating torsion, seismic and pressure were not combined together.

The Hub Block Assembly stress analysis methodology has been revised to include a dynamic torque of 435,000 in-lb but it appears to be the only area where dynamic torque was considered in the analysis.

Since the stress tables included in the submittal indicate the valve is overstressed in the condition analyzed, the stress report should be revised to reflect the loads the valve would experience in a LOCA following appropriate modifications (i.e., blocking). Provide a revised stress report that combines seismic, pressure, and torsional loads (as well as any additional loads experienced by the valve) for all applicable parts. In addition, provide the stress levels for all interface hardware (bolting, bonnet, etc.) that are calculated for the combined LOCA-seismic loads.

RESPONSE 2

The inboard motor operated valves and the outboard pneumatic/spring operated valves have been modified to maintain the valve disc angles at 40° and 55° from the full closed position respectively. This modification reduces the stresses in the valve components and operators to an acceptable level due to LOCA and seismic loadings.

A revised stress report is not available at this time. A proposal is being obtained from the Henry Pratt Company to perform this task. FPC will review the proposal and advise the Nuclear Regulatory Commission of the results of the review.

QUESTION 3

Since static seismic loads are being used to show operability qualification of this valve, confirm that these valve assemblies have been verified by test to be rigid.

RESPONSE 3

Operability qualification testing was not required or performed on the valve assemblies furnished to Crystal River Unit 3.

QUESTION 4

Pratt has indicated in discussions with the NRC on August 5, 1982 that model tests for the R1A valve have only been performed for straight pipe installations. Therefore confirm that all of the 48" purge valves are located in straight pipe installations or demonstrate by test that the torques used in the qualification analysis envelope the worst case installation configuration at Crystal River.

RESPONSE 4

Please refer to the Response for Enclosure 1, Question 3.

QUESTION 5

Provide a comparison of the torque levels calculated for the modified valves in the as-installed configurations at all angles with the available operator torque. The available operator torque for the Bettis operators will vary with disc angle.

RESPONSE 5

The minimum rating for the G. H. Bettis operator is 125,000 in-lb (45°) which exceeds the torque valves shown in the attached Torque Value Table (at 55° blocked angle closure).

QUESTION 6

Verify that torque limit switch settings are compatible with the new calculated loads for the Limitorque operators. Available torques for the Limitorque operators should be determined at minimum available voltages. Changes in closing time of the valve due to reduced voltages should be considered.

RESPONSE 6

Limitorque operators, type SMB-0-40/H3BC, are capable of producing 42,734 in-lb of seating torque, which corresponds to a torque switch setting of 1-3/4, at 460 volts ±10%, 3 phase, 60 hertz. This torque value is based on a minimum voltage of 414 volts which will be the lower limit of voltage on the 480 volt ES "A" bus once the second level under-voltage relaying is installed. (This installation is presently scheduled for Refuel IV). FPC is verifying that the torque limit switch settings are compatible with the new calculated loads for the limitorque operators.

We do not forsee a significant increase in the closing time of the valve due to reduced voltage.

QUESTION 7

If handwheels are used on these valves describe the means used to assure that these valves are not left in a manual mode.

RESPONSE 7

Step 4.4 of SP-179, "Containment Leakage Tests-Types "B" and "C"", states: "Closure of the containment isolation valves for the Type C test shall be accomplished by normal operation and without adjustments (e.g., no manual tightening of remotely operated valves after closure)". The use of normal operation for this test ensures that the valves are not left in a manual mode of operation.

QUESTION 8

If these valves are to be permanently limited to a maximum opening of less than 90° in operating modes, submit a description of how the valve will be blocked to prevent opening the valve beyond the required limit as a long-term modification.

RESPONSE 8

The following modifications have been completed by MAR 81-6-037.

The inboard valves have limitorque operators. The internal limit switches in these operators were readjusted to limit opening to 40°.

The outboard valves have Bettis pneumatic operators. The air supply to these operators is throttled to obtain an angle of 55° from full closed. The limit switch position indicators were also modified to accommodate the 55° disc angle.

Upon completion of this modification, the valves and operators were functionally tested as required by MAR 81-6-037.

QUESTION 9

Describe the qualification of the equipment and/or systems used to assure these valves will not have increased leakage in ambient temperatures of 60°F or less.

RESPONSE 9

The Reactor Building Purge discharge valves will not experience a temperature of less than 60°F since the air from the Reactor Building will not be less than 60°F during reactor operation. The minimum ambient temperature of the inlet valves could be less than 60°F.

The Reactor Building Purge Duct heaters are non-safety, non qualified resistance heaters. Their thermostates are set at 100°F minimum. A control room alarm occurs at 85°F and the reactor building Purge Supply Fans trip if reactor building purge duct temperature drops below 75°F.

Very truly yours,

Patsy Y. Baynard

Dr. Patsy Y. Baynard
Assistant to Vice President
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Attachments

cc: Mr. J. P. O'Reilly
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CALCULATION OF STRESSES FOR PURGE VALVE DISC BLOCKED AT 55°

1. Disc Stresses

Combined bending stress in disc,

$$S(1) = (S(2)^2 + S(3)^2)^{1/2}$$

where $S(2) = \dfrac{.90413\ P_s R_4{}^3 C_7}{I_4}$ = bending stress due to moment along shaft axis, PSI

$S(3) = \dfrac{.6666\ P_s R_4{}^3 C_8}{I_3}$ = bending stress due to moment about shaft axis, PSI

where P_s = standard calculation pressure = 85 PSI

R_4 = disc radius, in. = 23.359 in.

C_7 = distance to outer fiber of disc for bending along the shaft, in. = 2 in.

C_8 = distance to outer fiber of disc for bending about the shaft, in. = 2 in.

I_3 & I_4 = disc area moment of inertia for bending along and about the shaft, in^4 = 249 in^4.

combined bending stress in disc, S(1) = 9775 PSI $\leq$ 17500 PSI allowable.

2. Key Way Stress (Disc hub to shaft connection)

i) Bearing stress on hub key way, $S(4) = \dfrac{2\ T_8}{R_5 H_1 L_{10}}$

where T_8 = maximum dynamic torque at 55°, in-lbs = 112990 in-lb

R_5 = shaft radius, in = 2.375 in.

H_1 = disc hub key way height, in - 1.25 in.

L_{10} = disc hub key length, in = 4.75 in.

bearing stress on hub key way, S(4) = 16025 PSI $\leq$ 17500 PSI (S_m) allowable.

ii) Shear stress on key, $S(5) = \dfrac{T_8}{R_5 H_1 L_{10}}$

shear stress on key, S(5) = 8013 PSI $\leq .6s_m$ = 12000 PSI.

3. Key Stress (Top stub shaft to operator connection).

Shear stress in key, S(6) = $\frac{T_8}{bLR}$

Compressive stress in key, S(7) = $\frac{2T_8}{tLR}$

where T_8 = dynamic torque at 55' disc open = 112990 in-lbs.

b = width of key, in = 1.25 in.

L = Length of key, in = 4.75 in.

R = turn down shaft radius, in = $\frac{3.742}{2}$ = 1.871 in.

t = height of key, in = 1.25 in.

Shear stress in key, S(6) = 10171 PSI $\leq$ 30000, .40 X yield

Compressive stress in key, S(7) = 20342 PSI $\leq$ 22250, 1/4 of tensile strength

Note: Key Material: C1042

SUMMARY TORQUE TABLE - VALVE BLOCKED TO: 40 DEG.

MAX. ANG. FLOW RATE: 133330. CFM; 163159. SCM; 8969.29 LB/MIN

SEATING & BEARING & HUB SEAL TORQUE (M/M) = 39307 IN-LBS @ 0 DEG
MAX. DYN. - BEARING - HUB SEAL TORQUE (M/M) = 46451 IN-LBS @ 35 DEG

AT 1 SEC. DELAY TIME TO 3 CLOSED VLV. (LOCA) TIME (23.7 TO 37.8333 PSI UPSTR. PRESS.)

1.22169 = REYN. NO. FACTOR (MULTIPL.)

SUMMARY TORQUE TABLE - VALVE BLOCKED TO: 45 DEG.

MAX. ANG. FLOW RATE: 214666. CFM; 262691. SCFM; 14440.9 LB/MIN

SEATING & BEARING & HUB SEAL TORQUE (M/M) = 35379 IN-LBS @ 0 DEG.
MAX. DYN. - BEARING - HUB SEAL TORQUE (M/M) = 64372 IN-LBS @ 40 DEG.

AT 1 SEC. DELAY TIME TO 3.23 CLOSED VLV. (LOCA) TIME (23.7 TO 39.6 PSIA UPSTR. PRESS.)

1.26025 = REYN. NO. FACTOR (MULTIPL.)

SUMMARY TORQUE TABLE - VALVE BLOCKED TO: 50 DEG.

MAX. ANG. FLOW RATE: 203866. CFM; 249476 SCFM; 13764.4 LB/MIN

SEATING & BEARING & HUB SEAL TORQUE (M/M) = 35429 IN-LBS @ 0 DEG.
MAX. DYN. - BEARING - HUB SEAL TORQUE (M/M) = 87436 IN-LBS @ 45 DEG.

AT 1 SEC. DELAY TIME TO 3.5 CLOSED VLV. (LOCA) TIME (23.7 TO 40.833 PSIA UPSTR. PRESS.)

1.24169 = REYN. NO. FACTOR (MULTIPL.)

SUMMARY TORQUE TABLE - VALVE BLOCKED TO: 55 DEG.

MAX. ANG. FLOW RATE: 25375. CFM; 308830. SCFM; 16777.6 LB/MIN

SEATING & BEARING & HUB SEAL TORQUE (M/M) = 35480 IN-LBS @ 0 DEG.
MAX. DYN. - BEARING - HUB SEAL TORQUE (M/M) = 112990 IN-LBS @ 45 DEG.

AT 1 SEC. DELAY TIME TO 3.75 CLOSED VLV. (LOCA) TIME (23.7 TO 42.0662 PSIA UPSTR. PRESS.)

1.26169 = REYN. NO. FACTOR (MULTIPL.)