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ACCESSION NBR:8306160389 DOC.DATE: 83/06/10 NOTARIZED: YES DOCKET #
FACIL:50-331 Duane Arnold Energy Center, Iowa Electric Light & Pow 05000331
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DENTON,H.R. Office of Nuclear Reactor Regulation, Director

SUBJECT: Forwards response to NRC 830520 request for info re assessment of containment purge & vent valve operability. Valves will close during design basis LOCA.Valves will not be sealed.

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Iowa Electric Light and Power Company

June 10, 1983
NG-83-2024

Mr. Harold Denton, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Subject: Duane Arnold Energy Center
Docket No: 50-331
Op. License No: DPR-49
Containment Purge and Vent Valve Operability

Dear Mr. Denton:

On May 26, 1983 we received Mr. Vassallo's letter of May 20, 1983 and the attached Safety Evaluation on containment purge and vent valve operability. The letter requests that, within 15 days, we inform the NRC of our assessment of the operability of the DAEC purge and vent valves.

As stated in our letter of December 14, 1979, (LDR-79-355), we have concluded that the DAEC purge and vent valves will close during a design basis LOCA. The attachment to this letter provides specific information to support this conclusion.

Mr. Vassallo's letter also requested us to state whether or not we intend to maintain the purge and vent valves sealed closed until we submit information regarding valve operability. In view of the fact that the requested information is submitted herewith, we do not intend to seal the valves closed at this time.

We shall limit the time which the containment purge and vent valves can be open and replace the T-ring inflatable seals at intervals not to exceed four years as specified in our pending Technical Specification change RTS-144 transmitted to the NRC on June 10, 1982.

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Please advise us if you have questions regarding this submittal. The information in this letter and its attachment is true and accurate to the best of my knowledge and belief.

IOWA ELECTRIC LIGHT AND POWER COMPANY

BY Richard W McGaughy
Richard W. McGaughy
Manager, Nuclear Division

Subscribed and sworn to Before Me on this 10th day of June 1983.

Kathleen A. Herber
Notary Public in and for the State of Iowa

RWM/SLS/dmh*
Attachment

cc: S. Swails
L. Liu
S. Tuthill
F. Apicella
NRC Resident Office
Commitment Control No. 83-0154

RESPONSE TO PURGE AND VENT VALVE OPERABILITY CONCERNS IDENTIFIED IN NRC SAFETY EVALUATION DATED MAY 20, 1983

NRC SAFETY EVALUATION CONCERN NO. 1

The manufacturer and model number of the valves and actuators have not been provided.

IELP RESPONSE

The valves used are Fisher Controls Type 9220, Class 2, 18-inch diameter butterfly valves with CF8M offset cast discs. These valves incorporate air-to-open, fail-closed, Bettis 722C-SR-60 actuators.

NRC SAFETY EVALUATION CONCERN NO. 2

The licensee has not provided specific information on the particular valves used, or attempted to demonstrate valve operability at the 30° open position by presenting test data or analysis results.

IELP RESPONSE

As indicated in our December 14, 1979 response (LDR-79-355) to your letter of Septemher 27, 1979 Iowa Electric initiated a design review program to verify that the DAEC purge and vent valves are operable under Design Basis LOCA conditions. The results of that design review program verified that, with the DAEC purge and vent valves limited to a maximum of 30° open:

1. The DAEC valves have the capability to close and seal against worst case (Design Basis LOCA) Differential Pressure.

2. The DAEC valves and their operators are capable of performing their intended function during and following a postulated seismic DBE.

3. The DAEC valves are capable of closing within the time required by the DAEC Technical Specifications (5 seconds) against worst case (Design Basis LOCA) Differential Pressure.

4. The DAEC valve seal material is capable of functioning as intended under worst case (Design Basis LOCA) conditions.

The following analysis has been developed from analytical summary information provided by Fisher Controls Company and from DAEC plant specific details. The capacity and torque values used in sizing were based on a series of laboratory tests done at Fisher, using a selected group of models. The analysis complies with the operability criteria provided by D.G. Eisenhut's September 27, 1979 letter.

I. VALVE OPERABILITY

1.1 Valve Closure Rate/Time: The as-installed closure time for all these valves is 1-4 seconds under no-flow conditions (from 30° open as in the DAEC application). Because flow aids closure, the closure time under flow conditions will be at least this fast even at higher pressures in the drywell following a postulated LOCA. Only friction and seating loads must be overcome. These loads (in the order of 2000-3300 in-lb) are well within the capabilities of the spring-return torque from the actuator, disregarding the assistance from the flow-closed effect. Because of the scotch-yoke mechanism the closure rate will not be perfectly linear, however, closure would be achieved in 1-4 seconds or less at a differential pressure of at least 56 psi during flow conditions. Note: Containment design pressure is 56 psig, the maximum pressure resulting from a postulated design basis LOCA is 54 psig (which occurs more than 100 seconds after accident initiation).

1.2 Adequacy of Actuator

In the closing direction, the spring action must be sufficient to overcome the friction and seating loads only, because flow aids closure. These loads (3280 in.-lb at 0°, 2016 in.-lb at 30°), are well within the spring-return torque available (4750 in.-lb at 0°, about 3800 in.-lb at 30° open). Therefore, the actuator is adequate for achieving closure from the 30° open position against Design Basis LOCA differential pressure.

1.3 Flow Direction Through Valve: The preferred orientation for Type 9220 butterfly valves is to have the T-ring retaining ring on the outlet side of the valve. However, closure can be achieved regardless of flow direction. These valves are equipped with CF8M offset cast discs; therefore, flow direction will have no significant effect on valve capacity. However more torque will be required for flow into the hub side of the disc. This condition has been assumed as the worst case in paragraphs 1.1 and 1.2 above. When pinned at a 30° maximum opening angle as in the DAEC application, these valves will close, regardless of flow direction, against at least 56 pdi differential pressure.

1.4 Single Valve Closure or Simultaneous Closure: In the Duane Arnold installation the subject valves are installed in pairs (in series) outside the drywell. Thus, these valves are not exposed to external pressure/temperature buildup in the event of a LOCA. The solenoids and Bettis actuators would be free to vent without backpressure buildup effects, and the respective spring-actions would drive the solenoids and the butterfly valve actuators to their respective safety-mode positions. The Fisher Controls analysis shows that with the valves pinned at 30° maximum opening, either valve is capable of closing against at least 56 psi differential pressure. Both valves are expected to close simultaneously, therefore the total pressure drop will be shared and valve closure operability is enhanced.

The spacing hetween the DAEC valves is adequate to permit full disc motion. In the case of closely coupled valves, the shaft axes are parallel and the direction of disc opening is the same minimizing turhulence and discontinuities in the flow stream.

1.5 Containment Back Pressure Effect: Not applicable, because the subject valves are installed outside primary containment.

1.6 Adequacy of Accumulator: Not applicable, because accumulators are not used to power the actuator during valve disc closure. Air for pressurizing the T-ring seal comes from the H&V instrument air compressor systems (seismic category I, class 1E powered, redundant systems).

1.7 Adequacy of Actuators Using Torque Limiting Devices: Not applicable, because torque limiters are not used in the subject valve actuator system.

1.8 The Effect of the Piping System (turns, branches, etc.): Essentially uniform flow is achieved within 4-5 pipe diameters downstream from a pipeline discontinuity. If pipeline discontinuities are closer than 4-5 pipe diameters on the upstream side, the effect on capacity and torque is related to the disc shaft orientation with respect to the non-uniform flow pattern (see paragraph 1.9).

Six of the seven valves have no turns or bends within approximately 4 pipe diameters on the upstream side of the valves, consequently there is little effect on the flow pattern at the valve. One valve, CV-4301, is located approximately 2-1/2 pipe diameters downstream of a piping bend. The effects of this bend on valve closure is described in detail in Paragraph 1.9.

Four of the seven valves have no branch lines within 4-5 pipe diameters of the valves. Valves CV-4307 and CV-4308 have 6" branch connections approximately 2 pipe diameters upstream of the valves. These connections will not be in use while purging through CV-4307 or CV-4308 and will have a negligible effect on flow. Valve CV-4306 is located downstream of a piping branch and is discussed in detail in Paragraph 1.9.

1.9 The Effect of Valve Disc and Shaft Orientation: Orientation of the valve shaft at 90° to tbe plane of the piping branch would result in maximum unequal impingement on the valve disc wings for valves located within 4 to 5 pipe diameters of the branch. Orientation of the valve shaft in the plane (0 degrees) of the piping would result in no net effect on the valve disc from the non-uniformities of flow caused by the branch line.

As indicated in Paragraph 1.8, in two valve cases (CV-4301 and CV-4306) the effects of non-uniformities in flow (caused by a nearby bend or branch line) are minimized by the valve shaft orientation relative to the plane of the bend or branch line. These two valve cases are described below.

1.9.1 Valve CV-4301 is located near a pipe bend and is oriented with the valve shaft in the plane of the piping bend so that potentially non-uniform flow is split and equal on either side of the valve shaft. This configuration does not affect the torque thus allowing normal valve closure. There are no close discontinuities for the remaining valves, therefore the orientation of the disc and shaft is immaterial, because the flow will be essentially symmetrical.

1.9.2 Valve CV-4306 is located approximately one pipe diameter from a branch line (from the torus) which would affect the uniformity of flow at the valve. The valve shaft for valve CV-4306 is oriented 16 1/2 degrees to the plane of the piping branch. To analyze the effects of non-uniformities in flow (caused by this branch line) on closure operability of the valve, the 3 potential purging system lineups are considered.

For the case of system lineup to purge the drywell only or to purge both the drywell and torus simultaneously, the drywell purge isolation valves are open. The effect of non-uniform flow from the drywell (due to the LOCA transient) caused by the branch line opening is minimal because of the small angle (only 16 1/2 degrees) between the valve shaft orientation and the plane of the piping branch.

For the case of system line up to purge the torus only the drywell purge isolation valve is closed and the effect of non-uniformities in flow from the torus (due to the LOCA transient) are caused by the flow making the turn from the branch line. For such a case, the effect of the non-uniformities in flow are minimized by both the small angle between the valve shaft and the plane of the piping branch and because the pressure transient in the torus is both lower in peak value and delayed in time compared to the drywell transient and the maximum pressure across the valve would be 16 psi at 5 seconds post LOCA (using data from UFSAR Figure 6.2-45).

1.9.3 Based on these considerations, the operability of the DAEC purge and vent valves is not degraded by purge and vent piping effects (turns, branches, etc.) upstream and downstream of the valve installations.

1.10 Our March 15, 1982 response (LDR-82-078) committed to the installation of a debris screen on the drywell purge exhaust opening and demonstrated that debris screens are not required for the drywell purge inlet, torus purge inlet, and torus purge exhaust. Seismic category I debris screens were installed during the spring 1983 refueling outage on the drywell purge exhaust opening and, for additional protection, over the drywell purge inlet opening.

II. SEISMIC CAPABILITIES

A seismic analysis dated March 21, 1972 was performed for the subject valves by Fisher Controls Company. Based on the Fisher Controls calculations it has been demonstrated that the primary steady state stresses, when combined with the inertial loading resulting from the response to a ground acceleration of 4.0 g. acting in the vertical and 3.0 g. acting in the horizontal planes simultaneously, produce combined stresses which are safely within the yield stresses of the construction materials, both in tension and in shear.

Also, Fisher calculations have verified that the extended parts of each valve assembly have a natural frequency of vibration greater then 20 cycles per second.

The results of the seismic analysis demonstrates that the DAEC valves are capable of performing their intended function during and following a seismic DBE.

III. ACCEPTABILITY OF VALVE SEAL MATERIAL

The inflatable T-ring seal material is Dupont Nordel-Ethylene Propylene Elastomer (EPDM). The environmental conditions (worst case) for these seals are conservatively assumed to be the same as drywell service conditions [150°F continuous normal ambient temperature and 6.7×10^6 rads radiation (4 year normal plus 30 day accident dose in drywell). Actual radiation doses will be lower because these valves are located outside drywell]. Dupont data shows that the seal material has a maximum continuous service temperature of 293°F.

ASCO qualification test reports AQS 21678/TR Rev. A and AQR 67368 Rev. 0 document testing of solenoid valves with Ethylene Propylene Elastomer seals. The ASCO data confirms that ethylene propylene seals are qualified for at least 4 1/2 years when exposed continuously to a maximum normal temperature of 150°F followed by 30 days of LOCA conditions (maximum temperature and external pressure of 448°F and 110 psig respectively). The total integrated radiation dose for these tests was 2×10^8 rads.

Fisher suggests replacement of these seals at 4 year intervals which has been reflected in the proposed change to the Duane Arnold Energy Center Technical Specifications transmitted to the NRC on June 10, 1982 (RTS-133). These changes are currently being reviewed by the NRC.