Omaha Public Power District

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June 1, 1982
LIC-82-221

Mr. Robert A. Clark, Chief
U. S. Nuclear Regulatory Commission
Office of Nuclear Reactor Regulation
Division of Licensing
Operating Reactors Branch No. 3
Washington, D.C. 20555

Reference: Docket No. 50-285

Dear Mr. Clark:

Fort Calhoun Station Reactor
Coolant Gas Vent System

The Commission's letter to Omaha Public Power District, dated March 4, 1982, requested the District provide additional information regarding the Fort Calhoun Station reactor coolant gas vent system (NUREG-0737, Item II.B.1). Accordingly, the District's response is attached.

Sincerely,

WC Jones

W. C. Jones
Division Manager
Production Operations

Attachment

cc: LeBoeuf, Lamb, Leiby & MacRae
1333 New Hampshire Avenue, N.W.
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OMAHA PUBLIC POWER DISTRICT'S RESPONSE
TO THE COMMISSION'S MARCH 4, 1982 LETTER

Item 1.

Based on our review of the "Procedural Guidelines for Reactor Coolant Gas Vent System for Omaha Public Power District Fort Calhoun Unit No. 1", provided as part of your RCGVS submittal in response to NUREG-0737 Item II.B.1, we require the following additional information:

a. Provide operating guidelines on the methods and instrumentation (no direct reactor vessel measurement) used to detect and determine the volume of gases in the reactor coolant system (RCS). Also describe the indications expected during reactor vessel head venting, if non-condensible gases are trapped in the RCS loops.

Response

Operational guidelines and instrumentation indications which assist the operator in detecting the presence of a gas bubble in the RCS are detailed in the District's July 1, 1981 letter, Attachment 2, Section 4.1.3. Also, guidelines which assist the operator in determining the presence of an RCS void are detailed in Appendix A to Combustion Engineering report CEN-199, which was transmitted to the Commission by the District's letter of April 8, 1982. Methods or instrumentation to precisely determine the volume of the RCS gases are not provided by the present RCGVS. However, such volume determinations are expected to be provided when the inadequate core cooling modification (i.e., the heated junction thermocouple) is installed during the 1984 refueling outage.

The expected RCS pressure and pressurizer level indications and effects, during the venting of non-condensible gases in the RCS, are detailed in Section 4.1.3.2(c) and Figures 12-17 of Attachment 2 to the District's July 1, 1981 letter.

The District presently has completed and included instructions for operation of the RCGVS during normal and refueling outage operations in the Fort Calhoun Station Operating Instructions. The specific methods needed to detect the formation of a non-condensible RCS gas bubble during plant accident conditions will be included in the Fort Calhoun Station Emergency Procedures within sixty (60) days of Commission approval of the design and operating guidelines for the RCGVS.

Item 1.

b. Supplement section 4.0 (Emergency Plant Operations) to describe measures required before initiation of RCS venting. The measures could include for example, verification of the containment isolation, starting of all available containment air mixing systems, and bringing the RCS to steady-state conditions with a pre-determined minimum sub-cooling and pressurizer water level.

Response

As stated above, the District will implement an emergency procedure to address non-condensible gas venting from the RCS. This procedure will include a description of all measures or conditions that must be fulfilled prior to commencement of the venting of the RCS. The initial conditions will be included in the "Prerequisites" section of the procedure and will address items such as verification of containment isolation, initiation of all available containment air mixing systems, returning the RCS to a steady-state condition with a pre-determined minimum sub-cooling and pressurizer water level, operation of the containment hydrogen analyzer to monitor hydrogen concentrations, and operation of the charging pump(s) to maintain adequate RCS pressure and pressurizer level control.

Item 1.

c. It appears from the guidelines that venting is terminated after the predetermined venting time has elapsed. However, we believe that venting should be terminated following a significant change in plant parameters, such as rate of pressurizer level and/or pressure variations. Furthermore, venting should be terminated when the pressurizer level decreases or increases to a specified level, when reactor coolant sub-cooling decreases below a specified value, when pressurizer pressure decreases by a specified increment, or when the containment hydrogen level increases above a specified value. Revise the procedural guidelines to include clear and specific guidelines for operator termination of reactor vessel head and pressurizer venting.

Response

The District believes "clear and specific guidelines for operator termination of reactor vessel head and pressurizer venting" are detailed in Section 4.1.3.2, "Determination of Vent Duration", and the associated figures to this section in the subject Procedural Guidelines. Additionally, Section 4.1.3.2 states that RCS venting may have to be temporarily terminated to restore RCS pressure and pressurizer level. RCS venting versus containment hydrogen concentration is specifically addressed in Section 4.1.3.4, "Venting of Hydrogen to Containment", of the Procedural Guidelines. Specific limits for terminating venting have not been provided in the Procedural Guidelines because the operator must evaluate numerous plant parameters and conditions for any postulated event prior to terminating the venting process. However, the District will include clear guidance in the RCGVS Emergency Procedure to provide for venting termination in the event of a significant change in critical plant parameters.

The RCGVS, as designed, vents the RCS by means of a limited flowrate to maintain adequate pressurizer control. Therefore, RCS venting is not expected to result in uncontrollable pressurizer pressure or level changes.

Item 1.

d. Figure 19 "RCGVS Accident Response" of the procedural guidelines states that the charging pump(s) should be placed into operation prior to venting the pressurizer "if necessary". Define and justify when the charging pump(s) should and should not be used while venting the pressurizer.

Response

The charging pumps will normally be required to be in operation prior to and during RCS venting. Charging flow would only be terminated when the pressurizer level is above the operating limits, and then only to reduce the pressurizer level to maintain pressure control. Use of the words "if necessary" in Figure 19 of the Procedural Guidelines is with regard to insufficient pressurizer level prior to commencing venting. The importance of this guidance will be included in the prerequisites to the Fort Calhoun Station RCGVS Emergency Procedure.

Item 1.

e. It is the NRC position that your guideline on p. 9 concerning the decision to continue venting the reactor vessel if the containment hydrogen levels approach combustible levels is too absolute and should be revised to state that while this guideline should be generally followed, the decision must be based on full consideration of all plant conditions including the status of core cooling and the containment hydrogen level. Therefore, guidance should be provided to the operator for estimating the expected change of hydrogen concentration in the containment as a function of vent time.

Response

As indicated in the response to Item 1.c. above, the consideration of the effect of RCS venting versus containment hydrogen concentration is discussed in Section 4.1.3.4 of the Procedural Guidelines. Although not explicitly stated, the operator will have to terminate venting whenever the containment hydrogen concentration exceeds 3% because the combustible level is 4%. This operator instruction, along with the consideration of other pertinent plant parameters, will be included in the RCGVS Emergency Procedure.

Item 1.

f. Provide operating guidelines which in lieu of venting will assure that sufficient liquid or steam will flow through the steam generator U-tube region so that decay heat can be effectively removed from the RCS (reference Clarification C.(2)).

Response

The necessary operating guidelines have been addressed by a Combustion Engineering (CE) report transmitted to the Commission by CE's letter dated April 30, 1982. This report is entitled "Combustion Engineering

Emergency Procedure Guidelines" (CEN-152, Revision 1, Draft). These guidelines, when approved by the Commission and implemented by the District, will provide for operating procedures which, in lieu of RCS venting, will assure that sufficient liquid or steam will flow through the steam generator(s).

Item 2.

Verify that the flow restriction orifice provided in each vent path will limit reactor coolant leakage to less than the capacity of the reactor coolant makeup system by providing the pertinent design parameters of the reactor coolant system charging pumps and a calculation of the maximum postulated rate of loss of reactor coolant through a RCGVS flow restriction orifice (reference NUREG-0737 Item II.B.1 Clarification A.(4)).

Response

The Fort Calhoun Station RCGVS flow restriction orifice (7/32" diameter) is the standard size orifice utilized throughout the Combustion Engineering Nuclear Steam Supply System to limit mass loss from instrument line breaks to less than the makeup capacity of a single charging pump. To calculate the maximum postulated rate of RC loss through this orifice, initial pressure conditions upstream of the orifice were considered to be in the range of 1800-2250 psia at the corresponding saturation temperatures. The maximum RC mass flow rate through an orifice at these conditions was calculated to be approximately 4 lbm/sec (29 gpm), which is considerably within the flow capacity of 36 gpm (a charging pump is actually rated at 40 gpm, but 4 gpm is considered to be lost through the RC pump seals) for a single charging pump.

Item 3.

Demonstrate that internal missiles and the dynamic effects associated with the postulated rupture of piping will not prevent the essential operation of the portions of the RCGVS that form a part of the reactor coolant pressure boundary (i.e., at least one vent path remains functional) (reference Appendix A to 10 CFR Part 50, General Design Criterion 4).

Response

The District's evaluation of this concern has determined that there are no postulated internal missiles or pipe rupture accidents that could disable the proper functioning of all RCGVS vent (release) paths. The RCGVS reactor vessel isolation valves are located a substantial distance away from the remaining RCGVS isolation valves. Additionally, there is no high pressure piping in the immediate location of the RCGVS isolation valves.

Item 4.

Verify that the following RCGVS failures have been analyzed and found not to prevent the essential operation of safety-related systems required for safe reactor shutdown or mitigation of the consequences of a design basis accident:

a. Seismic failure of RCGVS components that are not designed to withstand the safe shutdown earthquake.

b. Postulated missiles generated by failure of RCGVS components.

c. Fluid sprays from RCGVS component failures. Sprays from normally unpressurized portions of the RCGVS that are Seismic Category 1 and Safety Class 1, 2, or 3 and have instrumentation for detection of leakage from upstream isolation valves need not be considered.

Response

The entire RCGVS has been seismically designed to withstand a safe shutdown earthquake. The only pressurized components of the RCGVS, which could generate postulated missiles, are the system isolation valves and pressure transmitter. These components are located in areas well removed from other safety-related equipment required for safe shutdown of the plant. In addition, the solenoid valves have completely sealed bonnets and the manual isolation valves are diaphragm-type valves which have been specially designed to prevent leakage. Therefore, postulated missiles and/or sprays by failure of RCGVS pressurized components will not prevent the operation of essential safety-related equipment required to mitigate the consequences of a DBA.

Item 5.

Demonstrate, using engineering drawings and design descriptions as appropriate, that the RCGVS vent paths to the containment atmosphere (both direct and via the quench tank rupture disc) discharge into areas:

a. That provide good mixing with containment air to prevent the accumulation or pocketing of high concentrations of hydrogen, and

b. In which any nearby structures, systems, and components essential to safe reactor shutdown or mitigation of the consequences of a design basis accident are capable of withstanding the effects of the anticipated mixtures of steam, liquid, and noncondensible discharging from the RCGVS (reference NUREG-0737 Item II.B.2 Clarification a.(9)).

Response

The RCGVS has been designed such that the primary vent path for large volumes of non-condensible gases (e.g., hydrogen) and steam and liquid mixtures is into the open areas of the containment where adequate mixture with the containment atmosphere will occur. Additionally, since the RCGVS primary vent paths are to open areas of containment, the concern regarding adverse effects on safety-related equipment from a potentially damaging discharge is not valid. The secondary vent path to the quench tank (QT) is intended to be used for relatively small volumes of non-condensible gases, which can be contained within the QT. If it would become necessary to use this secondary path for large volume venting, due to primary path failure, the QT rupture disc would probably rupture and the resulting environmental conditions (i.e., temperature and humidity) would be less severe than that caused by continued operation of the primary vent path relief valves.

Item 6.

Clarification A.(11) of NUREG-0737 Item II.B.1 requires operability testing in accordance with subsection IWV of Section XI of the ASME Code for Category B valves. Although your submittal of July 1, 1981, committed to several of the operability testing requirements, other requirements, e.g., verification of positive valve position indication and testing of fail safe valve position, were not discussed. Verify that all requirements of subsection IWV for Category B valves will be met.

Response

The subject clarification to Item II.B.1 of NUREG-0737 states that provisions to test the operability of the RCGVS and testing of the Category B valves in accordance with Subsection IWV of Section XI of the ASME Code should be provided. The schedule and valve operability tests detailed in the District's July 1, 1981 letter will be accomplished as stated and will fulfill all operability testing requirements indicated above. Subsection IWV of the ASME Code states that valves shall be exercised once every three months unless it is not practical during plant operation. The District believes it is not practical to test these valves during normal plant operation due to the potential adverse effect to the RCS pressure-temperature equilibrium when testing the primary path vent valves and the potential for rupturing the QT rupture disc when testing the secondary path vent valves. Therefore, the valve operability testing will be accomplished only during refueling outages.