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Director of Nuclear Reactor Regulation
United States Nuclear Regulatory Commission
Attn: Steven A. Varga, Chief
Operating Reactors Branch No. 1
Division of Licensing
Washington, DC 20555

Reference: Beaver Valley Power Station, Unit No. 1
Docket No. 50-334
Reactor Vessel Overpressure Protection System

Gentlemen:

Attached is the additional information requested in your letter of December 22, 1981, concerning the Reactor Vessel Overpressure Protection System Modification for the Beaver Valley Power Station, Unit No. 1. We trust that this additional information will permit you to complete your review of our overpressure protection system in a timely manner.

If you have any questions concerning this response, please contact my office.

Very truly yours,

J J Carey

J. J. Carey
Vice President, Nuclear

Attachment

cc: Mr. D. A. Beckman, Resident Inspector
U. S. Nuclear Regulatory Commission
Shippingport, PA 15077

U. S. Nuclear Regulatory Commission
c/o Document Management Branch
Washington, DC 20555

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ATTACHMENT

Reactor Vessel Overpressure Protection System

Response to NRC Letter of December 12, 1981

1. The Branch Technical Position RSB 5-2 requires the Reactor Vessel Overpressurization Protection System (RVOPS) to meet single active failure analysis when the initiating cause of the event is not considered as the single active failure. In your failure mode analysis submitted in your letter dated November 23, 1977, there were several failures of power supplies or power sources that would result in one of the PORV trains being disabled. Could the loss of any power source result in isolation of the letdown flow path, (considered the initiating event), and also results in disabling one of the PORVs. If the above scenario is possible, discuss your plant's provisions to mitigate an overpressurization transient without PORVs.

Response:

Three paths of letdown are possible depending on plant conditions. The loss of any one power source will not result in isolation of the letdown flow path and concurrent loss of both trains of RVOPS. The following is the basis for this conclusion:

Letdown via CVCS: valves LCV-CH460A, LCV-CH-460B, TV-CH-200A, TV-CH-200B, TV-CH-200C and TV-CH-204 are pilot solenoid air operated globe valves requiring 125 VDC to open; a back-up source of DC to the bus is available from the battery and/or its respective charger. Valve PCV-CH-145 receives its signal from PT-CH-145 for sensing system backpressure, this control valve fails open on loss of power. All other power operated valves downstream are designed to fail such that flow is diverted to the Volume Control Tank (VCT) thereby establishing a flow path for this method of RCS letdown. Redundancy between the battery and battery charger supplies to the DC bus and diversity between the power supplies to the PORVs, supplies adequate protection in consideration of the short periods of time that the system is operated in a solid water condition while filling and venting.

Letdown via the excess letdown heat exchanger: valves MOV-RC-557A, MOV-RC-557B, MOV-RC-557C, MOV-CH-201, and MOV-CH-137 are motor operated valves which fail as is upon loss of power and as such will not result in the isolation of letdown flow. Valve HCV-CH-389 is a pilot solenoid air operated valve requiring 125VDC for operation, additionally failure of this valve diverts flow to the VCT on loss of power.

Letdown via RHR: Valve MOV-CH-142 is a motor operated valve which fails as is upon loss of power and as such will not result in the isolation of letdown flow.

Thus, this design meets the intent of the requirements of Branch Technical Position RSB 5-2 for the Reactor Vessel Overpressurization Protection System (RVOPS) with regard to meeting the single active failure criteria. With a single charging pump operable and the normal safety injection flow path isolated in Mode 5, analyses have confirmed that a single PORV can mitigate potential overpressurization from inadvertent heat and mass inputs during solid water conditions; adequate provisions for protection are provided.

2. The branch position requires an alarm to alert the operator to enable the OMS at the correct plant condition during cooldown (a) You rely on a pressure actuated alarm to perform this function. How do you ensure that the Reactor Coolant System temperature does not fall below the allowable temperature corresponding to the above alarm pressure setpoint, thus violating Appendix G limits?, (b) What assurance do you have that once the enable alarm is received, the OMS is functional and properly lined up?

Response:

(a) Station shutdown procedures require the system to be placed into service at a cold leg temperature less than or equal to 275F with the RHR System in service. The alarm is utilized as a backup to alert the operator to the condition and the requirement to have the system in service, therefore we do not necessarily "rely on a pressure actuated alarm to perform this function." Reliance is placed on the operator to follow the shutdown procedure and the alarm serves as a reminder to assure the necessary alignment is made.

(b) The procedure requires positioning of the PORV block valve(s), verification of available backup nitrogen pressure, positioning of the key lock switches, and setpoint verification to assure that the system is functional.

3. Please respond to the following:

a. When are the RVOPS functional tests performed?

b. How are the PORVs functionally tested?

c. How do you ensure that these valves actually open during testing?

Response:

(a) The RVOPS is tested prior to use and monthly thereafter when the RVOPS is required.

(b) The PORVs are stroke tested each time the plant enters a cold shutdown condition unless they were tested within the preceding three months. Each PORV is demonstrated operable at least once per 18 months by performance of a channel calibration in accordance with plant technical specifications.

(c) Valve position indicators are observed and actual stroke times are recorded.

4. The Branch Technical Position requires the RVOPS to be functional through an Operating Basis Earthquake (OBE). In your November 23, 1977 submittal, you identified eight valves as interim valves because they lacked seismic qualification and you stated that they would be replaced by appropriate Seismic Category I valves during a subsequent refueling outage. In your followup letter of December 14, 1978, you state that the relief valves had received their seismic certification and that the RVOPS as it then existed was considered the permanent modification.

   a. How was the seismic classification resolved on the interim valves other than the relief valves mentioned in the December 14, 1978 letter?

   b. If a pipe rupture occurred in the non-seismic portion of the nitrogen supply (as shown in figure 3 of your November 23, 1977 submittal), what would prevent the nitrogen discharge?

   c. Are the PORV operators qualified to operate through an OBE?

Response:

(a) The remaining valves classified as interim valves for the RVOPS were seismically qualified by laboratory testing.

(b) The first valve installed on the seismic portion of the piping is normally closed. When the accumulator nitrogen pressure is established this valve is closed and remains closed as part of the normal system arrangement.

(c) The PORVs were purchased to a Westinghouse E Spec which required the valve operators and valve assemblies to withstand seismic loading equivalent to 3.0 g in the horizontal direction and 2.0 g in the vertical direction and be capable of performing all intended functions. An OBE is defined as a normalized acceleration of 0.06g and a Design Basis Earthquake is defined as a normalized acceleration of 0.125g.

5. In your March 1, 1977 letter, you provided some information on the training that you conducted on the overpressurization incidents; provide the following additional training information.

   a. What overpressure training have you performed since 1977?

   b. How do you ensure that a continued emphasis is placed on possible overpressurization situations in your licensing and retraining programs?

   c. How is this training and LER review documented?

Response:

(a) The operator training program addresses reactor vessel overpressurization protection as part of the standard course content. New trainees receive a lecture on the RVOPS and complete a system qualification check-off with qualified personnel.

(b) The licensed retraining program consists in part of plant system reviews which include the RVOPS description and operation. Also included in licensed retraining are applicable Power Reactor Event Reports which are issued by the NRC. Those events considered as significant by the NRC involving overpressurization events are included in this program.

(c) LERs for overpressure incidents used in the training program are included in the lesson plans for formal discussion and are attached to the student handouts. The operator training program and licensed operator retraining program are formally documented as to attendance and materials covered.

6. What is the present status of the Beaver Valley, Unit 1, RVOPS?

   a. Have all permanent RVOPS installations and modifications been completed?

   b. Have warnings and caution notes been included in all affected procedures?

   c. Have all necessary administrative documentation changes been made?

Response:

The system, as stated in our December 14, 1978, submittal is considered the permanent modification and is presently operable.

(a) All RVOPS installations and modifications are complete.

(b) Caution statements have been added to the appropriate procedures.

(c) Appropriate changes to Operating Manual procedures have been completed.

7. List all the administrative procedures and controls used to minimize the probability of an overpressure transient (i.e., solid-water operation limited to certain RCS pressure, pressurizer heater and HPI pumps disabled at certain RCS pressure and temperature, etc). Indicate which of the above procedures and controls appears in your plant's Technical Specifications.

Response:

Station shutdown procedures require the isolation of the Boron Injection Tank flow path to prevent overpressurization from a safety injection signal when RCS temperature decreases to less than 350F. When the RCS pressure decreases to less than 1000 psi the safety injection accumulator discharge isolation valves are closed and the integrity of their discharge check valves is verified periodically. Procedures require establishing a nitrogen bubble in the pressurizer before collapsing the steam bubble with the RVOPS in service and the pressurizer heaters are turned off. A setpoint functional test must be satisfactorily completed before placing the system in service. Procedures require placing the overpressure protection system in service when the RCS cold leg temperature decreases to 275F. When RCS temperature has decreased to less than 160F, reactor coolant pumps can be shutdown and a prerequisite of the procedure for collapsing the pressurizer bubble requires the RVOPS to be in service. If the RCS is to remain pressurized, a nitrogen bubble is established with the RVOPS in service. The standby charging pump control switch is placed in the pull-to-lock position at low system temperatures thereby preventing the possibility of two charging pumps operating simultaneously.

Station startup procedures require the RVOPS system to be tested prior to beginning start-up activities. The only time the pressurizer is normally taken solid is during fill and vent operations just prior to drawing a presurizer bubble. By procedure the RVOPS is in service at this time. The RCS is heated to 160F using the Residual Heat Removal System (RHR). At this time a reactor coolant pump (RCP) can be started, however, Technical Specifications require less than 50F temperature differential before starting a RCP. The nitrogen bubble will be replaced in the pressurizer by a steam bubble and the RVOPS is in service during this evolution. When the RCS cold leg temperature exceeds 275F, the overpressure protection system is removed from service. service. The equipment removed from service during plant cooldown is returned to service as plant heatup progresses with a steam bubble in the pressurizer, such that potential overpressurization of the RCS is avoided.

8. If the Westinghouse generic analysis applies to your plant, reactor coolant pumps should not be started when water-solid and with a temperature difference of greater than or equal to 50°F between the RCS and the steam generator secondary sides. What means are available at Beaver Valley to determine the representative temperature difference between the RCS and the steam generators?

Response:

The RCS cold leg temperature is indicated in the control room for each loop. The steam generator secondary side temperature can be obtained by either of two methods. Feedwater temperature is monitored by a Temperature Resistance Bulb downstream of the first point feedwater heater, and may be read on the plant computer. This would be an accurate indication of feedwater temperature when flow through the main feed system is established. An alternate method requires the use of a contact pyrometer to measure the pipe wall temperature on the steam generator blowdown line with flow established. If flow is provided via the auxiliary feed pumps, the water temperature would be no less than the outdoor ambient temperature as suction is supplied from the 140,000 gallon Primary Plant Demineralized Water Storage Tank.

In addition, we are restricted from starting a pump unless a RC temperature differential of less than 50°F exists between the RCS and the steam generators by Technical Specifications. Reactor coolant pump starts under solid water conditions are only performed following a system fill and vent, after which a steam bubble is formed in the pressurizer.

9. Provide current P&IDs of the RVOPS including air and nitrogen systems associated with it.

Response:

The following drawings are enclosed:

Drawings Nos. 11700-RM-167A
11700-RM-167B

These two (2) drawings comprise the response.

10. What precautions are taken when testing the RVOPS during low temperature operations in order to avoid an inadvertent pressurization event?

Response:

Testing is performed on a single channel when a steam or nitrogen bubble exists in the pressurizer.

11. In your November 23, 1977 letter, you state that you do not consider the safety injection accumulators as a credible mass input mechanism and you, therefore, did not analyze for adequacy of the RVOPS based on inadvertent accumulator injection to the RCS. There have been several overpressure events at plants of the same NSSS as Beaver Valley 1 where the initiating event was an inadvertent accumulator discharge to the RCS. Explain why an inadvertent accumulator discharge is not credible at Beaver Valley 1.

    a. Explain all of the procedural and administrative controls used to prevent accumulator discharge to the RCS at low temperatures.

    b. How do you verify that these controls are in place and how often is this verification performed?

Response:

(a) Station shutdown procedures require the isolation of the safety injection accumulator discharge valves and removal of control power when RCS pressure decreases to less than 1000 psig. They remain isolated until station startup when RCS pressure reaches 900 psig.

(b) To verify that the accumulators have been isolated from the system, a surveillence test is performed to verify isolation by leak testing between the discharge isolation valves and the system check valves. Satisfactory completion of this test verifies the accumulators are isolated and the shutdown procedure requires a sign off to this effect. The valves will not function unless a banana jack is inserted at the panel in the control room to restore power to the linestarter for the the valve motor operators.

12. What is the reactor pressure vessel age in effective full-power years (EFPYs) for which your Appendix G limits are calculated?

Response:

Current Technical Specifications for which Appendix G limits are calculated are applicable for the first 16 EFPYs. A Technical Specification Change Request is presently receiving Duquesne Light Company safety review prior to submittal to the NRC. This proposed Technical Specification changes the calculated reactor pressure vessel age to 6 EFPYs. This change is based on the results of the first irradiation surveillence capsule removed from the vessel during the first refueling. New reactor vessel pressure - temperature curves which were developed from the analysis of the specimen are more conservative than the existing curves and have been incorporated into the Station Operating Manual procedures for station startup and shutdown.