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TOLEDO EDISON

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Docket No. 50-346

License No. NPF-3

Serial No. 568

December 28, 1979

Director of Nuclear Reactor Regulation
Attention: Mr. Robert N. Reid, Chief
Operating Reactors Branch No. 4
Division of Operating Reactors
United States Nuclear Regulatory Commission
Washington, D. C. 20555

Dear Mr. Reid:

This is in response to your letter of November 21, 1979 (Log No. 469) requesting additional information concerning small break loss-of-coolant conditions at the Davis-Besse Nuclear Power Station, Unit 1. The item numbers attached correspond to those of your request.

Very truly yours,

R P Crouse

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Response to Small Break Loss of Coolant Accident Items

Item 1

Transitions from solid natural circulation to reflux boiling and back to solid natural circulation may cause slug flow in the hot leg piping. By use of analysis and/or experience, address the mechanical effects of the induced slug flow on steam generator tubes.

Response

Toledo Edison Company has requested the assistance of B&W to determine the mechanical effects of the induced slug flow on steam generator tubes. This effort is to be completed and submitted to Toledo Edison Company by January 18, 1980. Following our internal review of the B&W evaluation, we will submit this information to you for your review.

Item 2

How are the high pressure injection pumps protected against deadheading if the system repressurizes? If operator action is required, show that there is sufficient time for operator response. How is this covered in guidelines for emergency procedures? (Applicable to Davis-Besse Unit 1 only).

Response

The Davis-Besse Nuclear Power Station Unit 1, (DB-1) high pressure injection system is protected against deadheading by its design. As illustrated in Figure 6-19 of the Davis-Besse Unit 1 Final Safety Analysis Report, a recirculation path is provided downstream of each high pressure injection pump to the borated water storage tank. No operator action is required to initiate this protection.

Item 3

Evaluate the impact of RCP seal damage and leakage due to loss of seal cooling on loss of offsite power. How long can the RCP seals sustain loss of cooling without damage?

Response

Normal Operation of RC Pump Seals

During normal pump operation, both injection water and cooling water are supplied to each pump. Injection flow is divided at the point of entry to the external circulation system. Water (9.0 gpm) flows over the face of the lower seal, downward across the recirculation impeller and pump bearing, and into the reactor coolant system. About 1 gpm passes to the upper seal chambers to set the interseal pressure. This flow is returned to the makeup system. During normal operation, then, ~10 gpm of injection water is supplied to each pump.

Item 3 - Response (continued)

While running, there is a circulation flow of approximately 70 gpm generated by the recirculation impeller through the lower seal chamber and internal heat exchanger. This system provides cooling for the seals in case of a loss of seal injection flow. When the pump is not operating, the injection system provides the necessary cooling.

Operation With Loss of Cooling Water to RC Pump Seals

In the event that the supply of cooling water from the Component Cooling Water (CCW) System to the pump seal assembly is lost, the injection water will provide adequate cooling for the seals and the pump can be operated indefinitely if the seal injection is functioning normally. The seal injection at Davis-Besse Unit 1 is provided by the Makeup System. However, if CCW is lost to the RCP motor for over 10 minutes, under normal operating conditions the motor must be manually tripped.

Operation With Complete Loss of Seal Cooling

This evaluation of the consequences of a complete loss of seal cooling has been performed using engineering judgement and the limited experience applicable. The evaluation shows that leakage would not increase appreciably for approximately 10 minutes and would not be severe for up to 60 minutes. In this evaluation, it was assumed at time 0 that the pumps are stopped when both seal injection and seal cooling are lost, the seal return valve is open and initial leakage is at a normal maximum of 2 GPM for mechanical face type seals of the type in use at Davis-Besse Unit 1. (Note that pumps with a first stage film riding - hydrostatic seal may leak up to 5 GPM but due to the large internal heat sink of this type of seal, the projected times in this evaluation will be about the same.) The capability exists to manually reinitiate seal injection flow and to close the seal return valve without offsite power and to restore cooling water flow when offsite power is available.

The seal cavity temperatures and seal leak rates for the first 4 to 5 minutes from time zero will remain essentially stable, due to the mass of the heat sink at the shaft, seal cartridge and pump heat exchanger. This time period could be extended by about 2-3 minutes if the seal return valve is closed within 90 seconds.

With the seal return valve open, when the temperature in the seal cavity starts to rise, it will increase at a rapid rate. The seals will be passing steam in an additional 4 or 5 minutes. If seal injection can be gradually reinitiated or if the component cooling water flow is started within about 10 minutes, the temperature ramp will be turned around, and although some internal damage may have occurred, the seal system will gradually stabilize and return to approximately the initial leakage rate. Closure of the seal return valve within this time frame is most effective in slowing the rate of temperature rise on those pumps that had low seal leakage at time zero and have not reached the point of rapid temperature increase. Closure of the seal return valve shortly after time zero would have reduced the heatup rate by as much as 75% for low leaking seals or 50% for high leaking seals.

Item 3 - Response (continued)

If cooling continues to remain unavailable, the seal cavity temperature will continue to increase and is predicted to reach at least 350°F in 20 minutes. At this time, the shaft directly above the seals will be about 300°F and the heat exchanger will be at full system temperature (540°F).

The rapid restoration of cold seal injection water after the seals and pump parts are hot will shock all of the hot parts, causing distortion and possible cracking of seal parts, which could lead to an increased leak rate. However, it is felt that this will not cause an appreciable increase in leakage on a static pump. It is preferred that component cooling water be the first source reinstated, until the temperatures in the seal cavity have returned to normal and have stabilized. If component cooling water cannot be reinstated, then cold seal injection may be initiated, preferably at a gradual rate (approximately increasing the rate at one gallon per minute).

After steaming conditions are reached, significant seal degradation would not be expected, up to a period of approximately one hour after time zero. The elastomers which make up a part of the seal assembly will start to soften at approximately 300°F and can start to extrude before reaching 500°F. The amount of extrusion is based upon time, temperature and annular clearances. Experience has shown that leakage of seals because of elastomer extrusion does not increase appreciably within the first 30 minutes. It is estimated that under the worst conditions, leakage on a static pump may reach 5 gpm in 30 minutes and 10 gpm in 60 minutes.

After the pump experiences high seal cavity temperatures, the following parts must be inspected and replaced prior to operation:

a. Seal package - replace all elastomers and seal faces, inspect all structural parts including bolts for distortion, cracks, etc.

b. Water lubricated carbon bearings - inspect for cracking and steam cutting.

c. Perform pump-rotor alignment check.

d. Monitor shaft and frame vibration on pump start to determine if thermal shocking has produced a bow in the pump shaft.