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U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: RESPONSE TO NRC IE BULLETIN 84-03
REFUELING CAVITY WATER SEAL

Reference: IEB 84-03, "Refueling Cavity Water Seal"

The referenced Bulletin describes the rapid loss of refueling cavity water which occurred at Connecticut Yankee on August 21, 1984, and requested an evaluation of applicability. In response, attached is a summary report of the potential for and the consequences of a refueling cavity water seal failure incident at WNP-2. This evaluation addresses:

1) gross seal failure;
2) maximum leak rate due to failure of active components, such as inflated seals;
3) makeup capacity;
4) time to cladding damage without operator action and potential effect on stored fuel and fuel in transfer; and
5) emergency operating procedures.

The Supply System considers, as shown in the attached summary, that such an event is remote. Given such an occurrence, the failure of makeup sources to control the event is further removed from credibility. Despite

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the improbability, the Supply System has addressed all areas of NRC concern identified in the referenced IEB.

Should you have any further questions, please contact Mr. P. L. Powell, Manager, WNP-2 Licensing.

Very truly yours,

for G. C. Sorensen, Manager
Regulatory Programs

PLP/tmh
Attachment

cc: R Auluck - NRC
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SUMMARY REPORT ADDRESSING REACTOR CAVITY WATER SEAL FAILURE

NRC Concern: Gross seal failure and maximum leak rate due to failure of active components, such as inflated seals.

WNP-2 Response

The WNP-2 BWR design for the barrier between the reactor cavity and the drywell consists of two permanently installed bellows assemblies and a bulkhead plate. This barrier design does not contain any interference fit pneumatic seals; therefore, a gross failure due to lack of interference is not possible.

The bellows assemblies provided by Pathway Bellows, Inc., are welded in place. All critical stainless steel seal parts are welded in place and encased in 1/4-inch thick plate, at a minimum. The primary bellows is backed up by a secondary, self-energizing spring seal which restricts water loss in case of a bellows rupture. The outer diameter of the spring seal is the same as the inner diameter of the outer liner. In the event of a bellows rupture, the water pressure will force the seal even more tightly against the outer liner.

The bulkhead plate has HVAC penetrations which are closed for refueling by a pipe cap which is bolted down and sealed with an O-ring. There are several pipe penetrations through the bulkhead plate which are blank flanged with gaskets for refueling. This piping is for lines running to the reactor vessel head during normal operation.

In conclusion, large unrestricted openings in this barrier and excessive leak rates are not credible because:

- o All critical components are welded or bolted in place. There are no "active" components requiring the constant application of pneumatic energy to make them functional.
- o The bellows material is stainless steel which is a ductile material. Total fracture and displacement of the bellows is not likely. WNP-2 seal assemblies were designed to Seismic Class I requirements.
- o The redundancy and close fit of the self-energized spring seal also minimizes the potential for a large area leak path.
- o The design of the bellows assemblies provides for leak detection. Any leak greater than 1 gpm is alarmed in the main control room. This feature informs the operator of a deteriorated bellows assembly. Alarms are provided for both the outer bellows and the inner bellows. Installation of the inner bellows alarm is not complete at this time but will be completed prior to the first refueling outage.

NRC Concern: Makeup capacity

WNP-2 Response

Seven methods were identified to provide makeup water to the fuel pool and reactor well without requiring personnel exposure on the refueling floor. These are:

1. Initiation of feedwater injection to the vessel using the condensate pump and condensate booster pump to refill the reactor cavity in order to overcome an incredible major leak until all fuel is in the vessel or the storage rack. Normal operating pump capacity, per pump pair, is 11,025 gpm.

WNP-2 Response - Makeup capacity (Continued)

2. Control drive cooling water flow to the vessel. Flow indication scale is up to 100 gpm for normal operation. Without the vessel pressurized, flow higher than this is achievable.

3. Standby Service water from both spray ponds via a two-inch connector to the Quality Class I and Seismic Class I portion of fuel pool cooling piping. The flow rate is estimated at 120 gpm.

4. Condensate supply automatically delivers 120 gpm to the skimmer surge tank on a low tank level signal. Quality Class I fuel pool cooling pumps then transfer the water to the spent fuel pool. If the fuel pool cooling pumps were not available, the condensate supply valve to the tank can be remotely opened from the control room. With the control switch in "open", the automatic high level cutoff is bypassed and the tank will overflow back into the spent fuel pool.

5. The suppression pool cleanup pump can inject directly to the fuel pool through the diffusers with special valve lineup of the fuel pool cooling system. Normal operating pump capacity is 575 gpm.

6. RHR Loop B through the removable interconnection to the fuel pool cooling system is restricted to 2700 gpm to the fuel pool diffusers by an orifice. This method would take the most time to establish, as the spool pieces would need to be removed from site storage and would require scaffolding to install.

7. Initiation of ECCS injection to the reactor vessel. Combined flow rate of LPCS, HPCS, and RHR up to approximately 35,400 gallons per minute. In an incredible case, this method could be used to maintain reactor cavity level by circulating water returning to the suppression pool via a major leak into the drywell and the containment downcomers.

It should also be noted that five out of seven of these methods utilize critical electrical power supplies to the pumps involved. The ability to make up water in the reactor well and fuel pool is more than adequate to prevent fuel cladding damage.

NRC Concern: Time to cladding damage without operator action and potential effect on stored fuel and fuel in transfer

WNP-2 Response

The Supply System's Fuels Engineering Group performed two analyses with the assumption that decay heat load in the fuel assemblies was at a maximum in order to determine:

1. Time to cladding damage without operator action in the event that a loss of all refueling pool water occurs while a fuel assembly is suspended from the refueling bridge.

2. Time to boil off the water remaining in the spent fuel pool below the transfer gate without makeup flow and the time to cladding damage of stored fuel in this scenario. In the worst case possible, the loss of spent fuel pool water through the transfer gate to the reactor cavity leaves 1.5 feet of water remaining over the top of the stored fuel.

<u>WNP-2 Response</u> - Time to cladding damage without operator action and potential effect on stored fuel and fuel in transfer (Continued)

The results of the analyses are:

1. Time to cladding damage is approximately two hours when a fuel assembly is suspended in air from the refueling bridge.

2. Time to boil off water from the bottom of the transfer gate to the top of the fuel column is approximately two hours, and the stored fuel will fail in 3-1/2 hours after the active fuel column becomes exposed.

It should be noted that the second scenario requires a loss of all makeup capability outlined in the preceding section; this is considered extremely unlikely.

NRC Concern: <u>Emergency operating procedures</u>

<u>WNP-2 Response</u>

The WNP-2 fuel pool system is presently being modified to meet Seismic I criteria. The pool will not be used until the first refueling outage (Spring 1986). Obviously, with WNP-2 in first fuel cycle, there will be no requirement for the pool until that time. As a result of the modification in progress and there being no need to have procedures in place until 1986, the procedures addressing fuel pool activities are either in draft form or approved with reviews pending completion of the modifications. These procedures, in this interim condition, have been reviewed with respect to this concern, areas of clarification noted, and changes will be made, as necessary, on a schedule to support the first refueling outage.