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SUBJECT: Forwards summary of turbine bldg flood mods undertaken at facility, in response to NRC 860415 telcon request. List should assist NRC in current cost/benefit analysis work in conjunction w/evaluation of emergency feedwater sys.

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April 28, 1986

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

Attention: Mr. John F. Stolz, Project Director
PWR Project Directorate No. 6

Subject: Oconee Nuclear Station
Docket Nos. 50-269, -270, -287

Dear Sir:

Attached is a summary of the turbine building flood modifications undertaken at Oconee Nuclear Station (ONS). This summary was requested by the NRC staff during a conference call on April 15, 1986. The attached list of modifications should assist the NRC staff in its current cost/benefit analysis work in conjunction with evaluation of the ONS emergency feedwater system.

Current figures show expenditures of $450,000 to date on the main group of seven flood-related modifications with an additional $100,000 to be spent on finishing two other related modifications. Furthermore, construction of the turbine building basement drain following the 1976 flooding incident cost an additional $525,000. Overall, Duke Power Company has spent in excess of $1 million to date on flood-related modifications at ONS.

Very truly yours,

Hal B. Tucker

Hal B. Tucker

MAH:slb

Attachment

A001

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Turbine Building Flood Related Modifications At The Oconee Nuclear Station

One of the many scenarios considered by the Oconee PRA was a seismically induced flood of the turbine building basement. These flood sequences accounted for about one-third of the total seismic-related core damage probability. This figure represents a conservative estimate of the impact of seismically induced floods, since the analyses did not consider modifications made to the Oconee station that were intended to reduce the risk from flooding events. In other words, the seismic analyses used the so-called "unmodified plant" described in Section 9.5 of the Oconee PRA.

The preliminary results of the Oconee PRA provided many useful insights. One of these insights was that sequences caused by flooding of the turbine building and auxiliary building basements accounted for 65 percent of the overall core damage probability.

Due to the dominance of these flooding sequences, Duke modified some equipment, configurations, and procedures at the Oconee station. Using new assumptions based on these modifications, the Oconee PRA project team carried out a second series of analyses. The "modified plant" turbine building flooding analyses showed that the modifications had reduced the overall turbine building flood core melt frequency by about a factor of 20. Turbine building basement flooding sequences in the final version of the Oconee PRA account for only about 20 percent of the overall core damage frequency.

There were eight recommendations for hardware modifications or additions that were modeled by the modified plant analysis. They were:

(1) Penetrations in the turbine building/auxiliary building wall were sealed to a height of six feet (Elevation 781) above the basement floor, and the jambs of the six doors between the turbine building basement and the auxiliary building basement were strengthened [NSM 2160].

Backround: The original analysis showed that one of the major complications of turbine building flooding was that water would pour through doors and pipe penetrations, flooding the auxiliary building basement. This flood would potentially cause the loss of HPI pumps, LPI pumps, and reactor building spray pumps.

All penetrations in the turbine building/auxiliary building wall were provided with watertight seals. The six doors in the turbine building/auxiliary building basement wall were strengthened and secured. Normal access was not permitted through these doors.

(2) Override switches were installed to allow all CCW pump discharge valves to be closed from the control rooms [NSM 2158]

Backround: One of the major sources of water available to feed a turbine building flood is backflow through the CCW pump discharge valves. The control logic leaves one CCW pump discharge valve on each unit in the open position to ensure a flowpath for the gravity feed, emergency CCW system. These valves, before the modification, had to be closed from a panel in the equipment room. Procedures have been changed to instead use the override switch on the CCW panel following receipt of a "flood alert" alarm (see #3, below).

(3) Two water level alarms were installed: a high sump level alarm, and a turbine building basement flood "alert" alarm at Elevation 775 1/2 [NSM 2140].

Backround: The key to successful response to almost any incident is an early, correct diagnosis of the accident. The alarms, as installed, provide the operations staff with early indications of abnormal water levels in the sumps, and of high water on the basement floor.

The alarms have been installed on the Unit III Operator Aid Computer (OAC), due to a lack of space on the alarm panels; they register as Statalarms on panel location A18-11 in the Units I and II control room.

(4) A high pressure service water (HPSW) backup to low pressure service water (LPSW) cooling of the HPI pump motors is being added [NSM 2159].

Backround: It is highly likely that the LPSW pumps will be submerged and damaged in the early stages of a turbine building flood. This would fail cooling water to the HPI pump motors. While the HPSW pumps would probably be submerged at about the same time as the LPSW pumps, the elevated water storage tank contains about an eight-hour supply for the HPSW system. This NSM provides an automatic LPSW to HPSW switchover; the operations staff is instructed, by procedure, to verify coolant flow to the HPI pump motors whenever alarms are received that indicate low LPSW flow.

(5) The trash screen in front of the turbine building basement drain was redesigned [NSM 2152].

Backround: The flat security gate in front of the turbine building basement drain could have rendered the drain ineffective during a flood: trash and other loose items in the basement area could have clogged the gate. This could have reduced the maximum possible flow through the drain, causing higher water levels in the basement. The new screen in front of the gate is designed to divert trash; it also maintains the required security boundary at the drain entrance.

(6) Valves 3CCW-40 and 3CCW-42 on the CCW crossover piping have been locked closed and tagged during periods of normal operations.

Backround: This step was also designed to cut down on the amount of water that was available for a flood. Closing these two valves isolates the CCW systems on the three units during normal operation. CCW system dewatering procedures have been changed to include provisions for locking open the proper valve when a unit's CCW system is dewatered. This action ensures that the unit's LPSW system will have a source of suction during the dewatering period.

(7) HPSW backup to LPSW cooling of the service air compressors has been added [NSM 2139].

Backround: This item is similar to the HPSW backup cooling to the HPI pump motors (NSM 2159, discussed in item #4, above). Again, the concern is that the LPSW pumps will fail early in a flood. Compressed air is required for operation of many key components and systems. Service air serves as a backup to the instrument air system; the instrument air compressors are assumed to be flooded in most turbine building flood sequences. In the turbine building flood scenarios, prompt closure of the air-operated CCW pump discharge valves is a vital step to the proper mitigation of the accident.

(8) Valve alignments on the CCW side of the condensate coolers for all three units were changed to limit the backflow from the CCW system during a flood.

Backround: One condensate cooler on each unit has been isolated, using the manual block valves, to limit backflow from the CCW outlet during a flood. Thus, 1CCW-78 and 1CCW-79 are closed on cooler 1B; 2CCW-78 and 2CCW-79 are closed on cooler 2B; and, 3CCW-78 and 3CCW-79 are closed on cooler 3B. It is desirable, however, to allow a limited amount of backflow during a flood. This is necessary to provide suction for HPSW, LPSW, and the standby shutdown facility (SSF) auxiliary service water (ASW) pumps. Backflow through the RCW coolers would not be sufficient for these purposes. Therefore, temperature control valves 2CCW-84 and 3CCW-84 have had their air supplies disconnected, effectively failing them in the open position during all modes of plant operation. Valve 1CCW-84 was left in operation; there are no service water or SSF suction requirements on the Unit 1 system.

It is recognized that operating conditions will sometimes require restoring one or more of the isolated condensate coolers to service in order to maintain one or more of the units at full load. The PRA recognized this requirement; the assumption was that the three coolers in question would be isolated ten months out of each year of reactor operation.

In addition to the physical changes cited above, the PRA considered that the turbine building flood emergency procedure was revised to include the following:

(A) The EP is entered immediately upon receipt of a turbine building flooding "alert" alarm from the detectors mounted at Elevation 775 1/2 (6 inches above the floor). Immediate actions include tripping all three units.

(B) The operators are instructed to use the CCW pump discharge valve override closure control, mounted on the CCW panels in the control rooms.

(C) The operators have been instructed to verify operation of the proposed HPSW backup to LPSW cooling of the HPI pump motor jackets. This instruction is contained in a loss of low pressure service water procedure.

Two modifications have been undertaken since the publication of the PRA which should impact the flood analyses. These two modifications are:

(1) All penetrations in the turbine building/auxiliary building wall have been sealed up to elevation 795, water-tight doors have been installed in door positions 101B, 102B, and 103B, and all other non-"flood" doors in the basement wall have been sealed [NSM 2371].

Backround: Since the time of the original modifications to the turbine building/auxiliary building wall, it had become apparent that maintenance and other activities needed to support normal operations required frequent access to the basement areas through the doors that were secured. NSM 2371 provided for the installation of watertight flood doors in locations 101B, 102B, and 103B. These doors allow normal access between the basement areas while maintaining the integrity of the wall. The doors are alarmed; a timing circuit allows four minutes for normal access before activating an alarm in the control rooms. Periodic testing of the door seals, regular surveillance by personnel on shift tours, and prompt response to "open flood door" alarms received in the control rooms should provide a good level of auxiliary building flooding protection.

(2) Bypass lines and valves are being added around the atmospheric dump valves [NSM 2453].

Backround: Adding bypass lines around the atmospheric dump valves is intended to make use of the ADVs easier. This should help insure successful use of the low-head auxiliary service water (ASW) pump to deliver feedwater to the steam generators.

It should be noted that this pump was not considered by the Oconee PRA since a seismically induced flood was assumed to flood the auxiliary building basement through the turbine building/auxiliary building wall penetrations.