6/3/82

Supplement to the Safety Evaluation Report

Hydrologic Engineering Section

Waterford Steam Electric Station, Unit 3

Docket Number 50-382

2. SITE CHARACTERISTICS

2.4 Hydrologic Engineering

2.4.2 Flood Potential

2.4.2.3 Local Intense Precipitation

Waterford 3 has wet and dry cooling towers which are open at the top. There are two open cooling tower areas A and B. Local intense precipitation which falls directly over these open areas plus runoff from adjacent roofs will accumulate and pond on the floors of the dry cooling tower areas. A combination of floor drains and a network of drainage piping will convey this water to two sumps where a set of duplex pumps in each sump will remove water from the cooling tower areas.

Design Basis Rainfall Event:

In Section 2.4.2.3 of the Safety Evaluation Report, the staff concluded that the applicant's analysis of potential flooding in cooling tower areas A and B did not meet the design criteria suggested in Regulatory Guides 1.59 and 1.102 nor the requirements of GDC-2 because certain safety-related transformers and motor control centers located in the cooling tower areas could be flooded during a design basis rainfall event. The staff stated that safety related components in cooling tower areas A and B should be flood protected to 4.2 feet and 3.6 feet respectively. The staff also stated that lower flood protection depths would be acceptable if additional or larger pumps were used to reduce ponding levels or if the applicant could provide assurances that roof drains would not become clogged. The applicant subsequently presented an evaluation of the potential for blockage of roof drains. This evaluation showed that clogging of roof drains would be highly unlikely. However, as described below, the applicant conservatively assumed that 33 percent of the roof drains would be clogged during a design basis rainfall event. Based on the information presented by the applicant, the staff agrees that it is highly unlikely that all of the roof drains would become clogged. The Staff further agrees that a 33 percent blockage of roof drains is a conservative assumption.

In Amendment 21 to the FSAR, the applicant presented a revised analysis of potential flooding in cooling tower areas A and B. In this analysis roof drains were assumed to be 33 percent blocked. The applicant also assumed that one of the sump pumps in each cooling tower area would be inoperable during a probable maximum precipitation (PMP) event. Amendment 21 also stated that the sump pumps in the cooling tower areas each have a capacity of 325 gallons per minute (gpm). Initially, the FSAR had shown these pumps as having a capacity of 140 gpm. This revised analysis by the applicant resulted in lower ponding levels in the cooling tower areas. These levels however were not low enough to prevent flooding of the motor control centers which are located on the floors of the dry cooling towers. To further reduce ponding levels in the cooling tower areas, the applicant proposed to allow water to flow into and pond in the Fuel Handling Building. Openings will have to be provided between the cooling tower areas and the Fuel Handling Building. The applicant has determined that three 4-inch diameter openings have to be installed in the sills beneath exit doors located on each side of the Fuel Handling Building. However, to allow for some clogging of pipes, a total of eight 4-inch diameter pipes will be installed. The applicant has estimated that by allowing water to pond in the Fuel Handling Building, a maximum of 1.6 feet of water will pond in the cooling tower areas and in the Fuel Handling Building. The maximum height to which water can pond in the cooling tower areas before flooding of essential portions of the transformers occurs is 3.0 feet. For the motor control centers it is 1.71 feet.

The staff has reviewed the material presented by the applicant and has performed independent analysis. The staff therefore concludes that, with the eight 4-inch diameter opening installed as indicated by the applicant, water depths in the cooling tower areas will remain below 1.6 feet following a PMP event and will thus not affect the safe operation of Waterford 3.

Combination of Events:

Regulatory Guide 1.59 suggests that a sufficient number of combinations of flood causing events be tested or discussed to assure that the highest flood level has been determined. An alternative combination which should be considered is an operating basis earthquake (OBE), which fails the sump pumps, coincident with a rainfall event less severe than the PMP. This combination is considered appropriate since the pumps are not seismically qualified,[1] and thus cannot be shown to be operable following a seismic event. The staff therefore requested that the applicant provide an analysis of the effects of a Standard Project Storm (SPS)[2] assuming all four sump pumps in the cooling tower areas are inoperable.

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[1] The applicant has described the sump pumps as designed to seismic Category 1 requirements but not classified as seismic Category 1 (FSAR Table 3.2-1).

[2] The SPS is a storm used for design of flood control structures by the U.S. Army Corps of Engineers. Rainfall resulting from a SPS is generally equal to about 40 to 60 percent of the PMP.

The applicant's analysis of this combination of events showed that there would be some flooding of motor control centers about 7 hours after ponding in the cooling towers began. The applicant stated that reactivation of even one of the sump pumps would, at an increasingly rapid rate, reduce the total accumulated water level. There was no discussion or description of how the sump pumps would be reactivated nor how long it would take to do so. Thus the staff was unable to conclude that a rainfall event coincident with an OBE would not result in flooding of motor control centers and transformers in the cooling tower areas.

In analyzing the PMP, both the applicant and the staff determined that ponded water in the cooling tower areas would peak at about the 5th or 6th hour. After this, levels would decrease because the capacity of the sump pumps would exceed the amount of water coming in. Thus consideration of a 6 hour PMP as a design basis event was adequate. For the coincident SPS and OBE event, however, storm duration is a much more critical parameter because the sump pumps are assumed to be inoperable, allowing water to accumulate for the entire duration of the storm.

In Section 2.4.2.3 of the SER, a 48-hour PMP is estimated to be 43.5 inches. The 48 hour SPS rainfall would be about 21.8 inches assuming that the SPS is equal to 50 percent of the PMP. Since ponding depth in the cooling tower areas is dependent on the duration of the rainfall event, the staff considered a SPS of 96 hours duration. This event would produce a total rainfall of about 23 inches and would result in a ponding depth of about 1.9 feet in the cooling tower areas assuming that all four sump pumps are inoperable. Since this is higher than the maximum allowable ponding depth of 1.71 feet, the applicant has proposed to provide a portable pump with a pumping capacity of 100 gallons per minute (gpm) and sufficient head to pump over the cooling tower wall. This pump will be stored on pallets placed away from any non-seismic category I equipment which could fall and damage the pump. In addition, the pump will be included in the surveillance testing program which will include a demonstration at least once per refueling that the pump will circulate water. As part of the station's emergency procedures, a provision will be included for emplacing the portable pump within 6 hours of a seismic event if the installed pumps fail.

The staff has determined that a 100 gpm pump capable of lifting water 75 feet vertically is adequate to prevent flooding of safety related equipment in the cooling tower areas during a combined SPS-OBE event provided the pump is placed in operation within 6 hours.

Conclusion:

The staff now concludes that with respect to potential flooding of the cooling tower areas, the station meets the requirements of GDC-2 and the criteria of Regulatory Guides 1.59 and 1.102.

- Pages 2-18 & 2-19 from the Waterford SER dated July 1981.

Wet and dry cooling towers at Waterford 3 are open at the top and could be affected by local intense precipitation which falls directly over the cooling towers and by runoff from adjacent roofs. There are two open cooling towers areas, A and B. These areas have floor drains that flow into a sump for each area. Each sump is drained by two sump pumps which have a combined capacity of 280 gal/min. The pumps remove ponded water from the cooling tower areas to the exterior plant drainage system.

A rooftop drainage system has also been designed to prevent roof ponding of water for rainfall rates up to 6 in./hr. More intense rainfall will either pond below roof parapets or overflow. Part of this overflow will enter the open cooling tower areas.

The applicant performed an analysis of the effects of a 6-hr duration PMP on the open cooling tower areas and adjacent roofs. In this analysis, the rooftop drainage system was assumed to be functioning and all sump pumps, which are described as seismically designed, were assumed to be pumping water from each cooling tower area at a maximum rate of 280 gal/min. The computed ponding depths were 1.35 ft in cooling tower area A and 1.70 ft in cooling tower area B. The applicant stated that all safety-related equipment would be located above these ponding levels.

At the request of NRC, the applicant provided drawings and descriptions of safety-related components that are located in the cooling tower areas. These consist of transformers and motor control centers (MCCs) mounted on the floors of the dry cooling towers. Although these components will be partially inundated by water, the applicant has stated that the transformers are watertight for approximately the lower 3 ft and the MCC's can withstand ponded water up to 1.75 ft without harmful effects. Thus the applicant's analysis shows that water levels in Cooling Tower Area B, assuming that roof drains and sump pumps function as design, will be within 0.05 ft (5/8 in.) of flooding the MCC's and affecting the operability of the dry cooling towers. The margin in Cooling Tower Area A as calculated by the applicant, is 0.4 ft (4.8 in.). These margins could easily be exceeded should the roof drains become partially clogged or not function at their design capacity or if a sump pump does not switch on when needed or does not operate at full capacity. Based on this, the staff concludes that the applicant's analysis and design are not conservative and that the flood protection for the cooling tower areas does not meet the design criteria suggested in Regulatory Guides 1.59 and 1.102 nor the requirements of GDC 2.

The staff performed an independent analysis of potential flooding of these cooling tower areas, assuming that one sump pump in each area is inoperable and that the roof drainage system is clogged with debris during the PMP. This analysis resulted in a ponding depth of 4.2 ft in Cooling Tower Area A and 3.6 ft in Cooling Tower Area B. These ponding depths would inundate the transformers and MCC's in the cooling tower areas and affect the safety of the plant. The staff will require that all safety-related components in the cooling towers area be flood protected to these depths. Lower flood levels may be acceptable if the applicant can provide adequate assurances that the roof drains will not become clogged during a design basis event. Additional or larger capacity pumps may also be used to reduce calculated ponding level. NRC will need to review the applicant's proposal prior to issuance of an operating license. The results of review will be provided in a supplement to this report.