UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO A PROPOSED NEW METHOD FOR COOLING SPENT FUEL POOL

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GRAND GULF NUCLEAR STATION, UNIT 1

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1.0 INTRODUCTION

By letter dated November 1, 1991, Entergy Operations, Inc., the licensee for the Grand Gulf Nuclear Station, submitted a proposal to modify the use of the fuel pool cooling and cleanup (FPCC) system so as to minimize the need to rely upon the residual heat removal (RHR) system during the refueling period.

The fuel pool cooling portion of the FPCC system consists of two parallel trains, each containing a pump and heat exchanger (HX). Water from the component cooling water (CCW) system is used to cool the FPCC HXs during normal operation. However, in the event of loss of offsite power, the FPCC HXs are isolated from the CCW system; cooling thereafter is provided by the standby service water (SSW) system.

At present, the licensee is required to keep the spent fuel pool (SFP) temperature at or below 140°F. In the event that the pool temperature exceeds 140°F, it must be restored to 140°F or below within 8 hours (TS 3.7.9.a); if the pool temperature exceeds 140°F, the extrapolated pool temperature must not exceed 210°F for 20 hours (TS 3.7.9.b). In either case - a pool temperature at or above 140°F for 8 hours or an extrapolated temperature that exceeds 210°F within 20 hours - the licensee is required to have the plant proceed to the cold shutdown mode.

Further, to limit reliance upon the RHR system for supplemental cooling, the licensee is presently limited to storing a maximum of 2324 fuel assemblies (TS 5.6.3), rather than the pool total storage capacity of 4348.

2.0 EVALUATION

2.1 Decay Heat Generation

The licensee calculated the decay heat loads to be 21.4 MBTU/HR for the normal maximum case (normal reload) and 47.3 MBTU/HR for the abnormal maximum case (full core offload) with a completely filled SFP (4348 fuel assemblies). Previously, the licensee had calculated the heat generation for the two cases to be 18.9 and 47.8 MBTU/HR, respectively; the .fference in the normal maximum case results mainly from a change in planned reloads from 228 fuel assemblies previously to 284 in the present plan. This largely accounts for the difference calculated in the normal reload case.

The staff found the previous calculations acceptable. Based on the foregoing, the staff finds the new calculations of decay heat generation acceptable.

2.2 Fuel Pool Temperature

2.2.1 Maximum Normal Case (normal refueling offload filling SFP)

Presently, the licensee is permitted to use the RHR system to supplement the FPCC system during the first 35 days of the refueling pericd in order to maintain a fuel storage bulk coolant temperature of 140°F. In order to ensure that the FPCC system would be capable of maintaining the 140°F temperature thereafter, the staff required the licensee to limit the storage of fuel assemblies to 2324 in number instead of the maximum storage capacity of 4348 fuel assemblies.

The licensee, in a submittal dated April 27, 1989, proposed to use one FPCC system train with SSW as the coolant after 35 days with the SFP completely filled as a long term solution. However, in the latest proposal (submitted November 1, 1991), the licensee presented a different long term solution. In this, the licensee proposed to use both FPCC system HXs with one FPCC pump driven by the available diesel generator. The licensee stated that this method was proposed to avoid unnecessary restrictions in outage planning. The licensee further stated that the capability to use the RHR to assist in cooling the SFP was being retained but that reliance upon RHR supplemental cooling for normal design decay heat load, i.e., normal refueling with the SFP filled with 4348 fuel assemblies, was not required. This new method requires that the FPCC pump provide a flow rate of 1600 gpm (800 to each HX) in lieu of 1100 gpm; the SSW system must supply 1254 gpm to each HX.

The staff finds this modification to be acceptable, pending testing by the licensee to ensure that the desired FPCC and SSW coolant flow rates have been obtained (see Section 3.0, Conclusions, for further discussion).

2.2.2 Maximum Abnormal Case (full core offload filling SFP)

The licensee conducted two calculations to determine the spent fuel pool bulk coolant temperatures in the event of a full core offload. Both calculations assumed that both FPCC trains were operating, and the SFP was filled once the core was offloaded. In one calculation, it was assumed that the HXs were cooled by the CCW system; in the other, by the SSW system. In both cases, the coolant temperatures were below boiling, i.e., 212°F, in accordance with the criterion of Section 9.1.3 of the Standard Review Plan. The staff finds these results to be acceptable.

2.2.3 Upper Containment Fuel Storage Pool

The upper containment storage pool is used only for temporary fuel storage; no fuel may be stored in this pool during plant operation. The licensee stated that the temperature of the coolant in the upper containment pool is monitored so that cooling can be adjusted to prevent overheating.

2.2.4 Cask Storage Pool

The cask storage pool coolant temperature can also be monitored and adjusted by additional cooling to maintain desired coolant temperatures.

2.3 Alternate of Supplemental Cooling by Means of the RHR System

The RHR system is arranged so as to be able to aid in cooling all three pools, upper containment, spent fuel, and cask storage pool if needed. However, the three trains of the RHR system are part of the emergency core cooling system (ECCS) system and, thus, may not be diverted for use in cooling either of the pools during normal power operation.

2.4 Cooling by Other Means

In the event both offsite and onsite power (the available diesel generator) is lost, the licensee has revised emergency procedures to provide for cooling by means of the station fire truck, which will be used to pump fire water into the reactor. The water will flow at a controlled rate from the reactor, through the spent fuel pool and into the suppression pool. Manual operation of valves in the FPCC system, the low pressure core spray system, and the RHR system will be necessary to accomplish this task. The licensee calculated that the cooling effect of 722 gpm of water from the fire system would be required and that the fire truck was capable of pumping 1000 gpm. The staff finds this alternate method of cooling the spent fuel storage pool to be acceptable.

2.5 Heatup Time for SFP and Containment Pool

The licensee calculated the time required to raise the spent fuel pool bulk coolant temperature from 140°F to boiling (212°F) and made a similar calculation for the upper containment pool. In both cases, it was assumed that a full core, 800 fuel assemblies, are unloaded into the pool. The 800 assemblies fill the upper containment pool; the 800 unloaded assemblies, together with those already present, fill the SFP. In both cases, it is assumed that 243 hours have elapsed before unloading is complete.

According to the information provided by the licensee, the time required for the SFP bulk to reach the boiling point is 5.9 hours; for the upper containment pool, 3.1 hours.

The staff finds these times acceptable in that there appears to be sufficient time to develop alternate cooling via the fire truck.

2.6 SSW System Water Temperature

The licensee noted that the SSW system water temperature used in the calculation for the one pump/two heat exchanger method was 86°F in lieu of 90°F as specified in the final safety analysis report (FSAR) as the design basis temperature. The licensee justified the use of 86°F on the basis that the heat to be dissipated during refueling is much less than that to be dissipated during or in the event of a loss-of-coolant accident (LOCA) (the event for which the 90°F SSW system water temperature had been calculated).

The staff finds this temperature, 86°F, to be acceptable for use in the aforementioned calculation.

2.7 Effect of Use of Either Emergency Diesel Generator (EDG)

The licensee in response to a staff question reported that the use of one EDG (either one of the two used for the FPCC) during refueling would not prevent feeding both heat exchangers with coolant from the one operational FPCC pump or with coolant from the operational SSW pump.

The staff finds this to be acceptable.

3.0 Conclusion

The staff finds the method, i.e., use of two HXs with one FPCC pump, to be acceptable as a conceptual means of cooling the completely filled spent fuel pool (with 4348 fuel assemblies) and maintaining the bulk coolant temperature at or below 140°F in accordance with the licensee's calculations. However, since an FPCC pump is usually used to pump 1100 gpm to one heat exchanger and would now have to pump 800 gpm to each HX, the staff requires that these flow rates be verified by the licensee. In addition, while each SSW pump is rated at 12000 gpm, the licensee must also verify that the extra burden of 1254 gpm to a second HX is within the capability of one SSW pump while maintaining the remaining necessary flow rates. These verifications must be accomplished by the end of Refueling Outage (RFO) 6 scheduled to be completed in the fall of 1993. Therefore, the staff finds the licensee's method acceptable, pending verification of the stated flow rates by the licensee.

The staff also finds that the licensee complies with applicable requirements by maintaining the SFP bulk coolant temperature below boiling for the case of a full core offload which completely fills the SFP.

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