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February 2, 1982

Mr. Dennis M. Crutchfield, Chief
Operating Reactors Branch #5
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: Dresden Station, Unit 2
SEP Topic IX-1, Fuel Storage

NRC Docket 50-237

Reference: (1) T.J. Rausch letter to D.G. Eisenhut dated August 14, 1981

Mr. Crutchfield:

Reference (1) committed Commonwealth Edison to devote additional resources to completion of SEP. CECo committed to develop several topic Safety Assessment Reports (SAR) which would be submitted for Staff review. In accordance with this committment, CECo hereby provides as Attachment 1, the SAR for SEP Topic IX-1, Fuel Storage.

Please address any questions you may have concerning this matter to this office.

One (1) signed original and thirty-nine (39) copies of this transmittal have been provided for your use.

Very truly yours,

T.J. Rausch

T.J. Rausch
Nuclear Licensing Administrator
Boiling Water Reactors

SPPJ:mnh
1547D*
Attachment
cc: RIII Resident Inspector, Dresden

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Docket No. 50-237

Safety Assessment Report
SEP Topic IX-1, Fuel Storage

January 1982

Dresden Nuclear Power Station, Unit No. 2
Safety Assessment Report

Topic IX-1, Fuel Storage

1.0 INTRODUCTION

The objective of this topic is to assure that fuel is stored safely with respect to criticality ($K_{eff} < 0.95$), cooling capability (outlet temperature $< 150^{\circ}F$), shielding, structural capability.

2.0 CRITERIA

This topic has been reviewed for compliance to the requirements of ANSI N210-1976/ANS 57.2, Design Objectives for Light Water Reactor Spent Fuel Storage Facilities at Nuclear Power Stations and NUREG/CR-0891, seismic review of Dresden Nuclear Power Station - Unit 2 for the Systematic Evaluation Program.

3.0 RELATED SAFETY TOPICS

SEP Topic II-3.B, "Flooding Potential and Protection Requirements" identifies the design basis flood for which the plant must be adequately designed for.

SEP Topic III-1, "Classification of Structures, Components and Systems (Seismic and Quality)" is intended to assure that structures, systems and components important to safety are of the quality level commensurate with their safety function.

SEP Topic III-4.A, "Tornado Missiles" covers tornado missile protection of a number of structures and systems including fuel storage areas and support systems.

SEP Topic III-6, "Seismic Design Considerations" will ensure the capability of the plant to withstand the effects of earthquakes.

SEP Topic III-7.B, "Design codes, design criteria, load combinations, and reactor cavity design criteria.

4.0 DISCUSSION

In order to maintain full core reserve in the spent fuel pool, CECo installed additional spent fuel racks during the late 1970's. This modification increased the licensed storage capacity from 1,160 fuel assemblies to 1,420.

The NRC safety evaluation performed for this modification, Amendment No. 34 to the Facility Operating License, consisted of a detailed analysis of each area in which potential safety considerations were involved. The following has been excerpted from this review.

4.1 CRITICALITY CONSIDERATIONS

Approval was granted for installation of thirteen additional fuel racks to both Dresden Unit 2 and 3 spent fuel pools in January 30, 1978. These are identical to the racks which were currently in the pools. The racks are made of 3/16 inch thick aluminum alloy, and they are designed to hold the fuel assemblies on a nominal 6.5x12 inch pitch under safe shutdown earthquake (SSE) accelerations. With this pitch, there are only small water gaps between the fuel assemblies in the 6.5 inch direction but about 5 1/2 inch water gaps between the fuel assemblies in the 12 inch direction. The fuel region volume fraction in this storage lattice for fuel assemblies taken from Dresden Units 2 and 3 is 0.34.

The Nuclear Services Corporation (NSC) of Campbell, California, performed the criticality analysis for these fully loaded racks. They used the CHEETAH computer program to obtain the four group cross sections for diffusion theory calculations by the CITATION program.

The criticality analyses for this array were made assuming:

1. an infinite array of unirradiated fuel assemblies with the highest U-235 enrichment and no burnable poison;

2. pure, unborated water in the pool; and

3. a temperature of 100°C.

The analyses performed in the FSAR's for Dresden 2 and 3 (k_∞ = 0.83) were made for an assumed infinite array of assemblies. Consequently, the calculated neutron multiplication factor, as stated in the FSAR's for Dresden 2 and 3 will not change as more fuel assemblies are put into additional racks in the pool.

For unirradiated fuel assemblies with a fuel loading of 9.7 grams of U-235 per axial centimeter of fuel assembly and no burnable poison, the infinite neutron multiplication factor, K_∞, is calcualted to be 0.76. The exclusion of water from the water gap between the assemblies could change this factor, but this is a highly improbable situation due to the open design of the racks.

Conclusion

We conclude that the neutron multiplication factor for the pool will be much less than the NRC limit of K_{eff}=0.95. Since the calculations in the FSAR for Dresden 2 and 3 were performed for an infinite array of final assemblies, this stated maximum neutron multiplication factor is independent of the number of final assemblies in the fuel pool. Therefore, we conclude that the FSAR criticality analysis (i.e., k_∞ =0.83) remains valid for the fuel pools with the number of fuel racks installed and filled with spent fuel assemblies. On the basis of the above, we find that, from the standpoint of criticality, there is reasonable assurance that the health and sa[illegible] not be endangered by the installation of the addi[illegible] use in the proposed manner.

4.2 SPENT FUEL COOLING

The spent fuel pool cooling system, as described in Chapter 10 of the FSAR, consists of two pumps and two heat exchangers. Each pump is designed to pump 700 gpm (3.5×10^5 pounds per hour) and each heat exchanger is designed to transfer 3.65×10^6 BTU/hr from the fuel pool water to the reactor building cooling water which is flowing through the heat exchanger at a rate of 7.5×10^5 pounds per hour. When a full core is discharged to the spent fuel pool, one of the three loops of the shutdown reactor cooling system will be connected in parallel with the fuel pool cooling system. This connection will provide an additional flow of 3000 gpm (1.5×10^6 pounds per hour of fuel pool water which will cooled by the shutdown reactor cooling system.

Using the method given of pages 9.2.5-8 though 14 of the NRC Standard Review Plan, with the uncertainty factor, K, equal to 0.1 for decay times longer than 10^3 seconds, the maximum peak heat load for a discharge of spent fuel would be 13.2×10^6 BTU/hr and that the maximum peak heat load for a full core offload that fills the pool would be 26.2×10^6 BTU/hr. In both cases the spent fuel from previous refuelings contributes approximately 3.5×10^6 BTU/hr to the heat load. Based on calculations, it has determined that with both pumps operating, the spent fuel pool cooling system can maintain the fuel pool outlet water at an acceptable temperature below 141°F for a peak refueling heat load of 13.2×10^6 BTU/hr. In addition, we find that when the shutdown reactor cooling system is connected in parallel with the spent fuel pool cooling system, the combined system will have sufficient capacity to keep the spent fuel pool outlet water below an acceptable temperature of 145°F for a full core heat load of 26.2×10^6 BTU/hr.

Assuming a maximum fuel pool temperature of 145°F for accident analysis, the minimum possible time to achieve bulk pool boiling after any credible accident would be about eight hours. After bulk boiling commences, the maximum evaporation rate would be 54 gpm. We find that eight hours would be sufficient time for CECo to establish a 54 gpm make up rate. We also find that under bulk boiling conditions, the temperature of the fuel would not exceed 350°F. This is an acceptable temperature from the standpoint of fuel element integrity and surface corrosion.

4.3 STRUCTURAL AND MECHANICAL CONSIDERATIONS

The new fuel storage vault is a reinforced-concrete Class I structure, assessible only through top hatches. Racks in the vault can hold a maximum of 60% of a core load of fuel bundles in an upright position. Each new fuel storage rack is made of aluminum and is designed to store 20 fuel assemblies each. The racks are secured to the floor of the pool by one inch swing bolts (four per rack) which are already provided in each position. Each racks was originally designed to be free standing and does not rely on any lateral restraint from the pool walls or adjacent rack structures. It was determined that the racks will not impact the pool walls for the worst loading condition which includes the effects of the design basis earthquake (DBE).

The original design load for the spent fuel pool included a uniform load of 2000 psf for the racks and fuel assemblies on the entire pool slab area.

The fuel pool structure consists of concrete walls and floor, lined with a Type 304 stainless steel liner plate and has been adequately designed to withstand the anticipated earthquake loadings as a Class I structure. The 3/16 inch stainless steel liner will prevent leakage even in the unlikely event the concrete develops cracks. To avoid unintentional draining of the pool, there are no penetrations that would permit the pool to be drained below a safe storage level, and all lines extending below this level are equipped with suitable valving to prevent backflow. The passage between the fuel storage pool and the refueling cavity above the reactor vessel is provided with two double sealed gates with a monitored drain between event of such leakage. The depth of water in the pool is 39 feet and the depth of water in the transfer canal during refueling is 22 feet-9 inches. The water in the pool is continuously filtered and cooled by the fuel cooling and cleanup system.

Using the working stress and ultimate strength methods, analyses in accordance with ACI Building Code 318-71 were performed to determine the section strength and stiffness properties of pool floor and wall slabs. The pool temperature and maximum thermal gradient, (in accordance with ACE 307-69) operating and safe shutdown earthquake (SSE) were considered in the analyses. The resulting loads were evaluated in accordance with the applicable parts of Section 3.8.4 of the Standard Review Plan, dated November 1975.

4.3.1 MATERIAL

The structure of the fuel pool is compatible with the oxygen-saturated, high purity, deminerlized water, controlled to a maximum 145°F temperature. In this pool water environment, the corrosive deterioration of the 304 alloy should not excced a depth of 6.00×10^{-5} inches in 100 years, which is minute relative to the initial thickness.

4.3.2 CONCLUSION

Analyses, design, fabrication and installation of the fuel storage racks are in accordance with accepted criteria. The racks were designed as seismic Category I equipment.

4.4 RADIOLOGICAL CONSIDERATIONS

The fuel pools contribute a small increment to onsite occupational dose based on realistic assumptions for occupancy times and for dose rates in the spent fuel pool vicinity due to radioactive nuclides in the water. The spent fuel assemblies themselves contribute a negligible amount of exposure in the pool area because of the shielding effect of the water. Based on the additional 13 racks an estimate of less than one percent to the total annual occupational dose at Dresden Station.

The slight increase in occupational radiation exposure will not affect the ability to maintain individual occupational doses to as low as reasonable achievable and within the limits of 10CFR20. From the above consideration, we conclude that the proposed installation of the additional spent fuel storage capacity at Dresden station and the storing of additional fuel in the pools would not result in any significant increases in doses received by occupational workers.

As discussed in Section 5.3 of the Environmental Impact Appraisal, dated January 30, 1978, the additional total body dose that might be received by an individual or population within a 50 mile radius of of the stations is less than 0.001 mrem/yr and 0.005 man-rem/yr, respectively, and is thus far less than the normal variation in dose received by this population from normal background radiation. The incremental population doses thus resulting from the increased storage rack addition are insignificant.

5.0 CONCLUSION

Based on this review and the Staff's SER issued with Amendment 34 to DPR-19, Commonwealth Edison concludes that fuel is safely stored with respect to criticality, cooling capability, and structural capability of Dresden Unit 2 site. Also the future installaion of high density fuel racks not yet approved will meet current criteria. Pending resolutions of References (3) and (4) the installation will be approved to increase capacity from 1,420 to 3,537 fuel assemblies. This will give us full core discharge capabilities through 1995.

6.0 REFERENCES

1. ANSI N210-1976/ANS 57.2, Design Objectives for Light Water Reactor Spent Fuel Storage Facilities at Nuclear Power Stations.

2. NUREG/CR-0891, Seismic Review of Dresden Nuclear Power Station-Unit 2 for the Systematic Evaluation Program.

3. D.K. Davis letter to C. Reed dated January 30, 1978.

4. U.S. Nuclear Regulatory Commission Atomic Safety and Licensing Board (ASLB) Report, dated September 24, 1981, Partial Initial Decision Modifying Operating License To Permit Installation of Five High-Density Spent Fuel Storage Racks at Dresden Unit 3.

5. T.J. Rausch letter to D.M. Crutchfield dated January 20, 1982.