SAFETY EVALUATION
BY THE
DIVISION OF OPERATING REACTORS
CONCERNING
CONSUMERS POWER COMPANY'S
APPLICATION FOR AMENDMENT TO ITS OPERATING LICENSE
TO INCREASE THE AUTHORIZED CAPACITY OF THE SPENT FUEL POOL
AT THE BIG ROCK POINT PLANT
DOCKET NO. 50-155

1.0 INTRODUCTION

By its letter dated April 23, 1979, as supplemented by letter dated October 1, 1979, the Consumers Power Company (CPC) applied for a license amendment to increase the authorized storage capacity for spent fuel at the Big Rock Point Plant from 193 to 441 fuel assemblies.

2.0 DISCUSSION

The proposed spent fuel racks are to be made up of individual containers which are approximately 7.5 inches square by about seven feet long. These containers are to be fabricated from one quarter inch thick 304 stainless steel, and they are to be spaced in the racks on a lattice pitch of 9.0 inches. This will result in their being 1.5 inches of water between the containers. This nine inch pitch and the overall dimension of the fuel assembly, which is 6.513 inches, gives an overall fuel region volume fraction of 0.524 for the storage lattice.

CPC states that the highest anticipated U-235 enrichment is 3.8 weight percent in a 11 x 11 assembly. This results in a maximum fuel loading of 28.3 grams of U-235 per axial centimeter of fuel assembly.

2.1 CRITICALITY ANALYSES

As CPC stated in its April 23, 1979 submittal, the fuel pool criticality calculations are based on unirradiated fuel assemblies with no burnable poisons which have a fuel enrichment of 3.8 weight percent U-235.

The NUS Corporation (NUS) performed the criticality analyses for CPC. For parametric calculations, NUS used their version of the LEOPARD computer program, which is called NUMICE, to get four group cross sections for PDQ-7 diffusion theory calculations. The accuracy of this method was checked by using it to calculate water-moderated, uranium lattice experiments. NUS states that the calculated neutron multiplication factors from NUMICE/PDQ-7 deviated from the experimental values by an average of $\pm$ 0.009. In order to ensure that the results of these four group calculations for the storage lattice are accurate, NUS used the KENO Monte Carlo program with 123 group cross sections from the XSDRN program with the GAM-THERMOS library to check selected cases and to verify the neutron multiplication factor of the final design. This method was checked by using it to calculate critical experiments of shipping cask configurations. This series of calculations showed that this GAM-THERMOS/KENO method yielded neutron multiplication factors that are within $\pm$ 0.008 of the experimental values. However, there is an additional statistical uncertainty of $\pm$ .009 in these calculations.

NUS's use of these computer programs gave a neutron multiplication factor of 0.89 for an infinite array of these spent fuel assemblies located in the nominal storage lattice, which is assumed to be at a temperature of 68°F. NUS calculated that this neutron multiplication factor will increase to 0.90 when the pool outlet water temperature is increased to its maximum possible value of 212°F, and it calculated that with all tolerances, mislocations, and uncertainties included at a temperature of 212°F the maximum possible neutron multiplication factor could be 0.946. CPC states in its submittal that it will not be possible to inadvertently position a fuel assembly close enough to the outside of a filled rack to cause an increase in this maximum neutron multiplication factor of 0.946.

2.1.1 EVALUATION

The above described results compare favorably with the results of parametric calculations made with other methods for similar fuel pool storage lattaices. By assuming new, unirradiated fuel with no burnable poison or control rods, these calculations yield the maximum neutron multiplication factor that could be obtained throughout the life of the fuel assemblies. This includes the effect of the plutonium which is generated during the fuel cycle.

We find that all factors that could affect the neutron multiplication factor in this pool have been conservatively accounted for and that the maximum neutron multiplication factor in this pool with the proposed racks will not exceed 0.95. This is NRC's acceptance criterion for the maximum (worst case) calculated neutron multiplication factor in a spent fuel pool. This 0.95 acceptance criterion is based on the uncertainties associated with the calculational methods and provides sufficient margins to preclude criticality in the fuel. Accordingly, there is a technical specification which limits the effective neutron multipliation factor in all spent fuel pools to 0.95.

2.1.2 CONCLUSION

We find that when any number of the fuel assemblies described by CPC in these submittals, which have not more than 28.3 grams of uranium-235 per axial centimeter of fuel assembly, or equivalent, are loaded into the proposed racks, the k_{eff} in the fuel pool will be less than the 0.95 limit. We also find that in order to preclude the possibility of the k_{eff} in the fuel pool from exceeding this 0.95 limit without being detected, it is necessary, pending an NRC review, to prohibit the use of these high density storage racks for fuel assemblies that contain more than 28.3 grams of uranium-235, or equivalent, per axial centimeter of fuel assembly. On the basis of the information submitted, and the k_{eff} and fuel loading limits stated above we conclude that the health and safety of the public will not be endangered by the use of the proposed racks.

2.2 SPENT FUEL COOLING

The licensed thermal power for the Big Rock Point Plant is 240 MWth. CPC is refueling this reactor annually at which times 22 of the 84 fuel assemblies in the core are replaced. To calculate the maximum heat loads in the spent fuel pool CPC assumed a 48 hour time interval between reactor shutdown and the time either the 22 fuel assemblies in the normal refueling or the 84 fuel assemblies in a full core offload are placed in the spent fuel pool. For this cooling time, CPC used the method given in the NRC Standard Review Plan 9.2.5 to calculate maximum heat loads of 2.5×10^6 BTU/hr for fifteen successive annual refueling after the modification and 5.3×10^6 BTU/hr for the full core offload sixty days after the eleventh refueling after the modification.

The spent fuel pool cooling system at the Big Rock Plant consists of two pumps and two heat exchangers. Each pump is designed to pump 250 gpm (1.25×10^5 pounds per hour), and each heat exchanger is designed to transfer 3.0×10^6 BTU/hr from 119°F fuel pool water to 70°F cooling water which is flowing through the shell side of the heat exchanger at a rate of 1.25×10^5 pounds per hour.

CPC states that this system, with two pumps running, will be able to keep the spent fuel pool outlet temperature below 91°F through the fifteenth annual refueling, and 115°F for a full core offload sixty days after the eleventh refueling. In the event that one of the cooling loops were to fail just after the full core was offloaded into the pool, CPC states that the maximum spent fuel pool outlet temperature that could be obtained is 151°F.

In regard to emergency make up water for the spent fuel pool, CPC states that in the event of the loss of all AC power, make up water would still be available from the fire protection system at an eleven gallon per minute rate to replenish the boil off rate at the peak, full-core heat load.

2.2.1 EVALUATION

By using the method given on pages 9.2.5-8 through 14 of the November 24, 1975 version of the NRC Standard Review Plan, with the uncertainty factor, K, equal to 0.1 for fuel with decay times longer than 10^7 seconds, for a decay time of 48 hours, we find CPC's maximum heat loads are conservatively high. We also find that the maximum incremental heat load that could be added by increasing the number of spent fuel assemblies in the pool from 193 to 441 is 0.17×10^6 BTU/hr. This is the difference in peak heat loads for the present and the modified pools.

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We find that with two pumps operating the spent fuel pool cooling system can maintain the fuel pool outlet water temperature below 91°F for the normal refueling offload that fills the modified pool and below 115°F for any full core offload.

In the highly unlikely event that both spent fuel cooling loops fail to operate during the peak heating period of the full core offload that fills the modified pool the maximum possible heat up rate of the spent fuel pool water would be 4.25°F per hour. Thus, assuming that the average spent fuel pool water temperature is about 100°F at the time this complete loss of cooling occurs, there would be approximately twenty six hours before the water would boil. We calculate that after boiling starts the maximum possible required water make up rate will be 11 gpm. We find that 26 hours will be sufficient time to establish an 11 gpm make up rate from the fire protection system.

2.2.2 CONCLUSION

We find that the present cooling capacity for the Big Rock Point spent fuel pool will be sufficient to handle the incremental heat load that will be added by the proposed modification. We also find that this incremental heat load will not alter the safety considerations of spent fuel pool cooling which we previously reviewed and found to be acceptable. We conclude that there is reasonable assurance that the health and safety of the public will not be endangered by the use of the proposed design.

2.3 INSTALLATION OF RACKS AND FUEL HANDLING

In response to our request for a description of the precautions that will be taken during the installation of the new racks to prevent the possible damage to spent fuel assemblies that are stored there, CPC stated that detailed written procedures will be prepared for each operation and that only one operation will be carried on at one time. CPC stated that this administrative procedure, which will prescribe the paths for every rack movement, will prevent a rack from being handled or moved over stored fuel assemblies.

2.3.1 EVALUATION

We find that when these administrative procedures also include inspection and test procedures for the crane and all other rack lifting and transporting devices prior to the movement of the racks in or over the pool, CPC can adequately protect the spent fuel assemblies stored in the pool by rigorously following these written instructions.

After the racks are installed in the pool, the fuel handling procedures in and around the pool will be the same as those procedures that were in effect prior to the proposed modifications.

2.3.2 CONCLUSION

We conclude that there is reasonable assurance that the health and safety of the public will not be endangered by the installation and use of the proposed racks.

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