SAFETY EVALUATION

BY THE

DIVISION OF OPERATING REACTORS

CONCERNING

NIAGARA MOHAWK POWER CORPORATION'S

APPLICATION FOR AMENDMENT TO ITS OPERATING LICENSE

TO INCREASE THE AUTHORIZED CAPACITY OF THE SPENT FUEL POOL

AT THE

NINE MILE POINT UNIT 1

DOCKET NO. 50-220

1.0 INTRODUCTION

By its letter dated March 22, 1978, as supplemented by letters dated December 20, 1978 and December 21, 1978, the Niagara Mohawk Power Corporation (NMPC) applied for a license amendment to increase the authorized storage capacity for spent fuel at Nine Mile Point, Unit 1 from 1984 to 3009 fuel assemblies.

2.0 DISCUSSION

The structural part of the proposed spent fuel racks is made up of two types of rectangular containers which are fabricated from sheets of Type 304 stainless steel. One type of container will hold two spent fuel assemblies; the other will hold the neutron absorbing material. The fuel containers are the largest. They will be fabricated from 0.090 inch thick stainless steel and they will be about 6 inches by 12 inches in cross section and about 14 feet long.

To form the rack modules the 6 inch sides of these containers will be welded together to form rows. In between each row of fuel containers in a module will be a row of poison containers. These will be fabricated from 0.060 inch thick stainless steel and they will be about 1.9 inches by 12 inches in cross section and about 14 feet long. The 1.9 inch sides will be welded together to form the rows of neutron absorber containers. A 0.1 inch thick sheet of the B_4C material, Boraflex, will be held in place against each of the two 12 inch long walls by a stainless steel insert, which is fabricated from 0.031 inch thick stainless steel. Thus there will be two 0.1 inch thick sheets of Boraflex between every two rows of fuel assemblies in a module. In its December 20, 1978 response to our request for additional information NMPC stated that the minimum areal density in any Boraflex plate will be 0.0217 grams of boron-10 per square centimeter. In other units this is 1.3×10^{21} boron-10 atoms per square centimeter of plate.

In its December 1978 response NMPC also stated that the highest anticipated U-235 enrichment is 3.0 weight percent and that this is equivalent to a fuel loading of 15.2 grams of U-235 per axial centimeter of fuel assembly.

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2.1 CRITICALITY ANALYSES

As stated in NMPC's March 22, 1978 submittal, the fuel pool criticality calculations are based on unirradiated fuel assemblies with no burnable poisons which have a fuel enrichment of 3.0 weight percent U-235, which corresponds to a fuel loading of 15.2 grams of U-235 per axial centimeter of these fuel assemblies.

Pickard, Lowe, and Garrick Inc. (PLG) of Washington, D. C. performed the criticality analyses for the fully loaded racks. The basic method was to use PLG's version of the LEOPARD program to obtain four energy group cross sections for use in the PDQ-7 diffusion theory calculations. Integral transport theory was used in one dimensional, rectangular geometry to obtain the self-shielding factors for the boron ten atoms. This method was used to calculate five critical experiments which had boron plates in them. The results of these calculations were all within 0.01Δk of the experimental values.

These computer programs were first used to calculate the neutron multiplication factor for an infinite array of fuel assemblies in the nominal storage lattice and then used to calculate the changes in the neutron multiplication factor due to fuel and boron loading tolerances, mechanical tolerances, and changes in temperature. As stated in NMPC's December 20, 1978 response to our request for additional information, the maximum value of PLG's neutron multiplication factor for the most adverse mechanical and thermal conditions with calculational uncertainties included is 0.90.

In order to assure that the neutron multiplication factor in the spent fuel pool will not unknowingly increase due to the loss of boron from the racks, NMPC stated in their March 22, 1978, submittal that surveillance samples will be irradiated next to fresh spent fuel from every refueling and that one of the surveillance samples will be checked for boron content and distribution after each refueling.

In its December 20, 1978 response to our request for additional information NMPC acknowledged that there will be spaces in the pool where it will be possible to place a fuel assembly very close to the outside of racks which are filled with fuel assemblies. However, NMPC stated that the effect of placing a fresh fuel assembly as close as possible to any filled rack will not increase the neutron multiplication factor by more than 0.018. Thus under this condition the maximum neutron multiplication factor in the pool would be less than 0.92.

In regard to neutron attenuation testing for the boron plates, NMPC stated in its December 20, 1978 submittal that ten percent of the storage locations will be checked at the manufacturer's plant and that at least five storage locations in each rack module will be checked after NMPC receives the racks at the Nine Mile Point site.

2.1.1 EVALUATION

The above described results compare conservatively with the results of parametric calculations made with other methods for similar fuel pool storage lattices. 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 limit the effective neutron multiplication factor in the spent fuel pool to 0.95.

We find that NMPC's proposed neutron attenuation testing on the Boraflex plates will be adequate as long as no plates are found missing. However, if any Boraflex plates are found to be missing in either of the two neutron attentuation tests the NRC shall be notified and a complete test on every storage location shall be performed.

However, NMPC states that these racks are designed so that the poison assemblies could be removed from the fuel pool by using a special key to remove a lock bolt. Since the removal of a poison assembly from the spent fuel pool would invalidate the results of the statistical neutron attentuation test, NMPC shall establish a technical specification that prohibits the removal of the poison assemblies from the storage racks in the pools without prior notification of the NRC.

We also find that NMPC's boron surveillance program is satisfactory for continuously assuring that the boron content in the plates has not decreased below the design value of 1.3×10^{21} boron ten atoms per square centimeter of plate.

2.1.2 CONCLUSION

We find that when any number of the fuel assemblies, which NMPC described in these submittals, having no more than 15.2 grams of uranium-235 per axial centimeter of fuel assembly or equivalent are loaded into the proposed racks, the keff in the fuel pool will be less than the 0.95 limit. We also find that in order to preclude the possibility of the keff in the fuel pool from exceeding this 0.95 limit without being detected, the use of these high density storage racks will be prohibited for fuel assemblies that contain more than 15.2 grams of uranium-235, or equivalent, per axial centimeter of fuel assembly. On the basis of the information submitted, and the keff and fuel loading 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 Nine Mile Point, Unit 1 is 1850 mwth. NMPC plans to refuel this reactor every eighteen months at which times about 160 of the 532 fuel assemblies in the core will be replaced. To calculate the maximum heat loads in the spent fuel pool NMPC assumed a ten day time interval between reactor shutdown and the time when either the 160 fuel assemblies in the normal refueling or the 532 fuel assemblies in the full core offload are placed in the spent fuel pool. For this cooling time NMPC used the method given in the October 1973 revision of the ANS-5.1 Standard to calculate the heat loads.

The spent fuel pool cooling system consists of two seismic Category 1 cooling loops each of which has a pump and a heat exchanger. Each pump is designed to pump 600 gpm (13×10^5 pounds per hour), and each heat exchanger is designed to transfer 6×10^6 BTU/hr from 125°F fuel pool water to 90°F service water which is flowing through the heat exchanger at a rate of 3×10^5 pounds per hour.

NMPC stated that this system capacity will be adequate to keep the spent fuel pool water temperature below 125°F for all of the normal refuelings of approximately 160 fuel assemblies, throughout the filling of the proposed 3009 storage locations.

NMPC also stated in its March 22, 1978 submittal that procedural controls will be used to insure that when a full core of 532 fuel assemblies is offloaded into the spent fuel pool, its water temperature will not exceed 125°F.

2.2.1 EVALUATION

By using the method given on pages 9.2.5-8 through 14 of the NRC Standard Review Plan with ten days of decay time we calculate that the maximum possible heat load for any normal refueling in the proposed racks will be 7.7×10^6 BTU/hr. Since the total capacity of the system is 12×10^6 BTU/hr, we agree with NMPC that for any normal refueling the water temperature will probably not go above 125°F. We also calculate that the maximum possible heat load for the full core offload that fills the expanded pool will be 19.4×10^6 BTU/hr. This is only 1.5×10^6 BTU/hr greater than the maximum heat load that could have been obtained during a full core offload that filled the original racks. However, if this heat load were to be put into the spent fuel pool with both cooling loops operating its temperature would go up to about 147°F. In order to keep this temperature below 125°F NMPC can, in the event that a full core has to be offloaded from the reactor vessel, first do more accurate calculations using the actual power history of the core and a predicted service water temperature based on past measurements. If these calculations show that the spent fuel pool water temperature will still go above 125°F then NMPC will have to increase the ten day decay time prior to offloading the full core into the spent fuel pool.

2.2.2 CONCLUSION

We find that the spent fuel pool cooling system capacity will be sufficient to maintain the outlet water temperature below 125°F for any normal refueling. In order to prevent the fuel pool water temperature from going above 125°F during a full core offload NMPC shall not remove the core from the reactor vessel until it is established that the actual decay heat generation rateis low enough.

2.3 INSTALLATION OF RACKS AND FUEL HANDLING

NMPC stated that during the installation of the new racks: (1) a procedure will be followed that will insure that the racks will not travel over the fuel bundles in the pool; (2) all racks containing fuel bundles will meet the seismic Category I criteria at all times; and (3) applicable safety and design criteria will be satisfied in all steps of the rack replacement procedure.

In regard to fuel handling, NMPC states in the above cited submittal that the proposed modification does not create the possibility for an accident or malfunction of a different type than those evaluated in the FSAR.

2.3.1 EVALUATION

NMPC has upgraded the Nine Mile Point, Unit 1 overhead crane system, providing it with redundant features so that a single failure will not result in a dropped load. NRC found this modification to be acceptable in its January 7, 1976 letter to NMPC. The use of this upgraded crane along with NMPC's stipulation that racks will not be taken over fuel bundles present in the pool will make the probability for an empty rack falling on a loaded rack in the pool acceptably small. By using the same safety criteria and procedures that are used in handling the fuel cask, NMPC can install the new spent fuel storage racks without undue risk of either an increase in the neutron multiplication factor in the pool or the loss of capability for spent fuel cooling.

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. These have been reviewed and found to be acceptable by the NRC.

3.2.3 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.