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

SAFETY EVALUATION

BY THE OFFICE OF NUCLEAR REACTOR REGULATION

SUPPORTING AMENDMENT NO. 76 TO FACILITY OPERATING LICENSE NO. DPR-51

AND

AMENDMENT NO. 43 TO FACILITY OPERATING LICENSE NO. NPF-6

ARKANSAS POWER AND LIGHT COMPANY

ARKANSAS NUCLEAR ONE, UNIT NOS. 1 & 2

DOCKETS NOS. 50-313 and 50-368

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1.0 Introduction

By letter dated November 5, 1982 (Ref 1), supplemented by References 2 through 14, Arkansas Power and Light Company (the licensee or AP&L) proposed amendments to Facility Operating Licenses Nos. DPR-51 and NPF-6 for Arkansas Nuclear One, Units Nos. 1 and 2 (ANO-1&2). The proposed amendments would revise the provisions in the Technical Specifications (TSs) to allow modifications in the spent fuel design for ANO-1&2 which would increase the spent fuel storage capabilities for ANO-1 from 589 spaces to 968 spaces and for ANO-2 from 485 spaces to 988 spaces. This expansion would be accomplished by replacing the existing spent fuel storage racks with new high density storage racks.

The proposed change would allow refueling capability through the 15th refueling scheduled for the spring of 1998 for ANO-1 and through the 14th refueling scheduled for the spring of 2000 for ANO-2. Present storage capacities would force the shutdown of ANO-1&2 in 1989 due to the inability to refuel.

As addressed below, we have evaluated the safety considerations associated with the proposed changes to the ANO-1&2 spent fuel storage designs. A separate Environmental Impact Appraisal addressing these changes has been prepared.

2.0 Evaluation

2.1 Criticality Considerations

For both ANO-1&2, the spent fuel storage racks are divided into two regions. Region 1 of each unit is designed to accommodate non-irradiated fresh fuel and is sized to permit core offloads. Storage in Region 2 for each unit is restricted by burnup and enrichment limits. Placement of fuel in Region 2 is determined by burnup calculations and controlled administratively by AP&L. Fuel which does not meet the burnup criterion may be placed in Region 2 in a checkerboard arrangement. In these cases, the vacant spaces adjacent to the assembly being inserted will be physically blocked to prevent inadvertent assembly insertion. In addition, the area designated will be subdivided from the normal storage in Region 2 by a row of vacant storage spaces. The criticality aspects of the design of each region are discussed separately below.

2.1.1 Region 1 Design

The Region 1 racks consist of individual stainless steel storage cells with a neutron absorbing material, Boraflex, attached to each cell. There are 234 fuel assembly storage locations with a 10.65 inch center-to-center spacing between assemblies for ANO-1 and 220 fuel assembly storage locations with a 9.8 inch center-to-center spacing between assemblies for ANO-2. The criticality analysis of the racks is performed with the state-of-the-art AMPX system of computer codes for neutron cross section generation and KENO IV for reactivity determination. KENO IV is a three-dimensional Monte Carlo theory computer code designed for reactivity calculations. These codes have been benchmarked against a set of 27 critical experiments in the range of pellet diameters, water-to-fuel ratios and U-235 enrichments that encompass the ANO-1 & 2 designs. This benchmarking led to the conclusion that the calculational model is capable of determining the multiplication factor of the Region 1 racks to within 1.3 percent in reactivity with a 95 percent probability at the 95 percent confidence level.

In the nominal case criticality calculation for Region 1, several worst case assumptions were made to account for some mechanical tolerance uncertainties. These included the most reactive eccentric assembly position within the can and reduced poison plate width. The effects of various other uncertainties and biases such as variation in water gap thickness and boron particle self-shielding are conservatively accounted for. Combining these uncertainties at the 95/95 probability/confidence level with the above-mentioned calculational uncertainty yields values of 0.9418 and 0.9448 for the multiplication factors of the Region 1 racks for ANO-1 & 2, respectively, when loaded with fuel assemblies of 4.1 weight percent U-235 enrichment at the pool temperature yielding the maximum reactivity and with the water (unborated) density conservatively taken as 1 gm/cc. This meets our acceptance criterion of less than or equal to 0.95 for this quantity.

We, therefore, conclude that any number of fuel assemblies of the Babcock & Wilcox (B&W) 15x15 design having enrichments no greater than 4.1 weight percent U-235 may be stored in Region 1 of the ANO-1 racks and that any number of fuel assemblies of the Combustion Engineering (CE) 16x16 design having enrichments no greater than 4.1 weight percent U-235 may be stored in Region 1 of the ANO-2 racks.

2.1.2 Region 2 Design

The Region 2 racks consist of a honeycomb structure of stainless steel cells surrounded by spacer pockets which are designed to accept poison inserts if future need arises. There are 748 fuel assembly storage locations with a 10.65 inch center-to-center spacing between assemblies for ANO-1, and 754 fuel assembly storage locations with a 9.8 inch center-to-center spacing between assemblies for ANO-2.

The same methods were used for the basic reactivity determination as were used in the Region 1 analysis. In addition, the LEOPARD/CINDER codes were used to calculate the isotopic compositions and neutron cross sections of the fuel as a function of burnup history and subsequent decay time. The TURTLE code is used to determine the reactivity equivalence of assemblies with different initial enrichments and burnups. Direct verification of the codes was not possible because no critical experiments have been done with assemblies having large burnups. Therefore, verification of various aspects of the calculation was undertaken. For example, the ability to calculate the isotopic composition of irradiated fuel was verified by comparing the LEOPARD/CINDER calculation to the measured results of irradiations performed on mixed oxide fuel in Saxton. Similar evidence was used to assess the fission product buildup uncertainty and its reactivity effect as well as the reactivity effect of the transuranium isotopes. The result of these uncertainties in addition to uncertainties due to the method, the nominal eigenvalue, construction and material tolerances, and asymmetric assembly positioning give a total 95/95 uncertainty of 2.48 percent reactivity change.

In order to establish burnup criteria for storage in Region 2 for each unit, a constant storage rack infinite multiplication factor (with minimum post-shutdown fission product inventory) contour is constructed as a function of burnup and initial enrichment using LEOPARD and TURTLE. This contour is based on a high enrichment endpoint of 4.10 weight percent and 36,000 MWD/MTU as shown in Figure 3.8.2 from the proposed ANO-1 TSs and in Figure 3.9.2 from the proposed ANO-2 TSs.

The final multiplication factors for Region 2 are determined using the same KENO IV method used for Region 1 with the conditions determined by the zero burnup intercept point in Figure 3.8.2 for ANO-1 and Figure 3.9.2 for ANO-2. In these cases, the intercept points are at 1.4 weight percent U-235. Therefore, the design mode for Region 2 for ANO-1 & 2 is an unirradiated assembly of 1.4 weight percent initial enrichment. LEOPARD and TURTLE are thus used only to calculate relative reactivities as a function of burnup while the KENO IV Monte Carlo method is used to determine the actual storage rack reactivity. The nominal case multiplication factors are calculated to be 0.8892 for ANO-1 and 0.9068 for ANO-2. Increasing these by the above calculated 95/95 uncertainty of 2.48 percent gives final Region 2 multiplication factors of 0.914 for ANO-1 and 0.9316 for ANO-2 which meet our acceptance criterion of less than or equal to 0.95. Based on our review, we conclude that any number of B&W design 15X15 fuel assemblies with burnups in the non-restricted region of Figure 3.8.2 may be stored in Region 2 of the ANO-1 spent fuel storage racks and that any number of CE design 16X16 fuel assemblies with burnups in the non-restricted region of Figure 3.9.2 may be stored in Region 2 of the ANO-2 spent fuel storage racks.

The multiplication factor for Region 2 is also determined assuming a checkerboard storage configuration with unirradiated fuel assemblies at 4.1 weight percent enrichment. The nominal multiplication factors determined by KENO IV are 0.9068 for ANO-1 and 0.8860 for ANO-2. Adding the 95/95 uncertainties due to the nominal eigenvalue, the method bias, tolerances in thickness and asymmetric assembly position results in values of 0.9402 for ANO-1 and

0.9169 for ANO-2 which meet our acceptance criterion of less than or equal to 0.95. Therefore, B&W design 15X15 fuel assemblies and CE design 16X16 fuel assemblies of any burnup and up to 4.1 weight percent enrichment may be stored in Region 2 of ANO-1 & 2 respectively in a checkerboard configuration with adjacent vacant spaces between stored assemblies.

2.1.3 Postulated Accidents

The effect of credible accidents has been considered and the most consequential one is the dropping of a single fuel assembly outside the rack between the periphery of the storage racks and the side walls of the pool. The effective multiplication factor remains below 0.95 for this accident with all uncertainties and biases included. The pool water was assumed to contain soluble boron for this analysis. This is permitted by the double contingency principle of ANSI N16.1-1975 "American National Standard for Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors," which states that two unlikely, independent, concurrent events are required to produce a criticality accident. We have accepted this principle in previous Safety Evaluations.

2.1.4 Administrative Procedures and Proposed TSs

ANO Administrative Procedure 1022.12, "Control and Accountability of Special Nuclear Materials," provides the controls to be used in determining the storage location for new and irradiated fuel in the spent fuel pools. The "Spent Fuel Pool Inventory Maps" reflect the additional storage locations in the reracking of the spent fuel pools and also the separation of the pools into two distinct regions. The procedure will include a description of the two regions and the method used to determine whether irradiated fuel should be placed in Region 1 or Region 2.

Figures 3.8.2 and 3.9.2 in the ANO-1 & 2 proposed TSs respectively describe the classification of each assembly as "Restricted" or "Non-Restricted" by comparing its burnup with its initial enrichment. The procedure will also include an evaluation for the guidelines pertaining to "Restricted" fuel when stored in Region 2 (i.e., by using a checkerboard pattern and separating these "Restricted" assemblies from the "Non-Restricted" assemblies by a vacant row of storage spaces). This procedure will require an independent check by two individuals classifying the irradiated fuel as "Restricted" or "Non-Restricted" and verifying the correct storage location considering the Region and the assembly identification number.

The proposed TSs governing the criticality aspects of the spent fuel pools for ANO-1 & 2 provide for limits on the initial enrichment of fuel assemblies, burnup limits, required boron concentration, limits on the calculated effective multiplication factors and physical blocks in the vacant spaces adjacent to any fuel assembly in Region 2 in the event a checkerboard storage configuration is deemed necessary.

2.1.5 Conclusions

We conclude that the proposed storage racks meet the requirements of General Design Criterion 62 with regard to criticality. This conclusion is based on the following considerations:

1. State-of-the-art calculation methods which have been verified by comparison with experiment have been used.

2. Conservative assumptions have been made about the enrichment of the fuel to be stored and the pool conditions.

3. Credible accidents have been considered.

4. Suitable uncertainties have been considered in arriving at the final value of the multiplication factor.

5. The final effective multiplication factor value meets our acceptance criterion.

We also conclude that the proposed modifications to the ANO-1 & 2 TSs are acceptable to allow operation with the proposed expansion of the spent fuel pools' storage capacities.

2.2 Spent Fuel Pool Cooling and Makeup

2.2.1 Introduction

Each ANO unit has an independent spent fuel pool and spent fuel pool cooling and cleanup system (SFPCS). The spent fuel pool cooling and cleanup system is designed to remove the decay heat generated by the stored spent fuel assemblies and to maintain the water quality and clarity of the pool water. The ANO-1 SFPCS is composed of redundant trains, each train containing a pump and heat exchanger. The redundant trains can be cross-connected so that either pump can provide flow through either or both heat exchangers. The heat exchangers are cooled by the component cooling water system. The ANO-2 SFPCS is a closed loop system consisting of two half capacity pumps and one full capacity heat exchanger. The fuel pool water is drawn from the fuel pool near the surface and is circulated by the fuel pool pumps through the fuel pool heat exchanger where heat is rejected to the service water system.

The design of the storage pools is such that fuel will always be covered with water. Because of the locations of the fuel pool piping penetrations, the configuration of the pool and the use of siphon breaker vents, no incorrect operation or failure in the fuel pit cooling and refueling purification system could drain the fuel pool water level more than 4 feet below the normal level. The normal water level is 25 feet above the top of the fuel storage racks. In the event of a loss of the cooling system, makeup is available from the seismic Category I borated water storage tank or seismic Category I service water system. In addition, hose connections are available from the condensate tank and demineralized water supply.

The future refueling cycle for ANO-1 & 2 will be an 18-month period, and one-third of the core will be removed and stored in the spent fuel pool after each cycle. To limit the decay heat load, the one-third core will be removed from the reactor vessel and stored in the spent fuel pool 150 hours after reactor shutdown. In the event of a full-core discharge, the decay heat load will be limited by requiring a seven-day decay time after shutdown before core discharge. A full core contains 177 fuel assemblies.

2.2.2 Evaluation

To calculate the heat loads for the discharge of spent fuel to the pools, the licensee used Branch Technical Position ASB 9.2, "Residual Decay Energy for Light Water Reactors for Long-Term Cooling." The maximum normal heat load that includes full core offload at the fifteenth refueling discharge was calculated to be 28.02 x 10 BTU/hr. for ANO-1 and 32.5 x 10 BTU/hr/ for ANO-2. The pool temperature at ANO-1 is maintained below 120 F by operating any combination of two pumps and two heat exchangers for the normal heat load and at or below 150 F for the maximum normal conditions (full core offload). Upon failure of one pump or heat exchanger for the normal condition, sufficient cooling capacity remains to maintain bulk pool temperature below 135 F. Similarly, at ANO-2, the pool temperature is maintained under 120 F by recirculating spent fuel cooling water from the spent fuel pool through the parallel arranged pumps and a heat exchanger and back to the pool. For maximum normal conditions (full core offload), the pool temperature is maintained at or below 150 F, which meets the guidelines of Standard Review Plan Section 9.1-3, "Spent Fuel Pool Cooling and Cleanup

System." The American National Standard 57.2, " Design Objectives for Light Water Reactor Spent Fuel Storage Facilities at Nuclear Power Stations," indicates that the maximum pool temperature should not exceed 150 F under normal operating conditions with all storage racks full. The design, therefore, also meets this standard.

To verify that natural circulation of the pool water for the proposed expanded rack configuration provides adequate cooling of all fuel assemblies in the event of a loss of external cooling, the licensee performed a thermal-hydraulic analysis. In the event of the complete failure of the spent fuel cooling system, for the maximum normal heat load, there is at least four hours available before boiling occurs. The maximum boiloff rate is 50 to 60 gpm. Each of the two assured seismic Category I borated makeup water sources can be initiated in the required time. Sufficient makeup rates are also available from the seismic Category I service water system, condensate tank or demineralized water supply.

2.2.3 Conclusion

We have reviewed the calculated decay heat values and conclude that the heat loads are consistent with the Branch Technical Position ASB 9.2 and therefore, are acceptable. The SFPCS performance has been reviewed, and we conclude that the pool cooling is adequate. The available makeup systems, their respective makeup rates and the time required before makeup if needed have been reviewed and found acceptable. Based on the above, we conclude that the SFPCSs are acceptable for the proposed expansions.

2.3 Installation of Racks and Load Handling

2.3.1 Description

The proposed spent fuel storage modifications will provide storage locations for 968 fuel assemblies for ANO-1 and 988 fuel assemblies for ANO-2. The spent fuel storage racks are divided into two regions. Region I is designed to accommodate non-irradiated fresh fuel and is sized to permit core offloads. Storage in Region 2 is restricted by burnup and enrichment limits. There is no physical barrier between the two regions. Each fuel assembly will be stored in a double walled storage cell of type 304 stainless steel. The annular spaces between the double walls of the cells contain B C (Boroflex) neutron absorber elements positioned at the rack height corresponding to the active fuel length of the fuel assemblies. The individual storage cells are welded into rack arrays. At ANO-1, the storage racks will have three basic module configurations with dimensions of 10 x 11, 11 x 12 and 11 x 11 feet and weigh 27,500 lbs., 19,500 lbs. and 18,000 lbs. respectively. There will be two 10 x 11 modules, two 11 x 12 modules and four 11 x 11 modules. Similarly, at ANO-2 the storage racks will have a module configuration with dimensions of four 9 x 9, two 8 x 9, four 9 x 10 and two 8 x 10 feet. These modules will weigh from 13,000 lbs. to 20,300 lbs. The above configuration maintains cell pitch of 10.65 inches at ANO-1 and 9.8 inches at ANO-2 and prevents placement of a fuel assembly anywhere other than a design location.

The proposed neutron absorber fuel racks are designed to seismic Category I criteria. Structural and seismic analyses have been performed by the licensee to verify that the rack design is adequate to withstand normal operating, seismic and accident loading conditions.

2.3.2 Rack Handling and Installation

The review of heavy load handling at ANO-1 & 2 is being conducted as part of the ongoing generic review initiated by NUREG-0612, "Control of Heavy Loads at Nuclear Power Plants." The results of that review will be reported as part of Multiplant Action Item C-10. The evaluation provided herein is limited to the heavy load handling activities associated with the proposed spent fuel storage modifications.

Each unit has one seismic Category I overhead crane in the auxiliary building which will be used for removing the existing rack modules and lowering the new modules into the pool. The licensee has stated in its November 5, 1982 submittal that "no loads exceeding 2000 lbs. will be allowed over the fuel assemblies at any time." The TSs for ANO-1 & 2 also prohibit the travel over fuel assemblies in the storage pool of loads in excess of 2000 lbs. Since the weight of a rack module is much greater than 2000 lbs., we conclude that the rack modules will not be carried over the fuel assemblies and that there is reasonable assurance that an accident impacting assemblies in the pool will not occur. All movement of spent fuel racks will be controlled by written administrative procedures which will prohibit movement of the racks over locations in the pool where fuel is stored.

The licensee indicated that the movement of all loads into and out of the auxiliary building associated with this modification will be accomplished with the single-failure proof cask crane and double rigging to assure that a single failure will not result in an unanalyzed load-drop event. The licensee has committed to establish a program for installation and use of slings which complies with the criteria contained in ANSI B30.9-1971. In NUREG-0612, we concluded that this is acceptable.

The licensee also stated in response to NUREG-0612 that all crane operators and signalmen will be trained in accordance with ANSI B30.2-1976, and no exceptions from the standards are taken regarding training, qualification or operator conduct.

2.3.3 Conclusion

We have reviewed the described load handling operations and equipment needed for the spent fuel rack modifications. We conclude that the lifting devices and other apparatus used for the handling of the storage racks are acceptable.

2.4 Structural Design

2.4.1 Introduction

Both units at ANO are pressurized water reactors (PWRs). The spent fuel pools are similar right and lefthand arrangements. The pools are elevated with the top of the pools at the fueling floor level, elevation 404 feet. The inside bottom of the pools is at elevation 362 feet. The top of the slab-on-grade is at elevation 335 feet. The approximate inside dimensions of the pools are:

	ANO-1	ANO-2
Depth	42 ft.	42 ft.
Length	44 ft.	32.75 ft.
Width	23 ft.	23 ft.

The pool structures are reinforced concrete with floor thickness of about 5.15 feet and walls of various thickness from 4 to 6 feet. The outside walls of the pools are generally continuous to the foundation mat. These walls support the bottom slab of the pool.

Each pool is lined with a continuous, welded, watertight, 3/16 inch thick stainless steel plate.

The new racks are stainless steel "egg-crate" structures. The 9 cell by 9 cell rack is approximately 16 feet high by 7.4 feet long by 7.4 feet wide. The cells of the egg-crate are fabricated of cold-formed gage thickness material. These cells are supported by a heavy welded base and by a welded structural grid near the top of each rack. The racks are each free standing on the pool floor on four corner leveling pads.

2.4.2 Applicable Codes, Standards and Specifications

Structural material of the racks conform to the ASME Boiler and Pressure Vessel Code, Section III, Subsection NF. Computed stresses were compared with the ASME Code, Section III, Subsection NF. Load combinations and acceptance criteria for racks were compared with the "NRC Position for Review and Acceptance of Spent Fuel Storage and Handling Applications" dated April 14, 1978 and amended January 18, 1979 (hereafter referred to as the "NRC Position").

The pool structures were evaluated in accordance with the requirements of ACI 349-80 for load combinations based on the NRC Standard Review Plan, NUREG-0800, Section 3.8.4.

2.4.3 Loads and Load Combinations

Load and load combinations for the racks and the pool structures were reviewed and found to be in agreement with the applicable portions of the NRC Position.

2.4.4 Seismic and Impact Loads

Seismic loads for the rack design are based on the original design floor acceleration response spectra calculated for the plants at the licensing stage. This was based on a 0.2g safe shutdown earthquake (SSE) and a 0.1g operating basis earthquake (OBE). Acceleration in the verical direction was computed as being two-thirds of horizontal acceleration. Damping values for the seismic analysis of the racks and the pool structures were taken as two percent for OBE. Rack/fuel bundle interactions were considered in the structural analysis. The SSE load was computed as twice the OBE load.

Loads due to a fuel bundle drop accident were considered in a separate analysis for such an occurrence.

The postulated loads from such events were found to be acceptable.

2.4.5 Design and Analysis of the Racks

A non-linear, time history analysis was performed on a two dimensional model of the rack. This model included consideration of sliding and tipping of the racks as well as potential rack-to-fuel bundle impacts. The model consisted of spring, mass, damping and gap elements arranged to simulate the rack and fuel. Hydrodynamic effects were considered. Estimates of sliding and tipping of the racks were taken from the analysis and used in combination with thermal considerations to establish minimum limiting gaps between the racks in order to preclude rack-to-rack impacts.

A linear, response spectrum, finite element analysis was performed to design/verify the rack structure.

The rack structural design produced calculated stresses for the rack components which were within allowable limits. The racks were found to have adequate margins against sliding and tipping.

An analysis was conducted to assess the potential effects of a stuck fuel assembly causing an uplift load on the racks and a corresponding downward load on the lifting device as well as a tension in the fuel bundles. Resulting stresses were found to be within acceptance limits.

2.4.6 Seismic Analysis of the Pool Structure

A structural analysis of the reinforced concrete pool structures was conducted by the licensee, and it was found that each pool structure is adequate to withstand the effects of added loads due to the new racks under seismic loads. The analysis consisted of a detailed finite element examination of the pools including thermal and seismic loads as well as other applicable loads. No overstress conditions exist in the pool structures or liners for the proposed installations.

2.4.7 Conclusion

It is concluded that the proposed rack installations will satisfy the requirements of 10 CFR 50, Appendix A, GDC 2, 4, 61 and 62 as applicable to structures, and are therefore acceptable.

2.5 Materials

2.5.1 Materials Description

The proposed spent fuel storage racks have been fabricated of type 304 stainless steel, which is used for all structural components. The storage pool in each of the two units is divided into two regions. Region 1 in each case utilizes Boraflex as a neutron absorber material, attached to the active portion of each fuel assembly cell by a thin wrapper which is welded in place. Placement of the wrapper provides for venting the Boraflex to the pool environment, thereby eliminating potential pressure buildup, for example by radiolysis of entrained water vapor. Depending on criticality requirements, Boraflex is deployed on either all four sides, three sides or two sides of a cell. Region 2 features storage racks consisting of cells assembled in a checkerboard pattern, producing a honeycomb-type structure. Each cell has attached to its outer wall a stainless steel wrapper plate creating a pocket opened at the top and bottom. The spacer pockets are designed to accept poison inserts if future need arises. The type 304 stainless steel rack modules have been welded and inspected by nondestructive examinations performed in accordance with the applicable provisions of ASME Boiler and Pressure Vessel Code, Section III (and therefore, by reference, Section IX).

2.5.2 Chemical Compatibility

The spent fuel pools of ANO-1 and 2 are fabricated of materials that will have good compatibility with the borated water chemistry of the spent fuel pool. The corrosion rate of type 304 stainless steel in this water is sufficiently low to defy our ability to measure it. Since all materials in the pools are stainless steel, no galvanic corrosion effects are anticipated. No instances of corrosion of stainless steel in spent fuel pools containing boric acid have been observed throughout the country (Ref. 15). Boraflex has been shown to be resistent to radiation doses in excess of any anticipated in the spent fuel pools of ANO-1 & 2 (Ref. 16). The venting of the cavities containing the Boraflex to the spent fuel pool environment will ensure that no gaseous buildup will occur in these cavities that might lead to distortion of the racks. The Codes and Standards used in fabricating and inspecting these new fuel storage racks should ensure their integrity and minimize the likelihood that any stress corrosion cracking will occur during service. AP&L has described a materials surveillance program which would reveal instances of deterioration of the Boraflex during the life of the new spent fuel racks. The monitoring program consists of a series of eight jacketed poison coupons which duplicate the condition of Boraflex encased in the poison canisters. These coupons are to be hung alongside the high density racks and will be subjected to the neutron, gamma and heat fluxes. Sufficient coupons are included to permit examination of a sample on inspection intervals of 1 to 5 years over the life of the facilities. An additional strap of eight coupons will be suspended adjacent to the most recently discharged fuel element at each off-loading and examined at each subsequent off-loading. By an evaluation of these specimens, an accelerated testing of environmental effects will be obtained, simulating within an eight-year period the effects upon the normally exposed poison material during a 40-year period.

This monitoring program will ensure that, in the unlikely situation that the Boraflex will deteriorate in this environment, the licensee and the NRC will be aware of it in sufficient time to take corrective action.

2.5.3 Conclusion

From our evaluation as discussed above, we conclude that the corrosion that will occur in the spent fuel pools will be of little significance during the remaining life of the units. Components of the spent fuel storage pools are constructed of alloys which are known to have a low differential galvanic potential between them, and that have performed well in spent fuel storage pools at other PWR sites where the water chemistry is maintained to comparable standards to those in force at ANO-1 & 2. The proposed materials surveillance program is adequate to provide warning in the unlikely event that deterioration of the neutron absorbing properties of the Boraflex will develop during the design life of the racks. Therefore, with the selection of the materials, we believe that no significant corrosion should occur in the spent fuel storage racks for a period well in excess of the design life of the units.

We therefore conclude that the compatibility of the materials and coolant used in the spent fuel storage pools is adequate based on tests, data, and actual service experience in operating reactors. We find that the selection of appropriate materials by the licensee meets the requirements of 10 CFR Part 50, Appendix A, Criterion 61, by having a capability to permit appropriate periodic inspection and testing of components, and Criterion 62, by preventing criticality by maintaining structural integrity of components, and is therefore acceptable.

2.6 Spent Fuel Pool Cleanup System

2.6.1 Introduction

The spent fuel pool cleanup systems for ANO-1 and 2 consist of a demineralizer for each unit (mixed bed resin), filters, and associated piping, valves and fittings. The systems are designed to remove corrosion products, fission products, and impurities from the pool water. Pool water purity is monitored by monthly chemical and radiochemical analyses. Demineralizer resin will be replaced on the basis of an increase in differential pressure or when pool water samples show reduced decontamination effectiveness. However, these resins are routinely changed on an annual basis as a preventive measure even though they may not show reduced decontamination effectiveness. The licensee indicated that no change or equipment addition to the spent fuel pool cleanup systems is necessary to maintain pool water quality for the augmented storage facilities.

2.6.2 Evaluation

The spent fuel pool cleanup systems have been reviewed in accordance with Section 9.1.3 of the Standard Review Plan (NUREG-0800, July 1981).

Past experience showed that the greatest increase in radioactivity and impurities in spent fuel pool water occurs only during refueling and spent fuel handling. The refueling frequency, amount of the core to be replaced for each fuel cycle, and frequency of operating the spent fuel pool cleanup systems at ANO-1 and 2 are not expected to increase as a result of expansion of the spent fuel pools. There is no reason to believe that the chemical and radionuclide composition of the spent fuel pool waters will change as a result of the proposed modifications. Past experience also indicated that there is not any significant leakage of fission products from spent fuel stored in pools after the fuel has cooled for several months. Thus, the increased quantity of spent fuel to be stored at ANO-1 and 2 will not contribute significantly to the amount of radioactivity from fission products in the spent fuel pool waters.

On the basis above, we determined that the proposed expansion of the spent fuel pools at ANO-1 & 2 will not affect the capability and capacity of the spent fuel pool cleanup systems. Accordingly, no change to the present systems is required. More frequent replacements of the filters or demineralizer, required when the decontamination effectiveness is reduced, can offset any potential increase in radioactivity and impurities in the pool water as a result of the expansion. Thus, we have determined that the existing spent fuel pool cleanup systems with the proposed fuel storage expansion (1) provide the capability and capacity of removing radioactive materials, corrosion products, and impurities from the pool waters, and thus meet the requirements of General Design Criterion 61 in Appendix A to 10 CFR Part 50, as it relates to appropriate filtering systems for fuel storage; (2) are capable of reducing occupational exposures to radiation by removing radioactive products from the pool waters, and thus meet the requirements of Section 20.1(c) of 10 CFR Part 20, as it relates to maintaining radiation exposures as low as is reasonably achievable; (3) confine radioactive materials in the pool waters into the demineralizer and filters, and thus meet Regulatory Position C.2.f(2) of Regulatory Guide 8.8, as it relates to reducing the spread of contaminants from the source; and (4) remove suspended impurities from the pool water by filters, and thus meet Regulatory Position C.2.f(3) of Regulatory Guide 8.8, as it relates to removing cruds from fluids through physical action.

2.6.3 Conclusion

On the basis of the above evaluation, we conclude that the spent fuel pool cleanup systems meet GDC 61, Section 20.1(c) of 10 CFR Part 20 and the appropriate sections of Regulatory Guide 8.8 and, therefore, are acceptable for the proposed expansion of the spent fuel pools.

2.7 Occupational Radiation Exposure

We have reviewed the radiation protection aspect of the licensee's plans to modify the spent fuel pools for ANO-1 & 2.

The licensee has estimated 16 man-rems will be the collective occupational dose in replacing the ANO-1 & 2 spent fuel storage racks. This collective dose estimate includes detailed breakdown of exposure to individuals performing specific tasks for each phase of the following operations: decontamination, rack removal, clean-up and disposal and new rack installation. The licensee has also outlined measures that will be taken to ensure personnel exposure for divers working in the spent fuel pools is ALARA. Lessons learned from previous re-rack experience are also included in the program.

The licensee does not expect any significant increase in dose rates due to the buildup of crud along the sides of the pools. If crud buildup eventually becomes a major contributor to pool dose rates, measures will be taken to reduce such dose rates. The purification system for the pools includes filters and demineralizers to remove crud and will be operating during the modifications of the pools.

The licensee has presented four alternative plans for removal and disposal of the old racks. These are (1,2) burial with or without volume reduction; (3) decontaminate to releasable criteria of Regulatory Guide 1.86 and disposal; (4) to have an outside vendor chemically decontaminate and dispose of the intact racks. The disposal methodology will follow ALARA guidelines for each of the alternatives.

The licensee has an ALARA committee, which reviews all work in radiological controlled areas when the estimated collective dose for any job will exceed 1 man-rem. Some of the actions that will be taken by the licensee to assure that occupational doses during each task of the pool modifications will be ALARA are:

1. A health physicist and diving supervisor will be in direct communication with the divers at all times during the re-racking to monitor for excessive exposure by utilizing portable or hand-held radiation monitoring instruments. The dose rates will not be permitted to exceed 1 rem/hr whole body.

2. Personnel monitoring devices will be used by all personnel working in the radiologically-controlled area. Additional monitoring of the underwater divers will be done by multiple whole body TLDs and extremity TLDs.

3. Personnel shall be required to wear appropriate protective clothing as determined by the health physicist to preclude contamination.

4. As the racks are pulled out of the water, they will be washed.

5. Area radiation monitors will be used to alarm on a high radiation signal. Actual dose rates can be read locally and in the control room.

6. A portable filtered water vacuum system will be available to remove loosely deposited contamination from the fuel rack surfaces, pool floor and walls near divers' working areas to reduce the radiation exposure.

7. Contamination control measures will be used to prevent the spread of contamination and to protect personnel from internal exposure from radioactive material

8. Underwater radation surveys will be performed in all areas where divers must work or have the need for access to the work area. An underwater radiation monitoring instrument will be used to perform dose rate measurements in the pools.

Based on our review of the ANO-1 & 2 spent fuel pool modification description and relevant experience from other operating reactors that have performed similar modifications, we conclude that the licensee's modifications can be performed within the limits of 10 CFR Part 20 and in a manner that will maintain doses to workers ALARA.

We have estimated the increment in occupational dose during normal operations, after the pool modifications, resulting from the proposed increase in stored fuel assemblies. The spent fuel assemblies contribute a negligible amount to dose rates in the pool areas because of the depth of water shielding the fuel; the major source of dose rate is the radionuclide concentrations in the pool water. The mose significant contributor to the radionuclides is the movement of fuel rather than the number of fuel assemblies in the pools. Thus the additional assemblies will add a negligible amount to area dose rates. Based on present and projected operations in the spent fuel pool areas and experience from similar modifications, we estimate that the proposed modifications should add less than one percent to the total annual occupational radiation dose to plant personnel. The small increase in radiation dose should not affect the licensee's ability to maintain individual occupational doses within the limits of 10 CFR Part 20 and ALARA.

On the basis of the above, we have determined that the dose to personnel will be maintained within the limits of 10 CFR 20, "Standard for Protection Against Radiation", and as low as is reasonably achievable, and therefore, the licensee's occupational dose control program is acceptable.

2.8 Radioactive Waste Treatment

Each unit contains waste treatment systems designed to collect and process the gaseous, liquid, and solid wates that might contain radioactive material. The waste treatment systems were evaluated in the Safety Evaluation Reports (SERs) for Arkansas Nuclear One, Units Nos. 1 and 2, dated June 1973 and November 1977, respectively. The proposed modifications will not result in any significant additional radwastes that will need to be processed. Therefore, there will be no change in the waste treatment systems or in the conclusions given in Section 11.0 of the SERs because of the proposed modifications.

2.9 Radiological Consequences of Rack Module Assembly Drop, Cask Drop and Fuel Handling Accidents

2.9.1 Introduction

We have reviewed the licensee's plans for the expansion of the storage capacity of the spent fuel pools at ANO-1 & 2 regarding radiological consequences of rack module drop, cask drop and fuel handling accidents. The review was conducted according to the guidance of Standard Review Plans 15.7.4 and 17.7.5, and Regulatory Guide 1.25.

2.9.2 Evaluation and Findings

Rack Module Assembly Drop Accident

The overhead cranes in the auxiliary buildings at ANO-1 & 2 will be used for removing the existing rack modules and lowering the new modules into the pools. The licensee has stated in Section 8.1, Rack Modules Assembly Handling Considerations, of the November 5, 1982 submittal that "no loads exceeding 2000 lbs. will be allowed over the fuel assemblies at any time." The TSs for ANO-1 & 2 also prohibit the travel over fuel assemblies in the storage pool of loads in excess of 2000 lbs. Since the weight of a rack module is much greater than 2000 lbs., we conclude that the rack modules will not be carried over the fuel assemblies and that there is reasonable assurance that an accident impacting assemblies in the pools would not occur. The assessment of the radiological consequences of a rack module assembly drop accident is not required.

Fuel Handling Accident

The maximum weight of loads which may be transported over spent fuel in the pool is limited by TSs to that of a single assembly (2000 lbs.). The proposed spent fuel pool modifications do not increase the radiological consequences of fuel handling accidents considered in our SERs of June 1973 (ANO-1) and November 1977 (ANO-2), since this accident would still result in, at most, the release of the gap activity of one fuel assembly due to the limitation on the available impact kinetic energy.

Cask Drop Accident

In the evaluation of the cask drop accident, the licensee states in the November 5, 1982 submittal that the administrative procedures prevent a spent fuel cask from being moved over the spent fuel pools. We conclude that the proposed spent fuel pool modifications do not affect the result of the cask drop accident considered in the SERs.

2.9.3 Conclusion

Based upon the above evaluation, we conclude that the likelihood of a rack module assembly drop accident is sufficiently small - since the rack module assembly will not be allowed over the fuel at any time - that this accident need not be considered. Also, a fuel handling accident involving a dropped assembly or cask would not be expected to result in radionuclide releases leading to offsite radiological consequences exceeding those of the fuel handling accident evaluated in our SERs of June 1973(ANO-1) and November 1977 (ANO-2); that is, doses would be well within 10 CFR Part 100 values. We conclude therefore, that the proposed modifications are acceptable.

3.0 Conclusions

Based on our review, we conclude that the proposed modified fuel storage designs of 968 fuel assemblies for ANO-1 and 988 fuel assemblies for ANO-2 of 4.1 weight percent U-235 enrichment meet the requirements of General Design Criterions 2, 4, 61 and 62 of Appendix A to 10 CFR Part 50 and are, therefore, acceptable. Based on our review, we have determined that the proposed TS changes for ANO-1 & 2 are acceptable.

We have concluded, based on the considerations discussed above, that: (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, and (2) such activities will be conducted in compliance with the Commission's regulations and the issuance of these amendments will not be inimical to the common defense and security or to the health and safety of the public.

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