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U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, D. C. 20555

Perry Nuclear Power Plant
Docket No. 50-440
Technical Specification
Change Request - Removal
of Criticality Monitors

Gentlemen:

Enclosed is a request for amendment of Facility Operating License NPF-58 for the Perry Nuclear Power Plant (PNPP), Unit 1. In accordance with the requirements of 10 CFR 50.91(b)(1), a copy of this request for amendment has been sent to the State of Ohio as indicated below.

This amendment requests revision to Technical Specification 3.3.7.1, "Radiation Monitoring Instrumentation" to remove the requirement for fuel pool criticality monitors from Tables 3.3.7.1-1 and 4.3.7.1-1. In conjunction with this proposed Technical Specification change, a request for an exemption from 10 CFR 70.24, "Criticality Accident Requirements" is also being submitted (see letter PY-CEI/NRR-1387 L, dated February 28, 1992).

Attachmer' 1 contains the Summary, Background, Basis of the Change, proposed changes, d the Significant Hazards and Environmental Considerations. Attachment 2 provides a description of the criticality controls/analyses for each fuel storage location. Attachment 3 is a copy of the marked up Technical Specification pages.

If you have any questions, please feel free to call.

Sincerely,

Michael D. Lyster

MDL:RAL:ss

Attachment

cc: NRC Project Manager
NRC Resident Inspector Office
NRC Region III
State of Ohio

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1/1

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Summary

This proposed change would revise Technical Specification Tables 3.3.7.1-1 and 4.3.7.1-1, "Radiation Monitoring Instrumentation" and "Radiation Monitoring Instrumentation Surveillance Requirements" respectively, to remove item 5.a, Criticality Monitors, for the associated fuel pools/storage areas.

Background

Prior to receipt of the PNPP Unit 1 low power Operating License a Special Nuclear Materials license, License No. SNM-1928 was received to allow advance receipt of unirradiated new fuel, nuclear instrumentation, startup sources, etc. This license expired with the issuance of the Operating License. During early negotiations with the NRC over development of the PNPP Unit 1 Technical Specifications it was indicated to CEI that approval would occur more expeditiously if the number of deviations from the Standard Technical Specifications were minimized. With this in mind it was decided not to pursue removal of the criticality monitors from the Technical Specifications at that time even though an exemption request from the requirement to have criticality monitors installed was being pursued in parallel with the development of the Technical Specifications. The exemption request was based on the fact that the design of the fuel preparation and storage pool, the spent fuel pool (hereafter both referred to as the spent fuel pool) and the upper containment pools clearly met the requirements for an exemption from 10 CFR 70.24, "Criticality Accident Requirements" and therefore, a criticality monitoring system was not required. The new fuel storage vaults design, together with the administrative controls imposed, also met the requirements for an exemption from 10 CFR 70.24 and a criticality monitoring system was not required for this situation either. An exemption to Section 70.24 was received on the above basis within the Special Nuclear Material license. Therefore, a criticality monitoring system was not and is not needed at PNPP since accidental criticality is precluded by design and administrative controls.

A new exemption to 10 CFR 70.24 is being requested in a separate letter (see PY-CEI/NRR-1387L, dated February 28, 1992).

Basis For The Change

The spent fuel pool racks utilize the high density storage rack design, and the upper containment pool racks utilize geometry, to preclude inadvertent criticality for irradiated and unirradiated fuel stored/handled under water as discussed in Section 9.1.2 of the Updated Safety Analysis Report (USAR). The new fuel storage vaults provide dry storage of new (unirradiated) fuel. When administrative controls are applied (such as storing the new fuel in alternate rows and columns within the vault, as is committed to within the new 70.24 exemption request), an inadvertent criticality is impossible. The new fuel storage vaults are discussed in USAR Section 9.1.1. A detailed discussion of the criticality analyses/administrative controls for each of the fuel pools/vaults and rack designs is presented in Attachment 2.

Proposed Changes

Revise Technical Specification Tables 3.3.7.1-1 and 4.3.7.1-1 to delete reference to the Criticality Monitors, and to delete the Action and Table footnotes associated with the Criticality Monitor line items.

Significant Hazards Consideration

The standards used to arrive at a determination that a request for amendment involves no significant hazards considerations are included in the Commission's Regulations, 10CFR50.92, which state that the operation of the facility in accordance with the proposed amendment would not (1) involve a significant increase in the probability or consequences of an accident previously evaluated, (2) create the possibility of a new or different kind of accident from any previously evaluated, or (3) involve a significant reduction in a margin of safety.

The proposed amendment has been reviewed with respect to these three factors and it has been determined that the proposed changes do not involve a significant hazard because:

The only type of accident potentially affected by removing the criticality monitors from the Technical Specifications would be an accidental criticality event. All the other types of potential accidents/events involving fuel and fuel handling (e.g., dropping a fuel bundle) are unaffected by this change. Therefore, only the criticality related aspects are discussed below.

1. As discussed within Attachment 2 to this letter, the safety evaluations concerning the nuclear design and criticality controls for each of the fuel pools/rack types are contained within Sections 9.1.1 and 9.1.2 of the Updated Safety Analysis Report (USAR). An accidental criticality is precluded by the geometry of the racks, overmoderation, and for one rack design the use of a neutron absorbing material. These conditions apply for the racks in the fuel preparation and storage pools, spent fuel pool, and upper containment pool. For the racks within the new fuel storage vaults, accidental criticality is precluded by geometry and undermoderation or overmoderation for the dry and flooded conditions respectively. For the condition of optimum moderation within the new fuel storage vaults, accidental criticality is prevented by use of administrative controls such as solid vault covers and storage of the new fuel in alternate rows and columns as previously approved within the Special Nuclear Materials license. As noted in the NRC Safety Evaluation that accompanied the March 1985 Special Nuclear Materials license, storage of fuel in alternate rows and columns alone eliminates any criticality concern since the fuel cannot be made critical under any degree of moderation. The probability of occurrence of an accidental criticality for the various fuel storage pools is unaffected by this proposed change since accidental criticality is precluded by design features (geometry, use of neutron absorbing material) and the probability for the new fuel vaults is also unaffected even for the special case of optimum moderation, where

administrative controls are applied to preclude the event when the vaults are in use. The probability and consequences of an inadvertent criticality are therefore unchanged from those described within the USAR. The criticality monitors only provide an alarm function and initiate no action to prevent or mitigate an event. Therefore, the probability of occurrence and consequences are not significantly increased by removal of the criticality monitors from the Technical Specifications.

2. Removing the criticality monitors from the Technical Specifications can in no way introduce a new accident as they provide only an alarm function for in-plant personnel safety, which is not necessary since criticality is precluded by design or administrative controls. The installed monitors continue to function as area radiation monitors. The monitors are essentially passive and serve no preventive or accident mitigation function. Since they perform no active function, removal of the alarms from the Technical Specifications cannot introduce the possibility of a new or different kind of accident from any previously evaluated.

3. For the reasons previously discussed a significant reduction in the margin of safety is not involved because an accidental criticality is precluded by design considerations, i.e., the geometry of the racks, overmoderation, and for the high density rack design, the use of a neutron absorbing material. These conditions apply for the racks where fuel is stored/handled underwater. For the new fuel storage vaults, accidental criticality is precluded by design considerations, i.e., geometry and undermoderation or overmoderation for the dry and flooded conditions respectively, and for the condition of optimum moderation, criticality is prevented by administrative controls (as discussed above). Therefore, the proposed removal from the Technical Specifications of the criticality monitors does not involve a significant reduction in the margin of safety.

Environmental Consideration

The proposed Technical Specification change request has been reviewed against the criteria of 10 CFR 51.22 for environmental considerations. As shown above, the proposed change does not involve a significant hazards consideration, nor increase the types and amounts of effluents that may be released offsite, nor significantly increase individual or cumulative occupational radiation exposures. Based on the foregoing, it has been concluded that the proposed Technical Specification change meets the criteria given in 10 CFR 51.22(c)(9) for a categorical exclusion from the requirement for an Environmental Impact Statement.

Criticality Controls and Analysis for Each Fuel Storage Location

Two kinds of spent fuel storage racks are used for storing spent (irradiated) fuel: those achieving subcriticality by spacing in a loose packed geometric array, and those using a neutron absorber to achieve subcriticality in a close packed or dense geometric array. The low density fuel storage racks (furnished by General Electric) are used in the containment. The high density fuel storage racks (furnished by Programmed and Remote Systems Corporation (PAR)) are used in the spent fuel pools in the fuel handling and storage area of the Intermediate Building (herrafter called the Fuel Handling Building).

For new (unirradiated) fuel storage, the new fuel is either loaded directly into the spent fuel pool or the new fuel can be stored dry in the new fuel storage vaults in the Fuel Handling Building. The new fuel storage vaults utilize the same low density fuel storage rack design (furnished by General Electric) as those in containment.

For each type of fuel storage rack/pool location, the nuclear design and criticality safety evaluation is presented in the following Updated Safety Analysis Report (USAR) section:

Pool Location (Rack Type)	Safety Evaluation-Nuclear Design USAR Section	Criticality Control USAR Section
1. Upper Containment Pool (GE Racks)	9.1.2.1.3	9.1.2.3.1
2. Fuel Preparation and Storage Pool and Spent Fuel Pool (PAR Racks)	9.1.2.1.4	9.1.2.3.2
3. New Fuel Storage Vaults (GE Racks)	9.1.1.1.2	9.1.1.3.1

A. Criticality Control - Fuel Preparation and Storage Pool and the Spent Fuel Pool (PAR Racks)

Arrays of high density spent fuel storage racks are provided in the fuel preparation and storage pool, and in the spent fuel pool located in the Fuel Handling Building. As mentioned previously, these racks are designed and furnished by Programmed and Remote Systems Corporation. The high density storage racks use neutron absorber and structural material in a densely packed, square array of storage spaces to achieve subcriticality.

The high density storage racks are designed so that the center-to-center spacing between fuel assemblies within a rack is 6.625 inches and 0.375 inches between assemblies in adjacent locations. The fuel preparation and storage pool contains storage for 1620 fuel assemblies and the spent fuel pool contains storage for 2400 fuel assemblies. Arrays of fuel assemblies in this geometry would be supercritical without neutron poisons in the array. Therefore, square neutron absorber canisters have been built into the racks arranged in a checkerboard fashion: this produces one Boral (B_4C in an Al composite matrix) plate between adjacent pairs of fuel assemblies. The neutron absorber canisters contain concentric squares of stainless steel (SS) 304 with Boral plates sandwiched between the SS 304 on all four sides. There is one B_4C plate between every pair of fuel assemblies.

The design of the high density storage racks provides for a subcritical multiplication factor (k_{eff}) for both normal and abnormal storage conditions. For normal and abnormal conditions, k_{eff} is equal to or less than 0.95. Normal conditions exist when the high density storage racks are located in the pool and are covered with a normal depth of water (about 28 feet above the stored fuel) for radiation shielding and with the maximum number of fuel assemblies or bundles in their design storage positions. The spent fuel is covered with water at all times by a minimum depth required to provide sufficient shielding (the design and licensing basis is a minimum of 23 feet). An abnormal condition may result from accidental dropping of equipment or damage caused by the horizontal movement of fuel handling equipment without first disengaging the fuel from the hoisting equipment. To meet the requirements of General Design Criterion 62, a neutron absorber (sealed inside the rack's structure) and geometry are employed to ensure that k_{eff} will not exceed 0.95 under all normal and abnormal storage conditions. The PNPP Unit 1 Technical Specifications, Section 5.6.1.a: Fuel Storage - Criticality, require that the k_{eff} be maintained below 0.95.

B. <u>Criticality Control - Upper Containment Pool (GE Racks)</u>

The upper containment pool (for each Unit) contains 19 sets of racks which may contain up to 190 fuel assemblies. The design of the upper containment pool fuel storage racks provides for a subcritical multiplication factor for both normal and abnormal storage conditions equal to or less than 0.95. Normal conditions exist when the fuel storage racks are located in the pool and are covered with a normal depth of water (about 27 feet above the stored fuel) for radiation shielding and with the maximum number of fuel assemblies or bundles in their design storage position. The spent fuel is covered with water at all times by a minimum depth required to provide sufficient shielding (the design and licensing basis is a minimum of 23 feet). An abnormal condition may result from accidental dropping of equipment or damage caused by the horizontal movement of fuel handling equipment without first disengaging the fuel from the hoisting equipment. To meet the requirements of General Design Criterion 62, geometrically safe configurations of fuel stored in the fuel array are employed to assure that k_{eff} is less than or equal to 0.95 due to overmoderation. The PNPP Unit 1 Technical Specifications, Section 5.6.1.a: Fuel Storage - Criticality, require that the k_{eff} be maintained below 0.95. Section 5.6.1 also prohibits storage of spent fuel in the upper containment pool during Operational Conditions 1 and 2.

C. <u>Criticality Control - New Fuel Storage Vaults (GE Racks)</u>

There are two new fuel storage vaults each containing 18 sets of racks with 10 fuel assembly locations per rack (for a total of 360 fuel assembly locations in the two vaults). The new fuel storage vaults are designed for the dry storage of new (unirradiated) fuel.

The new fuel storage racks in the new fuel storage vaults are designed so that the center-to-center spacing between the 10 fuel assembly locations within a rack module is 7.00 inches, and 12.00 inches between those in adjacent racks (rows).

The calculations of k_{eff} are based on the geometrical arrangements of the fuel array and subcriticality does not depend on the presence of neutron absorbing materials. The arrangement of fuel assemblies in the new fuel storage racks within the new fuel storage vaults results in k_{eff} below 0.95 in a dry condition or completely flooded with water which has a density of 1 g/cc. To meet the requirements of General Design Criterion 62, it has been demonstrated analytically that the geometrically-safe configuration of fuel stored in the new fuel storage array will ensure that k_{eff} will not exceed 0.95 if fuel is stored in the dry condition or if the abnormal condition of flooding (water with a density of 1 g/cc) occurs. In the dry condition, k_{eff} is maintained ≤ 0.95 due to undermoderation. In the flooded condition, the geometry of he new fuel storage array assures the k_{eff} will remain ≤ 0.95 due to overmoderation.

Under conditions of optimum moderation (foam, small droplets, spray, or fogging), with all storage locations filled, the racks are not designed to maintain a k_{eff} of 0.98 or less. The condition of optimum moderation is precluded when each of the two new fuel storage vaults has its solid two piece cover installed. The additional administrative controls described below are used to preclude retention of moderator in the vault area, and controls are also placed on spacing in the vault areas. The floor of the vault is sloped to a drain to remove any water introduced into the vault. The requirements of General Design Criterion 62, "Prevention of Criticality in Fuel Storage and Handling" are satisfied by the vault design and administrative controls.

The new fuel storage vaults (when used) are only used during the limited time period between .uel receipt and refueling operations, a period of several weeks. During this period fuel shipments are received and new fuel is normally stored in the spent fuel pool for loading into the reactor. The new fuel storage vaults are not normally used (they have never yet been used at PNPP), and would only be used for temporary storage in special circumstances. During these limited periods of use of the vaults, the following administrative controls will be imposed by plant procedures:

a. When fuel handling activities are suspended the new fuel storage vault covers are reinstalled.

b. When new fuel bundles are stored in the new fuel storage vaults a Reactor Engineer ensures that the drain valves for the vaults are tagged open and there is no material in the vaults which could block the drains.

c. A Reactor Engineer ensures that the bundles are stored in such a manner that water can drain freely from the fuel assemblies in the event of flooding and subsequent draining of the new fuel sturage vaults.

Fuel assemblies are shipped and may be stored with plastic wrappers around them to protect the fuel from the storage environment and to keep dust off of the fuel. During the development of the SNM License, the NRC Staff expressed the concern that if the fuel assemblies were covered and the storage area flooded and drained, the assemblies could become internally moderated with water (retained in the wrappers) while spaces between assemblies would be occupied only with air. Within the NRC's Safety Evaluation Report to the SNM license the Staff indicated that they believe that large arrays under these conditions could become critical. We indicated within the SNM license application that the fuel packaging, i.e., plastic wrappers, would not retain water around or within the assemblies. Although with the imposition of the spacing criteria described below an internally moderated bundle could not present a criticality concern, we recognize the Staff's concern and therefore, propose retention of the commitment in item c. above, which is the same as the former Condition 22 within the Special Nuclear Materials license.

Although the incorporation of the spacing criteria discussed below obviates the need for the administrative controls committed to above (vault covers in place, drain valve tagging and ensuring free drainage of water from the fuel assembly), they will nevertheless be put in place because they do not impose an excessive burden.

During the periods when fuel is being moved and/or placed into the new fuel storage vaults, the vault cover(s) will be removed. When the vault covers are removed accidental criticality can be precluded by spacing the fuel bundles such that a criticality event is impossible, or administrative controls could be used to preclude entry of sources of optimum moderation (foam, small droplets, spray or fogging) into the vaults. These controls could include one or more of the following: fire protection personnel training; signs posted in the area; removal of only one of the two vault covers at a time; availability of non-water/foam based fire extinguishers in the area; control of combustibles storage in the immediate area; control of ignition sources in the immediate area, or use of solid stream nozzles on fire hoses in the area. Many plants use administrative controls to preclude such entry of sources of optimum moderation into new fuel storage vaults.

However, due to the low likelihood of a need to use the new fuel storage vaults prior to the time that the spent fuel pools are filled, the incorporation of these controls to preclude introduction of a moderator have been determined to be excessively burdensome to enforce.

Instead, to completely preclude any possibility of inadvertent criticality (even assuming the introduction of optimum moderation occurs) it is proposed to store the new fuel assemblies in the new fuel vaults in alternate rows and columns. This was discussed with the NRC Staff during application for the Special Nuclear Materials license and was added to the SNM license as License Condition 21. Under these conditions, the center-to-center distance between fuel assemblies in a row would be 14 inches and that between assemblies in alternate columns would be 24 inches. As noted in the NRC's Safety Evaluation Report that accompanied the March 1985 SNM license, arrays of fuel assemblies in this configuration can not be made critical regardless of the density of water moderation between fuel assemblies or the degree of water reflection surrounding the arrays. Administrative controls will be used to prevent insertion of fuel assemblies in the eight storage locations immediately surrounding each fuel assembly. The approved location of each storage position will be verified after each fuel assembly is placed in its storage location, and there will be periodic inventories when the new fuel vaults are in use. A fuel transfer record specifies the storage location for each fuel assembly in the new fuel storage vaults. The following administrative controls will be imposed by plant procedures when the new fuel vaults are in use.

a. Prior to storing fresh fuel assemblies in the New Fuel Storage Vaults a documented fuel assembly storage plan indicating the specific storage location of each assembly shall be developed. The plan shall show that the fuel assemblies are stored only in alternate rows and columns and be approved by the Reactor Engineer.

b. A Reactor Engineer or a Senior Reactor Operator shall verify the authorized storage location at the completion of each fuel assembly transfer.

As described on page 10 within the Safety Evaluation Report for the Special Nuclear Materials license, the NRC Staff indicated "that with this condition, the applicant has established reasonable and satisfactory precautions to avoid an accidental criticality in the new fuel storage vaults."