Entergy

Entergy Operations, Inc.
1448 S.R. 333
Russellville, AR 72802
Tel 479-858-3110

Timothy G. Mitchell
Vice President, Operations

2CAN030706

March 30, 2007

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

SUBJECT: License Amendment Request to Support a Partial Re-rack and Revised Loading Patterns in the Spent Fuel Pool
Arkansas Nuclear One, Unit 2 (ANO-2)
Docket No. 50-368
License No. NPF-6

REFERENCES:

1. Letter to the NRC dated August 8, 2002, "Use of Metamic™ In Fuel Pool Applications" (0CAN080201)

2. Letter from the NRC dated June 17, 2003, "Arkansas Nuclear One, Units 1 and 2 – Safety Evaluation for Holtec Report HI-2022871 Regarding Use of Metamic™ in Fuel Pool Applications" (TAC NOS. MB5862 and MB5863)

Dear Sir or Madam:

Pursuant to 10 CFR 50.90, Entergy Operations, Inc. (Entergy) hereby requests an amendment to the Arkansas Nuclear One, Unit 2 (ANO-2) Technical Specification (TS) 3.9.12, Fuel Storage, and TS 5.3, Fuel Storage.

The proposed TS changes support a planned modification to the ANO-2 spent fuel pool (SFP) that will utilize Metamic™ racks in an area designated as Region 1. Entergy submitted by letter dated August 8, 2002, a topical report (Reference 1) to allow the use of Metamic™ in SFP applications. The report, prepared by Holtec International, describes the physical and chemical properties of Metamic™ and includes the test results for the use of Metamic™ in fuel pool applications. The topical report was approved by the NRC on June 17, 2003 (Reference 2).

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The ANO-2 SFP racks are divided into two regions. The Region 1 racks contain Boraflex™ which has degraded and is currently not credited. These racks will be replaced with new racks that contain Metamic™, in which no loading restrictions will be imposed. The Region 2 racks do not contain any fixed poison panel assemblies. The proposed change will modify the loading pattern in Region 2.

In addition to the above proposed change and plant modification, Entergy proposes to continue to credit boron to assure a five percent subcriticality margin is maintained during normal and accident conditions. The allowance to credit boron is consistent with 10 CFR 50.68, *Criticality accident requirements*.

To accommodate future reload plans, Entergy proposes to increase the allowable initial fuel assembly Uranium-235 (U-235) enrichment from 4.55 ±0.05 weight percent (wt%) to a maximum U-235 enrichment of 4.95 wt%. Criticality analyses were performed using the higher U-235 fuel enrichment for the SFP racks and for the new fuel storage racks.

In accordance with the conditions of the topical report (Reference 2), the proposed change will include a coupon sampling program to monitor the potential changes in the characteristics of Metamic™.

A change is also proposed to delete the storage requirements associated with the dry storage cask. The criticality accident requirements contained in 10 CFR 50.68 are not applicable to dry cask loading and therefore are not required to be included in the ANO-2 Technical Specifications.

Portions of the Holtec Licensing Report for ANO Unit 2 Partial Rerack are of a proprietary nature to Westinghouse and Holtec. The non-proprietary version is included as Attachment 5 to this letter. A proprietary version is enclosed as Attachment 8 to this cover letter. Proprietary information is enclosed in brackets. Superscripts a, b, and c refer to Affidavit paragraphs. The Affidavits for withholding information are included in Attachment 9 to this letter. Therefore, based on the Affidavits, Entergy requests that the information which is proprietary to Westinghouse and Holtec be withheld from public disclosure in accordance with 10 CFR 2.390.

The proposed change has been evaluated in accordance with 10 CFR 50.91(a)(1) using criteria in 10 CFR 50.92(c) and it has been determined that this change involves no significant hazards considerations. The bases for these determinations are included in the enclosed Attachments.

The proposed change includes new commitments that are listed in Attachment 7.

Due to competing activities (e.g., dry cask storage, new fuel receipt, etc.) in the spent fuel pool area, Entergy requests approval of the proposed amendment by September 30, 2007. Approval by this date will support installation of the new racks prior to the receipt of fuel to support the spring 2008 refueling outage. Once approved, the amendment shall be implemented within 90 days. Although this request is neither exigent nor emergency, your prompt review is requested.

If you have any questions or require additional information, please contact Dana Millar at 601-368-5445.

I declare under penalty of perjury that the foregoing is true and correct. Executed on March 30, 2007.

Sincerely,

TGM/DM

Attachments:
1. Analysis of Proposed Technical Specification Change
2. Proposed Technical Specification Changes (mark-up)
3. Proposed Technical Specification Changes (revised)
4. Changes to Technical Specification Bases Pages (For Information Only)
5. Holtec Licensing Report for ANO Unit 2 Partial Rerack (Non-Proprietary)
6. Structural / Seismic Considerations for Replacement of Three Spent Fuel Racks at ANO-2
7. List of Regulatory Commitments
8. Holtec Licensing Report for ANO Unit 2 Partial Rerack (Proprietary)
9. Affidavits for Withholding Information

cc: Dr. Bruce S. Mallett
Regional Administrator
U. S. Nuclear Regulatory Commission
Region IV
611 Ryan Plaza Drive, Suite 400
Arlington, TX 76011-8064

NRC Senior Resident Inspector
Arkansas Nuclear One
P. O. Box 310
London, AR 72847

Arkansas Department of Health & Human Services
Division of Health
P.O. Box 1437
Slot H-30
Little Rock, AR 72203-1437

U. S. Nuclear Regulatory Commission
Attn: Ms. Farideh E. Saba
MS O-8 B1
Washington, DC 20555-0001

Attachment 1

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Analysis of Proposed Technical Specification Change

1.0 DESCRIPTION

This letter is a request to amend Operating License NPF-6 for Arkansas Nuclear One, Unit 2 (ANO-2).

The proposed changes will revise the ANO-2 Technical Specifications (TSs) 3.9.12 and 5.3 to:

- Credit Metamic™ racks that will replace the existing Boraflex™ racks in Region 1 of the ANO-2 spent fuel pool (SFP).
- Redefine the loading pattern based on the new Region 1 racks and in the remaining racks, which are designated as Region 2 racks.
- Allow an increase in the maximum fuel assembly uranium-235 (U-235) enrichment from the current U-235 enrichment of 4.55 ± 0.05 weight percent (wt%) to a maximum of 4.95 wt%.
- Delete TS 3.9.12.d and the related SR associated with dry cask loading.
- Revise the boron concentration credited to assure the effective neutron multiplication factor (K_{eff}) remains less than 0.95.

The change also includes the addition of a new Metamic™ coupon sampling program.

Appropriate changes will also be made to the associated TS Bases. A markup of the TS Bases is included for information only in Attachment 4.

The changes are desired in order to support the partial re-rack in the ANO-2 SFP. The new racks will include Metamic™ poison panels. In addition, the increase in maximum fuel assembly U-235 enrichment is desired to support future reactor fuel loading capabilities. Approval of the proposed changes is desired by September 30, 2007 to support installation of the racks in the SFP prior to the receipt of fuel associated with the spring 2008 refueling outage. The NRC's approval of this amendment request will allow ANO-2 to maintain full core offload capability during and following the spring outage.

2.0 PROPOSED CHANGE

<u>Technical Specification 3.9.12, Fuel Storage</u>

ANO-2 TS 3.9.12, the actions, the associated SRs, and figures define the storage restrictions, the maximum fuel enrichment, and the minimum required SFP boron concentration for the ANO-2 SFP. The following changes are proposed to this specification:

- TS 3.9.12.a, which defines the fuel assembly U-235 enrichment, will be changed to allow storage of fuel assemblies with an initial U-235 enrichment of 4.95 wt%.

- TS 3.9.12.b and Figure 3.9-2 define loading restrictions for fuel assemblies that are stored in the ANO-2 SFP. Figure 3.9-2 will be deleted and revised loading restrictions, which will be reflected in proposed Table 3.9-1, will be added.

- TS 3.9.12.d, associated Figure 3.9-1, and SR 4.9.12.d will be deleted. This limiting condition for operation and loading restriction was added to support dry cask loading activities. Dry cask loading activities are not governed by 10 CFR 50.68, *Criticality accident requirements*, and therefore are not required to be included in the ANO-2 Technical Specifications that are governed by 10 CFR 50.36, *Technical specifications*.

- Surveillance Requirement 4.9.12.a will be modified to reflect the new fuel assembly U-235 enrichment.

- Surveillance Requirement 4.9.12.b will be changed to reference proposed Table 3.9-1.

- A new SR (proposed SR 4.9.12.d) will be added to direct performance of the coupon sampling program. The coupon sampling program will be added as TS 6.5.17.

<u>Technical Specification 5.3, Fuel Storage</u>

ANO-2 TS 5.3.1 b defines that k_{eff} will be maintained less than or equal to 0.95 if the spent fuel pool racks are fully flooded with at least 240 parts per million (ppm) of borated water. The proposed criticality analysis, as allowed by 10 CFR 50.68, will continue to credit boron (revised to 452 ppm) to assist in maintaining $k_{eff} \leq 0.95$ during normal operating conditions.

ANO-2 TS 5.3.2 a defines a maximum U-235 enrichment of 4.55 $\pm$ 0.05 wt% for fuel assemblies stored in the new fuel storage racks. The proposed change will allow the maximum U-235 enrichment to be 4.95 wt%.

<u>Technical Specification 6.5.17, Metamic Coupon Sampling Program</u>

A coupon sampling program will be added as proposed TS 6.5.17.

In summary, the proposed change will modify the ANO-2 TSs to support a partial re-rack of the storage racks in the ANO-2 SFP. Changes are proposed to TS 3.9.12 to: 1) support higher fuel assembly U-235 enrichment; 2) apply the appropriate loading restrictions; and 3) delete the dry cask loading restrictions. TS 5.3.1 b will be changed to reflect a different SFP boron concentration that is needed to assure K_{eff} remains less than or equal to 0.95. TS 5.3.2 a will be modified to reflect a higher fuel assembly U-235 enrichment. A new coupon sampling program will be added as TS 6.5.17.

3.0 BACKGROUND

3.1 <u>Spent Fuel Pool Racks</u>

The stainless steel lined (type 304L) reinforced concrete SFP provides storage for 988 fuel assemblies. Spent fuel assemblies are stored in vertical racks. The racks, which are freestanding modules, are comprised of:

- four modules, containing 81 fuel storage locations each, in a 9 x 9 array;
- four modules, containing 90 fuel storage locations each, in a 9 x 10 array;
- two modules containing 80 fuel storage locations, in an 8 x 10 array; and
- two modules containing 72 fuel storage locations, in an 8 x 9 array.

Each fuel storage module is made up of rectangular storage cells which are capable of accepting one fuel assembly. The cells are open at the top and bottom to provide a flow path for convective cooling of spent fuel assemblies through natural circulation. The fuel storage cells are structurally connected to form storage modules which provide the assurance that the required minimum fuel assembly spacing is maintained for all design conditions including the design basis earthquake (DBE).

Section 9.1.2 of ANO-2 SAR contains a description of the ANO-2 SFP storage area.

3.2 New Fuel Storage Area

New fuel is stored dry in vertical racks. Room is provided for 63 new fuel assemblies, with fuel assembly spacing and vault construction sufficient to preclude criticality. New fuel assemblies may also be stored in the spent fuel racks.

Section 9.1.1 of ANO-2 SAR contains a description of the ANO-2 new fuel storage area.

3.3 Fuel Pool System

The fuel pool system is designed to:

- maintain the pool temperature less than or equal to approximately 150 °F during a full core discharge. The cooling system's heat removal capacity as a function of service water temperature is depicted in ANO-2 SAR Figures 9.1-19 and 9.1-20. Refueling operations are administratively controlled in order to minimize the potential of exceeding a pool temperature of 150 °F during a full core discharge whenever service water system temperature is elevated.
- maintain purity and optical clarity of the fuel pool water;
- maintain purity of the water in the refueling cavity and in the refueling water tank; and,
- maintain the water level a minimum of 9.5 feet above the top of the active fuel during fuel handling and storage operations.

The cooling portion of the fuel pool system is a closed loop system consisting of two half capacity pumps for normal duty 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. From the outlet of the fuel pool heat exchanger, the cooled fuel pool water is returned to the top of the fuel pool via a distribution header at the opposite end of the pool from the intake.

The clarity and purity of the water in the fuel pool, refueling cavity, and refueling water tank are maintained by the purification portion of the fuel pool system. The purification loop consists of the fuel pool purification pump, ion exchanger, filters, strainers, and an installed connection for a floating skimmer. The purification flow is drawn from the suction piping and can be aligned to three different levels within the fuel pool. A basket strainer is provided in the purification line to the pump suction to remove any relatively large particulate matter. The fuel pool water is circulated by the pump through a filter, which removes particulates, and through an ion exchanger to remove ionic material. Connections to the refueling water tank and refueling water cavity are provided for purification and makeup.

Makeup to the fuel pool is provided from the chemical and volume control system (CVCS) via the blending tee, the refueling water tank via the purification pumps, or the boric acid makeup system (BMS) holdup tanks if chemistry specifications are met. In an emergency, Seismic Category I makeup is available from either service water system loop. The boric acid makeup tanks are also available for boration of the spent fuel pool. Overflow protection is provided by transferring the fuel pool water on high level alarm to the refueling water tank or one of the BMS holdup tanks via the purification pump.

The fuel pool system is manually controlled from a local control panel. High fuel pool temperature and high and low fuel pool water level alarms are annunciated in the control room. Spent resins from the fuel pool ion exchanger are sluiced to the solid waste management system. Local sample connections are provided on the influent and effluent of the fuel pool purification filters and the fuel pool ion exchanger effluent for verifying purification performance.

Section 9.1.3 of the ANO-2 SAR contains a detailed description of the SFP system. No modifications are proposed to these systems in order to support the proposed changes.

3.4 Loading Pattern / Storage Procedural Controls

The controls used in determining the storage location for new and irradiated fuel in the new or spent fuel storage racks are governed by procedure. The procedure currently contains guidelines pertaining to fuel assembly classifications as reflected by the TS. The new loading pattern restrictions will continue to be governed by procedure. Checkerboard storage configurations and vacant spaces will be administratively controlled by procedure.

Prior to moving a fuel assembly, the fuel assembly is required to be classified based on initial U-235 fuel enrichment, decay time, and burnup to determine where it can be placed in the SFP. ANO administratively controls the proper placement of fuel assemblies based upon their fuel assembly classification. A qualified engineer using the procedure for nuclear fuel checks the fuel assembly classification for each assembly. An independent review by a qualified engineer assures the proper fuel assembly classification.

The above defined classification process is used before placement of fuel assemblies into the SFP. The process for placement of fuel assemblies within the pool is controlled by site procedures as described below.

When it is desired to move a fuel assembly to the SFP, the classification of that fuel assembly is checked. A qualified engineer then develops a nuclear fuel transfer report. The engineer checks the most recent inventory map, any restricted storage areas, and checks any outstanding transfer reports that have been performed after the last update to the map. The qualified engineer verifies that the cell where the fuel assembly will be stored is empty and that it is the correct cell. If a checkerboard loading pattern is required, then the qualified engineer verifies that the cells surrounding where the fuel assembly will be stored meet the checkerboard loading pattern requirements. The area that is designated to require a checkerboard pattern is classified as a checkerboard area and the empty spaces are administratively controlled. If required, the qualified engineer ensures assemblies are moved out of cells that are required to be empty of nuclear fuel prior to placing a fuel assembly in the checkerboard arrangement. The qualified engineer completes the transfer report.

The entire process for controlling the movement of fuel assemblies is independently reviewed by another qualified engineer. The Reactor Engineering Superintendent approves the transfer report and ensures that the transfer report has been independently reviewed. The transfer report is then sent to Operations for review.

Movement of fuel assemblies is performed by qualified fuel handling personnel. Prior to grappling and un-grappling a fuel assembly the qualified fuel handler verifies the fuel handling grapple or fuel assembly is over the correct location designated by the transfer report. These locations are independently verified prior to grappling and un-grappling the assembly. Upon completion of the nuclear fuel transfer report two qualified engineers then independently perform an inventory of the storage locations to verify that the nuclear fuel has been moved to the proper location. After the nuclear fuel location verification is complete, the inventory maps are updated along with the nuclear fuel location record.

As part of the standard implementation process for an approved TS change, the process and procedures described above will be modified to reflect the proposed loading restrictions for the different regions in the ANO-2 SFP.

3.5 Technical Specification Surveillance Requirements and Response

ANO-2 SR 4.9.10 requires monitoring of the SFP level. To satisfy this SR, the ANO-2 Operations staff monitors SFP level at least weekly using local indication at the SFP. The Operations staff is trained to monitor for unexpected deviations in their recorded readings and take appropriate actions to determine and correct the cause of the deviation as needed. In the unlikely event a decreasing trend is not appropriately observed a SFP low level annunciator, which alarms at two inches below normal pool level, is provided in the ANO-2 control room. Upon receipt of the alarm, an Operator is dispatched to the SFP to verify actual level and if level is dropping, actions are taken to makeup to the SFP. During fuel movement, the minimum SFP level can drop as much as 6 inches below normal pool level and still assure sufficient water level above the fuel is maintained for radiological shielding.

If the SFP level alarm malfunctioned with an inventory loss, it would take a long period of time for the SFP level to significantly drop (the SFP contains approximately 470 gallons of borated water per inch). Eventually, there would be an increase in radiation levels that would be detected by the SFP area radiation monitors, which are monitored by Operations personnel every 12 hours and alarm in the ANO-2 control room.

Additionally, the SFP boron concentration is sampled at least monthly as required by TS SR 4.9.12.c. If there were an unexpected downward trend in boron concentration, Operations would be notified to investigate the cause and take appropriate corrective actions.

3.6 SFP Structural Integrity

Spent fuel pool structural integrity is maintained in accordance with TS 3.7.12. The reinforcing steel in the walls of the SFP was erroneously terminated into the front face instead of the rear face of the adjoining walls during construction of the SFP. Therefore, the specific structural integrity inspections of the SFP are required to be performed to ensure that the pool remains safe for use and that it will adequately resist the imposed loading. The last inspection indicated there is no structural degradation.

3.7 Fuel Type

No fuel types other than Combustion Engineering or Westinghouse 16 x 16 fuel assemblies, including Next Generation Fuel (NGF), will be stored in the ANO-2 SFP. If different fuel types are used in the future, changes to the fuel assembly design, key fuel assembly mechanical features, and the changes in operating strategy will be evaluated under 10 CFR 50.59, *Changes, tests and experiments*.

4.0 TOPICAL REPORT AND COUPON SAMPLING PROGRAM

Entergy submitted to the Nuclear Regulatory Commission (NRC) by letter dated August 8, 2002, a topical report that supports the use of Metamic™ in SFP applications. The NRC approved Entergy's submittal by letter dated June 17, 2003. The topical report describes the manufacturing process, the material composition, the corrosion testing results, and the resistance of Metamic™ to radiation damage. The report also describes various coupon sampling programs that have been established at test facilities to monitor the physical and chemical property changes over time.

Although the conditions and limitations listed in the NRC Safety Evaluation (SE) are not explicitly referenced as conditions 1, 2, 3 and 4, for the sake of communication the conditions are broken out into separate line items below. Entergy's response to the conditions and limitations is as follows:

Condition 1 The staff conditions the use of the material [Metamic] upon a coupon sampling program to ensure consistent performance with that described in the Holtec report.

Entergy's Response

To ensure the physical and chemical properties of Metamic™ behave in a similar manner as that found at the test facilities, Entergy will establish a coupon sampling program which will be reflected in TS 6.5.17, Metamic Coupon Sampling Program. A new TS Surveillance Requirement (SR) 4.9.12.d will be created to direct the performance of the sampling program.

Condition 2 In addition, the staff requests that any application of this SE include a discussion of the following:

- Size and types of coupons to be used (i.e., similar in fabrication and layout as the proposed insert including welds and proximity to stainless steel);
- Technique for measuring the initial B_4C content of the coupons;
- Simulation of scratches on the coupons;
- Frequency of coupon sampling and its justification; and
- Tests to be performed on coupons (e.g., weight measurements, measurement of dimensions (length, width and thickness), and B_4C content); these tests should also address, as a minimum, any bubbling, blistering, cracking, flaking, or areal density changes of the coupons, any dose changes to the coupons, or the effects of any fluid movement and temperature fluctuations of the pool water.

Entergy's Response

Entergy will establish a coupon sampling program. The coupon measurement program is intended to monitor for the physical properties of the Metamic™ absorber material and thus provide a method of verifying that the assumptions used in the SFP criticality analyses remain valid.

The surveillance coupons will be approximately 4" x 8" and 0.106" thick, identical in composition and manufacturing process as the Metamic™ in the racks (i.e., created from the same manufacturing lot used to manufacture the Metamic™). The coupons will be mounted in stainless steel jackets simulating the actual insert design and held by a stainless steel coupon tree. The coupons are made from production runs and undergo the same cleaning process as the poison insert panels.

The coupon tree will have ten coupons. The coupon tree has been designed to be installed within a Region 2 storage cell selected by Reactor Engineering.

The coupons will be staggered and placed adjacent to the active fuel region where, based on the burnup profile, the localized burnup is greater than the assembly average burnup. This design will maximize the dose received by the coupons as compared to the Metamic™ racks and simulate the flow characteristics, pool chemistry, and differential metal interfaces that the Metamic™ racks will experience. No welding will be used on the Metamic™ as per the rack design.

The initial B_4C content of the surveillance coupons will be determined by the same chemical analysis technique used to establish the B_4C content of the Metamic™ in the rack. The B_4C used in the production of the Metamic™ was tested to determine the concentration of boron within each batch. The B_4C and aluminum matrix were accurately weighed and combined in a ratio to ensure the panels have a nominal B_4C content of 30.5 weight percent. Samples of the B_4C and aluminum mixture were then chemically tested to determine the B_4C concentration. Additional samples were taken of the final product, which were also chemically tested to confirm the concentration of B_4C in Metamic™. Representative samples of the batches used will undergo neutron attenuation or chemical testing to validate the B_{10} loading in the Metamic™ racks and coupons. The testing of the initial B_4C content in the Metamic™ racks and the Metamic™ coupons is performed under a Quality Assurance program using written procedures.

Scratches will be simulated by the mechanical etching or scribing the surface of the coupons. The scratches will be formed using hardened materials made out of carbon steel, stainless steel, and Metamic™. The scratches will not be cleaned after being applied to ensure an evaluation will be performed of the corrosion affects of leaving the trace material in a scratch.

The surveillance coupons will be removed and examined on a regular schedule to be established by TS 6.5.17. A different coupon will be removed each sample period. Coupons will be examined on a two year basis for the first three intervals and thereafter on a 4 to 5 year interval over the service life of the inserts. During the first six years, freshly discharged fuel assemblies will be placed on two sides of the coupon tree to ensure that the dose to the coupons is maximized. The initial two year period is based on providing sufficient exposure time to the environment such that any degradation would be observable. The sampled coupons may be returned to the pool and remounted on the tree at the discretion of the reviewing engineer.

The following table summarizes the sampling period for the Metamic™ coupon program. The number of coupons was based on testing the Metamic™ for at least 40 years from 2008, which bounds the current operating license for ANO-2. Even though there are a sufficient number of coupons to last the existing operating life of the plant, the coupons may be placed back on the coupon tree after evaluations have been completed at the discretion of the reviewing engineer. However, if the integrity of the coupon is compromised or if the contamination levels are extremely high, the coupon will not be returned to the coupon tree.

In general the Metamic™ coupon testing program is very similar to testing programs used on Boral™ surveillance coupon testing programs.

Sample Coupon Measurement Schedule

Coupon #	Years of Exposure in SFP	Sampling Period Years
1	2	2
2	4	2
3	6	2
4	10	4
5	15	5
6	20	5
7	25	5
8	30	5
9	35	5
10*	40	5

* When coupon #10 is removed, the accumulated exposure time will be 40 years; the expected lifetime of the poison insert panel.

Measurements to be performed at each inspection will be as follows:

- Physical observations of the surface appearance to detect pitting, swelling or other degradation,
- Length, width, and thickness measurements to monitor for bulging and swelling (Measurements will be taken in five procedurally defined locations prior to placing the coupons in the ANO-2 SFP. When the coupon is removed, measurements will be taken in the same locations as the original measurements.)
- Weight and density to monitor for material loss, and
- Neutron attenuation to confirm the B_{10} concentration or destructive chemical testing to determine the boron content.

The acceptance criterion for each of these parameters is as follows:

- Physical observation – visual examination and photography

  Upon receipt of a coupon for testing, the exposed coupon should be carefully examined and photographed to document the appearance of the coupon, noting any sign of degradation that may be observed. Special attention will be paid to any edge or corner defects and to any discoloration, swelling, or surface pitting that might exist.

- Dimensional measurements – length, width, and thickness

  Measurements on post-irradiated coupons will be made at the same approximate locations used for pre-irradiation characterization measurements and recorded. Length and width dimensions shall not exceed ± 0.125 inches when compared to the initial width or length.

  Thickness is used to monitor swelling and an increase in thickness at any point shall not exceed ± 0.01 inches of the initial thickness at that point.

- Weight and density

  The weight of each coupon should be obtained within ± 5% of the initial coupon weight.

- Neutron Attenuation

  Post-irradiated coupons that exhibit a decrease of no more than 5% in Boron-10 content, as determined by neutron attenuation or chemical analysis, is acceptable. This is the same as a requirement for no loss of boron within the accuracy of the measurement.

  Changes in excess of any acceptance criteria may require investigation and engineering evaluation which may include early retrieval and measurement of one or more of the remaining coupons to provide corroborative evidence that the indicated change(s) is real. If the deviation is determined to be real, an engineering evaluation shall be performed to identify further testing or any action that may be necessary.

Condition 3 In addition, applications for the use of Metamic™ should include a description of the anodizing process if anodized Metamic™ is used, and should include the cleaning technique to ensure sufficient removal of surface contaminants prior to installation.

Entergy's Response

Anodized Metamic™ will not be used.

The only instance in which the Metamic™ is mechanically cleaned using air blasting is after the billet is extruded into a "bloom" stock. After pressing and sintering a specified mixture of boron carbide and type 6061 aluminum powders, the sintered billet is extruded through a specially designed die. This extrusion process is the primary source of surface contamination as the very hard boron carbide powder gouges minute particles of steel (iron) from the extrusion die. These minute particles of iron must be removed from the bloom stock in order to avoid a possible source of corrosion (pitting). A small amount of the surface of the Metamic™ and surface impurities are removed by blasting with air containing finely-divided aluminum oxide powder or small glass beads. Air blasting is performed until a visually uniform luster (appearance) is observed over the entire panel (both sides) and the panel is free from the presence of inclusions or foreign material embedded in the surface. In the EPRI tests some pitting corrosion was observed in samples that had not been adequately cleaned of these foreign particles. Cleaning the bloom stock prior to rolling the final plates is expected to be adequate to reduce the surface contamination in the final panels to reasonable and acceptable levels.

After shearing and dimensional verification and immediately prior to packaging for shipment, the Metamic^{TM} panel is chemically cleaned by wiping the panel with a clean lint-free cloth wetted with dilute nitric acid solution. This is followed with wiping the panel using a clean lint-free cloth wetted with denatured alcohol or acetone.

Local areas may be cleaned chemically as described previously or mechanically using Scotch-Brite^{TM} or similar material. Both steps are followed with wiping the panel using a clean lint-free cloth wetted with denatured alcohol or acetone.

Condition 4 The staff also limits the use of this SE to a B_4C content of 31 wt% as evaluated and discussed in the Holtec report.

Entergy's Response

The Metamic^{TM} racks are designed with a nominal B_4C content of 30.5 wt%.

5.0 TECHNICAL ANALYSIS

5.1 Spent Fuel Pool Re-rack

The proposed change will result in installing new racks in Region 1. Unrestricted loading is proposed in the new Region 1 racks, in which credit for Metamic^{TM} will be taken. A loading pattern is proposed for Region 2. In addition, Entergy is proposing to increase the fuel assembly maximum U-235 enrichment. Attachments 5 and 6 to this letter provide detailed technical analyses in support of the proposed change. A brief summary of the content of the analysis contained in these attachments is included below.

Dose Consequences

The proposed modification will replace the existing Region 1 racks with new racks. The change does not increase the number of fuel assemblies that can be stored in the racks or the ANO-2 SFP.

The proposed change also includes an increase in the allowable U-235 fuel enrichment to 4.95 wt%. The current fuel handling accident dose analysis (see below) is based on an enrichment of 5.0 wt%. Therefore, the proposed change in fuel enrichment does not result in a change in the fuel handling accident (FHA) dose results.

The average fuel burnup limit is restricted by an ANO-2 Operating License condition that states: "Entergy Operations is authorized to operate the facility with an individual rod average fuel burnup (burnup averaged over the length of a fuel rod) not to exceed 60 megawatt-days/kilogram of uranium." No change is proposed to the burnup limit.

The impact on dose rates associated with the new rack design is minimal.

The dose rate at the surface of the pool from direct radiation is typically not affected unless the allowable burnup of the fuel being stored has increased. The allowable burnup of the fuel being stored has not increased.

Increasing storage capacity or adding racks to an area of the pool previously unoccupied can have an effect by changing the local dose rate above the pool. The storage capacity of the spent fuel pool is unchanged and the new replacement racks will occupy approximately the same area of the spent fuel pool. Additionally, the critical parameters of the new replacement racks (i.e., center-to-center spacing (pitch) and cell inner diameter) are preserved in the new design.

Dose rates above the pool from radionuclides in the water are typically governed by the clean-up systems associated with the pool and not the number of assemblies in the pool or the type of racks. There are no changes proposed to the spent fuel purification system.

The proposed modification does not impact the pool water level that provides shielding to ensure that the pool surface dose rate remains below 5 mrem/hr. The dose rate from a fuel assembly in transit is therefore unchanged.

The calculated gamma dose rate through the wall of the spent fuel pool is a result of the radioactive decay from the fuel. Current calculations very conservatively estimate this dose rate to be 5.5 mrem/hr at 100 hours cooling in the most active fuel region. The actual dose rates through the wall have been demonstrated to be lower than this value and are determined periodically, or as needed. Stay times are appropriately determined, if necessary. If a general area dose rate is found to be higher than expected, the site can re-categorize an area/room as needed, including updates to the radiation maps in the FSAR, if required.

Fuel Handling Accident Dose Analysis

The current license basis for the potential offsite and control room dose radiological consequences of a Fuel Handling Accident (FHA) was performed considering a maximum U-235 enrichment of 5.0 wt%.

A FHA is a postulated accident involving damage to an irradiated fuel assembly during refueling. Two possibilities exist for this accident: mechanical damage resulting in a release of activity and/or a criticality accident. Section 4 of Attachment 5 prepared by Holtec International addresses the criticality aspects of the FHA. The dose consequences associated with a FHA, which (see ANO-2 SAR 15.1.23 for additional information) were calculated assuming a maximum burnup of 65 megawatt-days/kilograms of uranium, resulted in the following:

	Exclusion Area Boundary Without Filtration (rem)	25% of 10 CFR 100 Limits (rem)
Whole Body	0.1	6.25
Skin (1)	.38	6.25 (2)
Thyroid	53	75

(1) The total skin dose that is reported is the skin dose resulting from gamma radiation plus that resulting from beta radiation.

(2) 10 CFR 20.1201 (a)(2)(ii) limits the shallow dose equivalent of 50 rem to the skin of the whole body or to the skin of any extremity.

From the information provided above, it can be seen that the dose consequences result in only a small fraction of the 25% of 10 CFR 100 and the 10 CFR 20.1201 limits.

Material Considerations

It is proposed that Metamic™ will be inserted in the new Region 1 racks. The physical and chemical properties of Metamic™ were included in the topical report that supports the use of Metamic™ in SFP applications.

Criticality Considerations

A criticality safety evaluation was performed for storage of fresh and spent fuel in the ANO-2 SFP. The evaluation considered two regions that are designated as Region 1 and Region 2. Peripheral cell locations were also considered. In the new analyses, credit was taken for the Metamic™ in Region 1. It was concluded that in order to assure keff remains less than 0.95 for the allowable storage configuration for both spent fuel and fresh fuel assemblies, a minimum soluble boron concentration is required. The boron concentrations for each region determined by the analyses to assure K_{eff} remains below 0.95 are bounded by the TS required boron concentration. The fuel loading patterns are defined by the criticality safety evaluation included in the proposed changes and will be governed, as they are now, by procedure.

The criticality analyses also include consideration for storage of fuel assemblies with a maximum U-235 enrichment of 4.95 wt%. Analyses were performed for the new fuel storage racks and the SFP racks considering storage of the higher U-235 enrichment.

Thermal Hydraulic Considerations

A thermal hydraulic analysis conservatively demonstrated that natural circulation of the pool water for the proposed configuration provides adequate cooling of all fuel assemblies in the event of a loss of external cooling. Additionally, corrective actions can be taken prior to SFP boiling. The analysis also demonstrated that fuel cladding will not be subjected to departure from nucleate boiling under the postulated accident scenario of the loss of all SFP cooling and that cladding integrity would be maintained. None of the temperature limits or corrective actions for the SFP cooling system will be changed.

Mechanical Accident

In line with the current approved philosophies, the postulated fuel assembly drop and the misloaded spent fuel and fresh fuel events were evaluated. A boron concentration of 881 ppm assures k_{eff} will remain less than 0.95 if any of these postulated accidents were to occur.

In addition, an analysis was performed to evaluate a postulated fuel assembly drop or misloaded spent fuel or fresh fuel event during fuel handing operations. The accidental drop or misplaced fresh fuel assembly next to two assemblies in the fuel upender is the bounding accident scenario. In this event, a boron concentration of 1000 ppm assures k_{eff} will remain less than 0.95.

The current ANO-2 TS boron concentration assures k_{eff} will remain less than 0.95.

Structural/Seismic Analysis

A structural analysis of the new Region 1 spent fuel rack was considered for all applicable loading configurations and all potentially governing conditions. The analysis evaluated normal, seismic, and accident conditions. The evaluations demonstrate satisfactory margins of safety in all storage racks.

The structural integrity of the new Region 1 racks under normal and seismic conditions is essential to maintaining the assumptions of the criticality analysis. The rack design has been evaluated for normal and seismic conditions and all safety factors are greater than 1.0.

SFP Structural Integrity for Increased Loads from SFP Racks

An evaluation of the SFP structural integrity for the effects of the new SFP racks was performed. The evaluation demonstrated that the structural integrity of the pool structure is maintained.

5.2 Dry Cask Loading Activities While Cask is in the Spent Fuel Pool (Deletion of TS 3.9.12.d, SR 4.9.12.d and Figure 3.9-1)

Specification 3.9.12.d, associated Figure 3.9-1 and SR 4.9.12.d were added to the ANO-2 TSs to address concerns identified in Regulatory Issue Summary (RIS) 2005-05, *Regulatory Issues Regarding Criticality Analyses for Spent Fuel Pools and Independent Spent Fuel Storage Installations*. The RIS expressed an expectation that a license amendment request be submitted to add a TS to the site's Part 50 license restricting the minimum burnup of fuel assemblies loaded in dry casks in accordance with the criticality analysis guidance contained in 10 CFR 50.68. On January 30, 2007, a new revision to 10 CFR 50.68 became effective. The revision added paragraph (c) which states that the requirements in 10 CFR 50.68(b) do not apply to the fuel located within a dry cask when the dry cask is in the spent fuel pool. Therefore, TS 3.9.12d, SR 4.9.12d, and associated Figure 3.9-1 will be deleted.

6.0 REMOVAL AND INSTALLATION OF REGION 1 RACKS

During removal and installation of the fuel storage racks in Region 1 of the ANO-2 SFP, work will be controlled and performed in strict accordance with specific written guidance. Any movement of fuel assemblies required to support removal or installation of the racks will be performed during normal SFP fuel movement activities as described in Section 3.4 of this attachment. Dry cask storage activities will be suspended during the rack removal and installation period. Safe load paths will be determined and written procedures followed to ensure that the racks are not carried over any fuel assemblies. With the proposed limitations on rack and cask movement, there should be no impact to spent fuel and no radiological consequences due to fuel rack installation.

Lifting and transferring the racks to and from the ANO train bay to a laydown area in the vicinity of the SFP will be performed by the L3 fuel handling crane in conjunction with a designated special lifting device. This transfer is conducted in accordance with the procedure for the control of heavy loads. The control of heavy loads procedure implements the requirements of NUREG-0612, *Control of Heavy Loads at Nuclear Power Plants,* and ensures safe load paths and proper heavy load handling practices are observed during the removal and installation of the racks.

The L3 crane is a 130-ton capacity single failure proof bridge crane designed to NUREG-0554, *Single Failure Proof Cranes for Nuclear Power Plants.* The L3 crane handles the spent fuel shipping cask in the Unit 1 and 2 auxiliary buildings. The L3 crane transports the spent fuel cask to and from the rail car located in the train bay at Elevation 354' and to the Unit 1 and Unit 2 cask loading pits. ANO-2 SAR Table 9.1-10 provides site specific information regarding compliance with Ederer's Generic Topical Report for single-failure-proof cranes. The designated special lifting device (rigging) is designed to meet the criteria of ANSI N14.6-1993 and NUREG-0612-1980 in order to be operated without redundant links between the L3 crane and the lifted rack.

Because the L3 crane is single failure proof, dropping of the racks during installation is not postulated and therefore, any affect on plant operation as described in ANO-2 SAR Section 15.1.23, Fuel Handling Accidents, is not anticipated to occur.

Installation / Implementation Plan

Due to the current loading restrictions, it may be possible to offload the fuel from only two of the existing (Boraflex™) Region 1 racks instead of all three racks. If this is the case, the following sequence will occur during the Technical Specification implementation period:

- Off load fuel from two Boraflex™ racks
- Remove two Boraflex™ racks
- Install one Metamic™ rack
- Transfer fuel from remaining Boraflex™ rack to new Metamic™ rack, taking credit for Metamic™ and therefore partially implementing the Technical Specification addressed in this application.
- Remove the remaining Boraflex™ rack
- Install two Metamic™ racks
- Transfer fuel as necessary to comply with the loading restrictions addressed in this license amendment request. Loading restrictions for Region 1 will credit Metamic™ as addressed in this license amendment request.

If all three Boraflex™ racks can be offloaded, the following sequence will occur during the Technical Specification implementation period:

- Off load fuel from three Boraflex™ racks
- Remove three Boraflex™ racks
- Install three Metamic™ racks
- Transfer fuel as necessary to comply with the loading restrictions addressed in this license amendment request. Loading restrictions for Region 1 will credit Metamic™ as addressed in this license amendment request.

7.0 REGULATORY ANALYSIS

7.1 Applicable Regulatory Requirements/Criteria

The proposed changes have been evaluated to determine whether applicable regulations and requirements continue to be met.

Spent Fuel Pool Partial Re-rack

A change is proposed to modify the Arkansas Nuclear One, Unit 2 (ANO-2) Spent Fuel Pool (SFP) Region 1 racks that will result in replacing the existing racks with new racks that contain Metamic™ poison material for reactivity control. The proposed change also introduces new loading restrictions. And finally, the proposed change increases fuel enrichment to 4.95 weight percent uranium-235.

ANO-2 is currently in full compliance with 10 CFR 50.68 paragraph (b).

The dose consequences associated with increasing the fuel enrichment is bounded by the current licensing basis and is a small fraction of the 25% of 10 CFR 100 limits.

Entergy has determined that the proposed changes do not require any exemptions or relief from regulatory requirements, other than the TS, and do not affect conformance with General Design Criteria (GDC) 61, *Fuel storage and handling and radioactivity control*, or GDC 62, *Prevention of criticality in fuel storage and handing*, differently than described in the ANO-2 Safety Analysis Report.

Dry Cask Loading Activities While Cask is in the Spent Fuel Pool

In accordance with 10 CFR 50.68, *Criticality accident requirements*, paragraph (c), while a spent fuel storage cask approved under 10 CFR Part 72 is in the spent fuel pool: 1) the requirements of 10 CFR 50.68(b) do not apply to the fuel located within the cask; and 2) the requirements of 10 CFR 50.72 and the requirements of the Certificate of Compliance for the cask apply to the fuel within the cask. Therefore, the deletion of the associated TS, Figure and surveillance requirement is consistent with the allowances in 10 CFR 50.68.

7.2 No Significant Hazards Consideration

The proposed changes will modify the Arkansas Nuclear One, Unit 2 (ANO-2) Technical Specifications (TSs) related to spent fuel storage and uranium-235 (U-235) fuel assembly enrichment.

A plant modification is proposed to remove the existing Boraflex™ racks from the ANO-2 spent fuel pool (SFP) and install new racks that contain Metamic™ as a neutron absorber. With the installation of the new racks, two regions (designated as Regions 1 and 2) will be established in the ANO-2 SFP. The Region 2 racks will not contain fixed neutron absorbers. No loading restrictions are proposed for the new Region 1 racks. Specific loading restrictions, which are included in the proposed TS change, will be imposed in Region 2 based on assembly minimum burnup at varying initial assembly U-235 enrichment and cooling time.

To support the use of Metamic™ as a neutron absorber, a coupon sampling program will be added.

Entergy also proposes to increase the SFP boron concentration that is credited to assure a five percent subcriticality margin is maintained during normal conditions. The allowance to credit boron is consistent with 10 CFR 50.68, *Criticality accident requirements*.

To accommodate future reactor core loading flexibility, Entergy is also proposing to increase the allowable U-235 fuel assembly enrichment to a maximum of 4.95 weight percent (wt%).

Based on the NRC's recent change to 10 CFR 50.68 a change is also proposed to delete the cask loading requirements that were included in the ANO-2 Technical Specifications.

Entergy Operations, Inc. has evaluated whether or not a significant hazards consideration is involved with the proposed amendment by focusing on the three standards set forth in 10 CFR 50.92, "Issuance of amendment," as discussed below:

1. Does the proposed change involve a significant increase in the probability or consequences of an accident previously evaluated?

   Response: No.

   Fuel Handling Accidents

   The current licensing bases for the dose consequences associated with a fuel handling accident (FHA), which was performed considering a maximum U-235 enrichment of 5.0 wt% and a maximum burnup of 65 megawatt-days/kilograms of uranium, does not exceed 25% of 10 CFR 100 limits. The proposed change is bounded by the current analysis and therefore, there is no increase in the dose consequences associated with a FHA.

   During rack removal and installation, safe load paths will be determined and written procedures followed to ensure that the racks are not carried over any fuel assemblies. With the proposed limitations on rack and cask movement, there should be no impact to spent fuel and no radiological consequences due to fuel rack installation. The racks will be moved with a single failure proof crane. Therefore, a postulated drop of a rack is not a credible accident.

   The probability of having a FHA has not increased.

   Criticality Accidents associated with a Dropped Fuel Assembly

   The three fuel assembly drop accidents described below can be postulated to increase reactivity. However, for these accident conditions, the double contingency principle of ANS N16.1-1975 is applied. This states that it is unnecessary to assume two unlikely, independent, concurrent events to ensure protection against a criticality accident. Thus, for accident conditions, the presence of soluble boron in the storage pool water can be assumed as a realistic initial condition since its absence would be a second unlikely event.

Three types of drop accidents have been considered: a vertical drop accident, a horizontal drop accident, and an inadvertent drop of an assembly between the outside periphery of the rack and the pool wall. The structural damage to the pool liner, the racks, and fuel assembly resulting from a dropped fuel assembly striking the rack, the pool floor, or another assembly located in the racks is primarily dependent on the mass of the falling object, drop height, and structural configuration of the rack. The two parameters related to the fuel assembly (mass and drop height) are not changed by the proposed rack modification. The new rack design was evaluated for all postulated structural drops and the structural damage to these items remains within acceptable limits. In all cases the proposed TS limit for boron concentration ensures that a five percent subcriticality margin is met for the postulated accidents.

Criticality Accidents associated with a Misplaced Fuel Assembly

The fuel assembly misplacement accident was considered for all storage configurations. An assembly with high reactivity is assumed to be placed in a storage location which requires restricted storage based on initial U-235 loading, cooling time, and burnup. The presence of boron in the pool water assumed in the analysis has been shown to offset the worst case reactivity effect of a misplaced fuel assembly for any configuration. This boron requirement is less than the boron concentration required by the ANO-2 TS. Thus, a five percent subcriticality margin is met for postulated accidents, since any reactivity increase will be much less than the negative worth of the dissolved boron.

Optimum Moderation Accident

For fuel storage applications in the SFP, water is usually present. An "optimum moderation" accident is not a concern in SFP storage racks because the rack design prevents the preferential reduction of water density between the cells of a rack (e.g., boiling between cells). In addition, the criticality analysis has demonstrated that the effective neutron multiplication factor (K_{eff}) will remain less than 1.0 when the SFP is fully flooded with unborated water.

An "optimum moderation" accident in the new fuel vault was evaluated and the conclusions of that evaluation confirmed that the reactivity effect is less than the regulatory limit of 0.98 for K_{eff}.

Loss of SFP Cooling

The proposed modification to the ANO-2 SFP racks does not result in a change to the SFP cooling system and therefore the probability of a loss of SFP cooling is not increased.

The consequences of a loss of spent fuel pool cooling were evaluated and found to not involve a significant increase as a result of the proposed changes. A thermal-hydraulic evaluation for the loss of SFP cooling was performed. The analysis determined that the minimum time to boil is about two hours following a complete core off load and a complete loss of forced cooling. This provides sufficient time for the operators to restore cooling or establish an alternate means of cooling before the water shielding above the top of the racks falls below 10 feet. Therefore, the proposed change represents no increase in the consequences of loss of pool cooling.

Seismic Event

The proposed rack modification does not result in an increase in the probability or consequences of a design basis seismic event. The new racks were analyzed and all structural acceptance criteria are shown to be met during seismic events. The structural capability of the SFP and liner will not be exceeded as a result of the new rack design.

Therefore, the proposed change does not involve a significant increase in the probability or consequences of an accident previously evaluated.

2. Does the proposed change create the possibility of a new or different kind of accident from any accident previously evaluated?

   Response: No.

   The presence of soluble boron in the pool water assumed in the criticality analysis is less than the boron concentration required by the ANO-2 TSs. Thus, a five percent subcriticality margin is met for postulated accidents, since any reactivity increase will be much less than the negative worth of the dissolved boron.

   No new or different types of fuel assembly drop scenarios are created by the proposed change. During the installation of the new racks, the possibility of dropping a rack is not a credible accident since a single failure proof crane and safe load paths will be used for rack movements. No new or different fuel assembly misplacement accidents will be created. Administrative controls currently exist to assist in assuring fuel misplacement does not occur.

   No changes are proposed to the spent fuel pool cooling system or makeup systems and therefore no new accidents are considered related to the loss of cooling or makeup capability.

   Therefore, the proposed change does not create the possibility of a new or different kind of accident from any previously evaluated.

3. Does the proposed change involve a significant reduction in a margin of safety?

   Response: No.

   With the presence of a nominal boron concentration, the SFP storage racks will be designed to assure a subcritical array with a five percent subcritical margin (95% probability at the 95 % confidence level). This has been verified by criticality analyses.

   Credit for soluble boron in the SFP water is permitted under accident conditions. The proposed modification that will allow installation of the new racks does not result in the potential of any new misplacement scenarios. Criticality analyses have been performed to determine the required boron concentration that would ensure the maximum K_{eff} does not exceed 0.95. The ANO-2 TS for the minimum SFP boron concentration is greater than that required to ensure K_{eff} remains below 0.95. Therefore, the margin of safety defined by taking credit for soluble boron will be maintained.

The structural analysis of the new spent fuel racks along with the evaluation of the SFP structure indicated that the integrity of these structures will be maintained. The structural requirements were shown to be satisfied, thus the safety margins were maintained.

In addition the proposed change includes a coupon sampling program that will monitor the physical properties of the Metamic™ absorber material. The monitoring program provides a method of verifying that the assumptions used in the SFP criticality analyses remain valid.

Therefore, the proposed change does not involve a significant reduction in a margin of safety.

Based on the above, Entergy concludes that the proposed amendment presents no significant hazards consideration under the standards set forth in 10 CFR 50.92(c), and, accordingly, a finding of "no significant hazards consideration" is justified.

7.3 Environmental Considerations

The proposed amendment does not involve (i) a significant hazards consideration, (ii) a significant change in the types or significant increase in the amounts of any effluent that may be released offsite, or (iii) a significant increase in individual or cumulative occupational radiation exposure. Accordingly, the proposed amendment meets the eligibility criterion for categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the proposed amendment.

Attachment 2

2CAN030706

Proposed Technical Specification Changes (mark-up)

REFUELING OPERATIONS

FUEL STORAGE

LIMITING CONDITION FOR OPERATION

3.9.12.a Storage in the spent fuel pool shall be restricted to fuel assemblies having initial enrichment less than or equal to ~~4.55 ± 0.05~~4.95 w/o U-235. The provisions of Specification 3.0.3 are not applicable.

3.9.12.b Storage in the spent fuel pool shall be further restricted by the limits specified in ~~Figure 3.9.2~~Table 3.9-1. The provisions of Specification 3.0.3 are not applicable.

3.9.12.c The boron concentration in the spent fuel pool shall be maintained (at all times) at greater than 2000 parts per million.

~~3.9.12.d Storage in the MPC-32 shall be further restricted by the limits specified in Figure 3.9-1. The provisions of Specification 3.0.3 are not applicable.~~

APPLICABILITY: During storage of fuel in the spent fuel pool

ACTION:

Suspend all actions involving the movement of fuel in the spent fuel pool if it is determined a fuel assembly has been placed in an incorrect location until such time as the correct storage location is determined. Move the assembly to its correct location before resumption of any other fuel movement.

Suspend all actions involving the movement of fuel in the spent fuel pool if it is determined the pool boron concentration is less than 2001 ppm, until such time as the boron concentration is increased to 2001 ppm or greater.

SURVEILLANCE REQUIREMENTS

4.9.12.a Verify all fuel assemblies to be placed in the spent fuel pool have an initial enrichment of less than or equal to ~~4.55 ± 0.05~~ 4.95 w/o U-235 by checking the assemblies' design documentation.

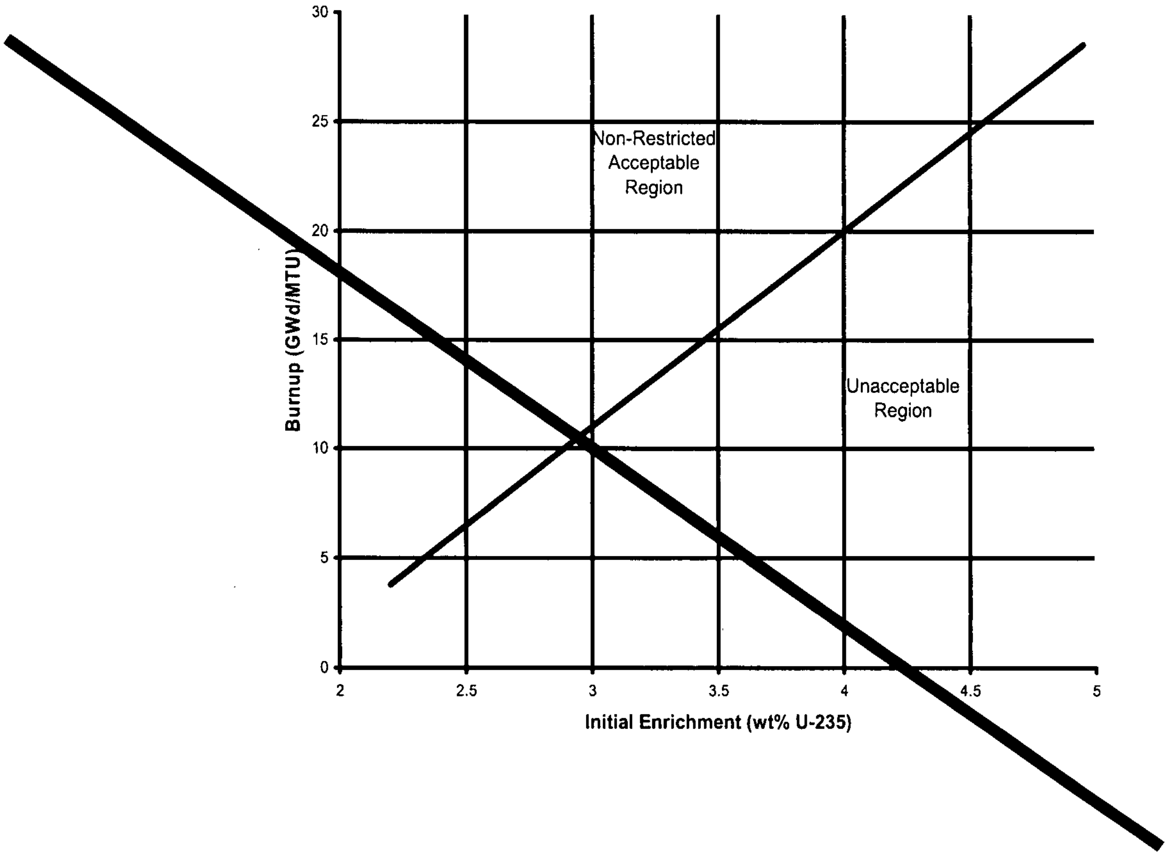
4.9.12.b Verify all fuel assemblies to be placed in the spent fuel pool are within the limits of ~~Figure 3.9.2~~ Table 3.9-1 by checking the assemblies' design and burnup documentation.

4.9.12.c Verify at least once per 31 days the spent fuel pool boron concentration is greater than 2000 ppm.

4.9.12.d Verify Metamic properties are in accordance with, and are maintained within the limits of, the Metamic Coupon Sampling Program. ~~Verify all fuel assemblies to be placed in a storage cask are within the limits of Figure 3.9-1 by checking the assemblies' design and burnup documentation~~

~~**Figure 3.9-1**~~

~~**Loading Restrictions for MPC-32**~~



Insert 1

Figure 3.9-2

~~Pattern 1~~

~~BC~~	~~BC~~
~~BC~~	~~BC~~

~~Pattern 2~~

~~F~~	~~X~~
~~X~~	~~F~~

~~Pattern 3~~

~~F~~	~~CC~~
~~CC~~	~~CC~~

~~Pattern 4~~

~~Fc~~	~~C~~
~~C~~	~~Fc~~

~~Pattern 5~~

~~B~~	~~C~~
~~C~~	~~C~~

~~Legend:~~

~~1.~~ ~~Type "F" –~~ ~~fresh fuel assemblies with an initial enrichment less than or equal to 4.55 ± 0.05 wt%.~~

~~2.~~ ~~Type "B" –~~ ~~an assembly with a maximum initial enrichment of 4.1 wt%, a minimum burnup of 11.3 GWD/MTU and zero years cooling time. Typically "B" type assemblies have only one cycle of burnup.~~

~~3.~~ ~~"Fc" –~~ ~~fresh fuel assemblies with an initial enrichment of less than or equal to 4.55 ± 0.05 wt% with a CEA inserted. The CEA must be of the new design.~~

~~4.~~ ~~"A" –~~ ~~an assembly that meets specific burnup requirements that are included in Table 1 below.~~

~~5.~~ ~~"BC" –~~ ~~a "B" type assembly with a CEA inserted. This CEA may be of the old or new design.~~

~~6.~~ ~~"C" –~~ ~~a high burnup assembly that meets specific burnup requirements that are included in Table 2 below. Initial enrichment is less than or equal to 4.50±0.05 wt%.~~

~~7.~~ ~~"AC" –~~ ~~an "A" type assembly with a CEA inserted. This CEA may be of the old or new design.~~

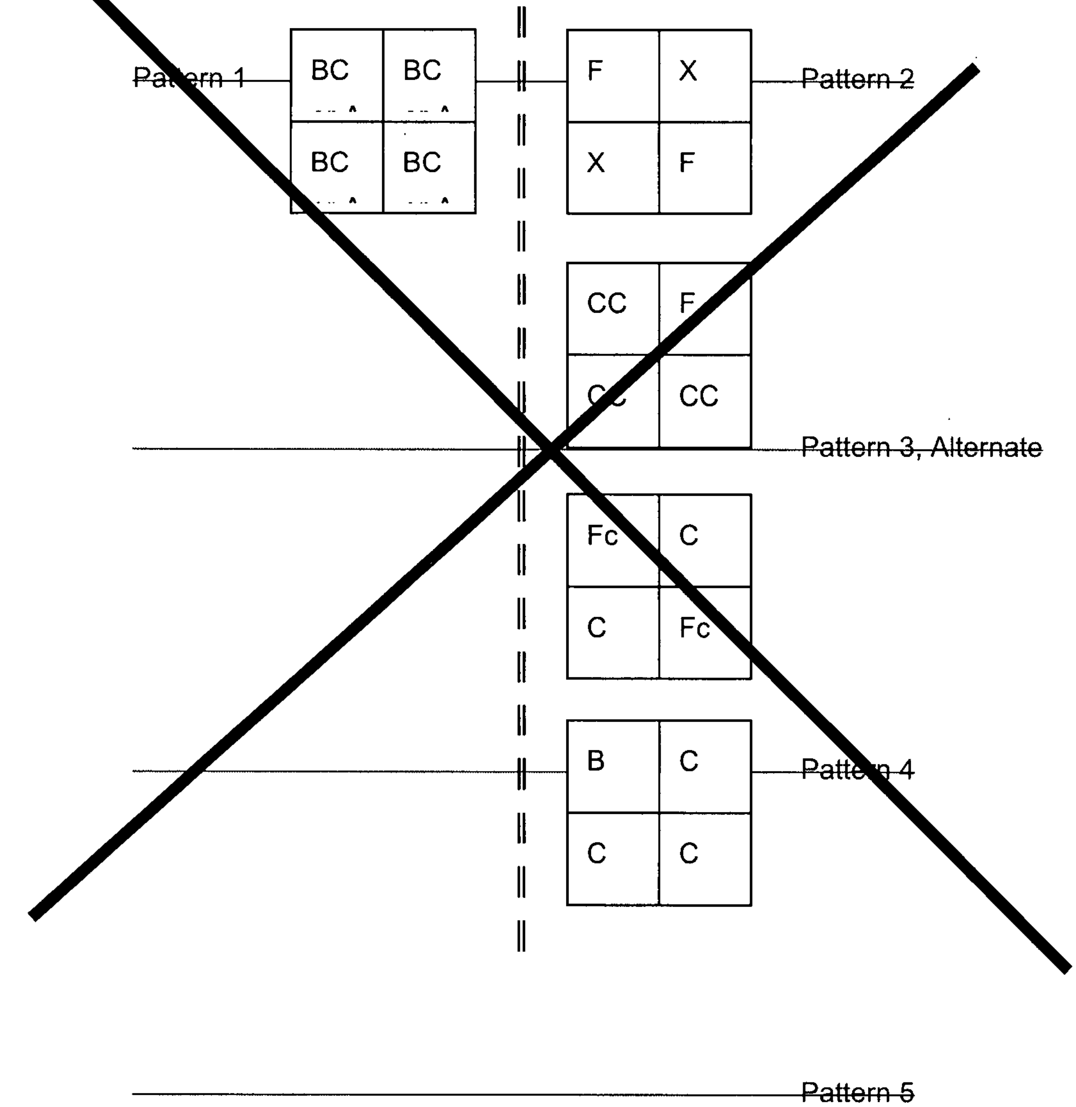
~~8.~~ ~~"CC" –~~ ~~a "C" type assembly with a CEA inserted. This CEA may be of the old or new design. Initial enrichment is less than or equal to 4.50 ± 0.05 wt%.~~

~~9.~~ ~~"X" –~~ ~~a water cell with no fuel.~~

~~Note: Any less restrictive assembly may be substituted for another assembly within the pattern. Fuel assembly types are ranked 1 through 9, with the highest reactivity ranking being 1.~~

~~Figure 3.9-2~~

~~Allowable Pattern Interfaces~~



~~Figure 3.9-2~~

~~Allowable Pattern Interfaces~~

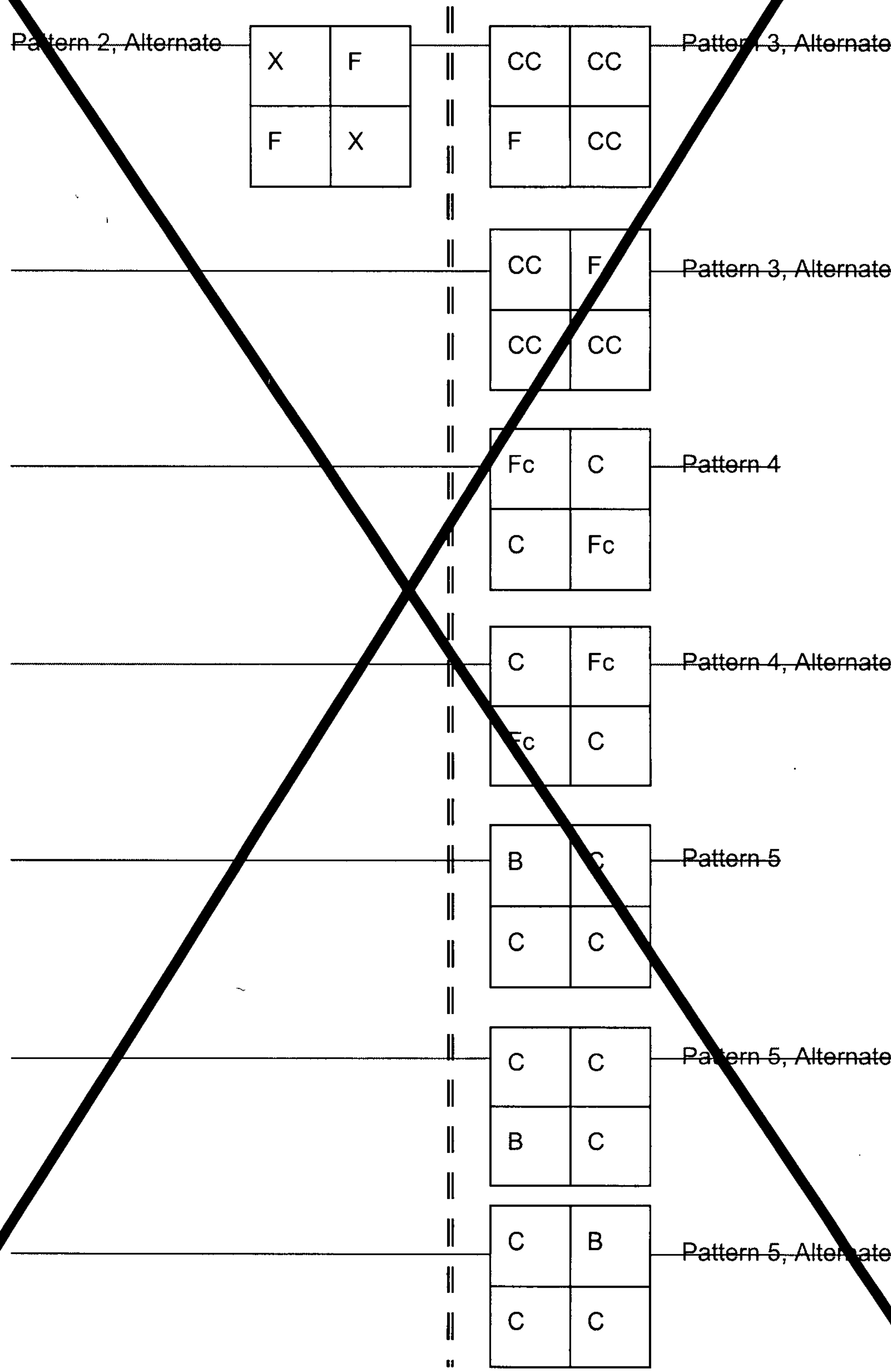
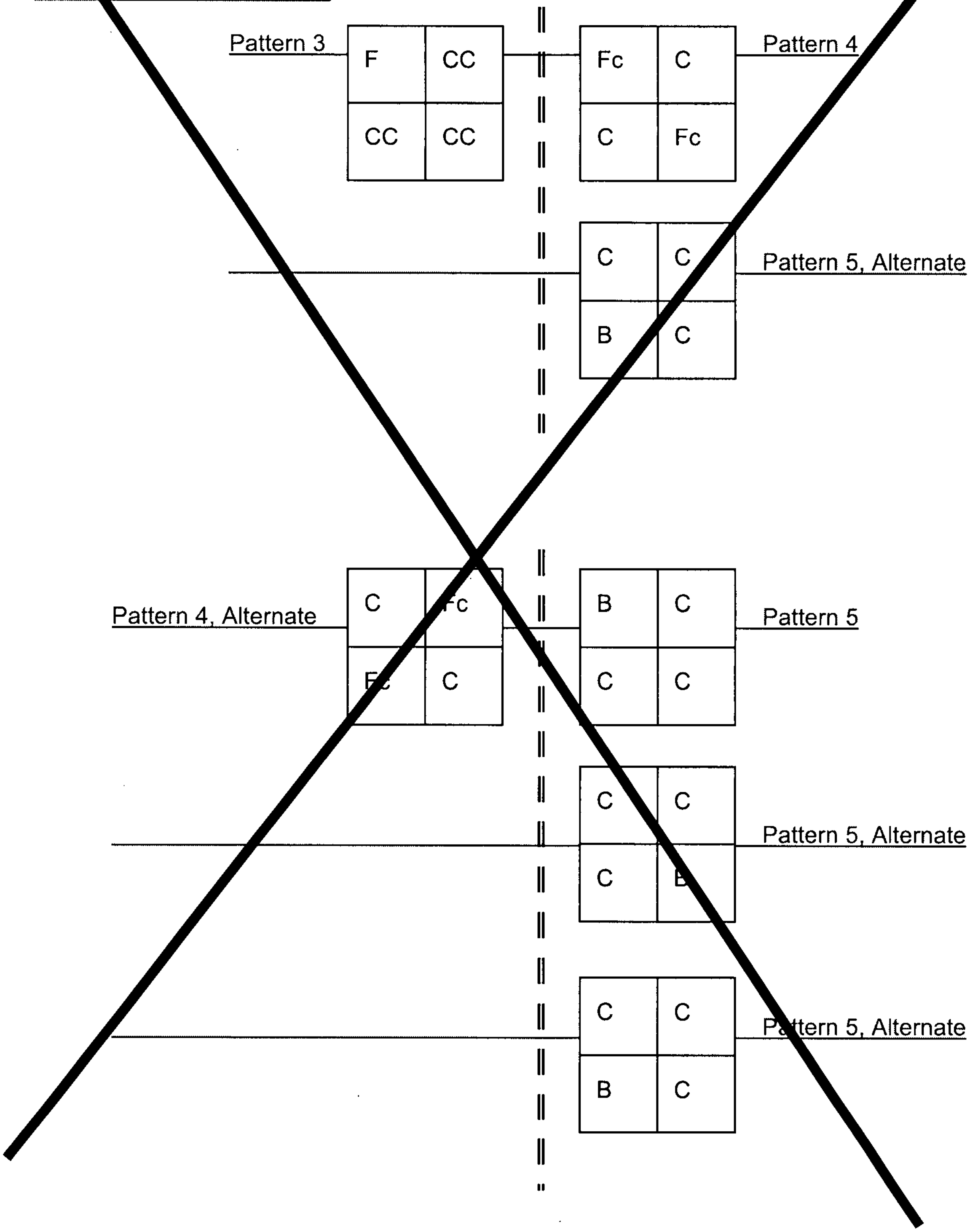


Figure 3.9-2

Allowable Pattern Interfaces



~~Figure 3.9-2~~

~~Table 1~~
~~Minimum Burnup Requirements for "A" Assemblies at~~
~~Varying Enrichment and Cooling Time~~

~~BURNUP, MWD/KgU~~					
~~Average Enrichment, wt% U-235~~	~~0 Years Cooling Time~~	~~5 Years Cooling Time~~	~~10 Years Cooling Time~~	~~15 Years Cooling Time~~	~~20 Years Cooling Time~~
~~2~~	~~7.56~~	~~7.56~~	~~7.56~~	~~7.56~~	~~7.56~~
~~2.5~~	~~14.94~~	~~14.21~~	~~13.47~~	~~12.74~~	~~12.00~~
~~3.0~~	~~21.30~~	~~20.30~~	~~19.30~~	~~18.30~~	~~17.30~~
~~3.5~~	~~27.10~~	~~25.95~~	~~24.80~~	~~23.65~~	~~22.50~~
~~4.0~~	~~32.67~~	~~31.38~~	~~30.09~~	~~28.79~~	~~27.50~~
~~4.5~~	~~39.30~~	~~37.73~~	~~36.15~~	~~34.58~~	~~33.00~~
~~4.95~~	~~45.00~~	~~43.33~~	~~41.65~~	~~39.98~~	~~38.30~~

~~Table 1-1~~

~~Bounding Polynomial Fits to Determine Minimum Acceptable Burnup~~
~~for "A" Type Assemblies~~
~~Storage as a Function of Initial Enrichment~~

~~Decay Time, Years~~	~~Burnup, MWD/KgU~~
~~0~~	$\cancel{0.68 * E^3 - 7.449 * E^2 + 38.56 * E - 45.20}$
~~5~~	$\cancel{0.5489 * E^3 - 5.9344 * E^2 + 32.496 * E - 38.05}$
~~10~~	$\cancel{0.4153 * E^3 - 4.3948 * E^2 + 26.356 * E - 30.75}$
~~15~~	$\cancel{0.2867 * E^3 - 2.9045 * E^2 + 20.367 * E - 23.80}$
~~20~~	$\cancel{0.153 * E^3 - 1.3649 * E^2 + 14.227 * E - 16.60}$

~~Note: E = Initial average enrichment in wt% U-235~~

~~Figure 3.9-2~~

~~Table 2~~
~~Minimum Burnup Requirements for "C" Assemblies at Varying Enrichment and Cooling Time~~

~~BURNUP, MWD/KgU~~					
~~Average Enrichment, wt% U-235~~	~~0 Years Cooling Time~~	~~5 Years Cooling Time~~	~~10 Years Cooling Time~~	~~15 Years Cooling Time~~	~~20 Years Cooling Time~~
~~2~~	~~17.00~~	~~15.00~~	~~14.00~~	~~13.30~~	~~13.00~~
~~2.5~~	~~25.00~~	~~22.00~~	~~21.00~~	~~20.30~~	~~20.00~~
~~3.0~~	~~32.00~~	~~29.00~~	~~27.00~~	~~26.00~~	~~25.00~~
~~3.5~~	~~37.00~~	~~35.00~~	~~32.50~~	~~31.00~~	~~30.00~~
~~4.0~~	~~43.00~~	~~40.00~~	~~39.00~~	~~38.00~~	~~37.00~~
~~4.5~~	~~49.75~~	~~46.00~~	~~45.00~~	~~44.00~~	~~43.00~~

~~Table 2-1~~

~~Bounding Polynomial Fits to Determine Minimum Acceptable Burnup for "C" Type Assemblies Storage as a Function of Initial Enrichment~~

~~Decay Time, Years~~	~~Burnup, MWD/KgU~~
~~0~~	$\cancel{1.3148 * E^3 - 13.552 * E^2 + 57.491 * E - 53.6}$
~~5~~	$\cancel{0.3704 * E^3 - 4.5397 * E^2 + 29.59 * E - 28.8}$
~~10~~	$\cancel{0.6667 * E^3 - 6.5714 * E^2 + 32.976 * E - 30.3}$
~~15~~	$\cancel{0.7111 * E^3 - 6.919 * E^2 + 33.634 * E - 31.3}$
~~20~~	$\cancel{0.8148 * E^3 - 7.7302 * E^2 + 35.169 * E - 32.0}$

~~Note: E = Initial average enrichment in wt% U-235~~

5.3 Fuel Storage

5.3.1 Spent Fuel Storage Rack Criticality

The spent fuel storage racks are designed and shall be maintained with:

a. Fuel assemblies stored in the spent fuel pool in accordance with Specification 3.9.12;

b. $k_{eff} \leq 0.95$ if fully flooded with ~~240~~ 452 ppm borated water, which includes an allowance for uncertainties as described in Section 9.1 of the SAR; and

c. $k_{eff} < 1.0$ if fully flooded with unborated water, which includes an allowance for uncertainties as described in Section 9.1 of the SAR; and

d. A nominal 9.8 inch center to center distance between fuel assemblies placed in the storage racks.

5.3.2 New Fuel Storage Rack Criticality

The new fuel storage racks are designed and shall be maintained with:

a. Fuel assemblies having a maximum U-235 enrichment of ~~4.55 ± 0.05~~4.95 weight percent;

b. $k_{eff} \leq 0.95$ if fully flooded with unborated water, which includes an allowance for uncertainties as described in Section 9.1 of the SAR;

c. $k_{eff} \leq 0.98$ if moderated by aqueous foam, which includes an allowance for uncertainties as described in Section 9.1 of the SAR; and

d. A nominal 26 inch center to center distance between fuel assemblies placed in the storage racks.

5.3.3 Drainage

The spent fuel storage pool is designed and shall be maintained to prevent inadvertent draining of the pool below elevation 399' 10½".

5.3.4 Capacity

The spent fuel storage pool is designed and shall be maintained with a storage capacity limited to no more than 988 fuel assemblies.

6.5.17 Metamic Coupon Sampling Program

A coupon surveillance program will be implemented to maintain surveillance of the Metamic absorber material under the radiation, chemical, and thermal environment of the SFP. The purpose of the program is to establish the following:

- Coupons will be examined on a two year basis for the first three intervals with the first coupon retrieved for inspection being on or before the end of October 2009 and thereafter at increasing intervals over the service life of the inserts.

- Measurements to be performed at each inspection will be as follows:

  a. Physical observations of the surface appearance to detect pitting, swelling or other degradation,

  b. Length, width, and thickness measurements to monitor for bulging and swelling

  c. Weight and density to monitor for material loss, and

  d. Neutron attenuation to confirm the B-10 concentration or destructive chemical testing to determine the boron content.

- The provisions of SR 3.0.2 are applicable to the Metamic Coupon Sampling Program.

- The provisions of SR 3.0.3 are not applicable to the Metamic Coupon Sampling Program.

INSERT 1
Table 3.9-1
SFP Loading Restrictions

Region 1
No loading restrictions other than U-235 enrichment.

Region 2
Minimum Burnup at Varying Initial U-235 Enrichment and Cooling Time (Notes 1 and 2)

Enrichment (Wt% U-235)	2.0	2.5	3.0	3.5	4.0	4.5	4.95
Cooling Time (Years)	Minimum Burnup (GWD/MTU)						
0	6.4	13.7	21.2	27.9	33.8	40.7	46.8
1	NC	NC	NC	27.1	33.0	39.5	45.8
2	NC	NC	NC	26.7	32.5	38.9	44.8
3	NC	NC	NC	26.5	32.1	38.4	44.3
4	NC	NC	NC	26.2	31.6	38.0	43.7
5	5.9	12.6	19.3	26.1	31.2	37.4	43.1
10	5.7	12.0	18.4	25.3	29.7	35.6	41.1
15	5.6	11.6	18.1	25.0	29.1	34.4	39.7
20	5.4	11.4	17.5	24.3	28.6	34.0	38.9

Region 2 Peripheral Cells
Minimum Burnup versus U-235 Enrichment
with Spent Fuel at 0 Years Cooling Time (Note 3)

Enrichment (Wt% U-235)	2.0	2.5	3.0	3.5	4.0	4.5	4.95
Minimum Burnup (GWD/MTU)	0	4.7	9.7	15.0	21.8	27.6	33.3

Rack Interface Allowances

1. Region 1 to Region 2, fresh fuel checkerboard in Region 2 is allowed. Spent fuel in Region 2 is allowed.
2. Region 2 Racks – a fresh fuel checkerboard and uniform spent fuel loading may be placed adjacent to each other in the same rack. If both patterns are placed in a single rack, no fresh fuel assembly may be placed with more than one face adjacent to a spent fuel assembly.
3. Region 2 Racks – if adjacent racks contain a checkerboard of fresh fuel assemblies, the checkerboard must be maintained across the gap, i.e., fresh fuel assemblies may not face each other across a gap.
4. Region 2 Racks – one rack may contain a checkerboard of fresh fuel and empty storage locations and the adjacent rack may contain spent fuel with no loading restrictions.

Notes: 1. Linear interpolation between burnups for a given cooling time is allowed. However, linear interpolation between cooling times is not allowed, therefore the cooling time of a given assembly must be rounded down to the nearest cooling time.

2. NC = Not Calculated, if any fuel assembly is within these limits, use 0 cooling time and interpolate for enrichments to determine loading restrictions per note 1.

3. Linear interpolation between burnups is allowed.

Attachment 3

2CAN030706

Proposed Technical Specification Changes (revised)

FUEL STORAGE

LIMITING CONDITION FOR OPERATION

3.9.12.a Storage in the spent fuel pool shall be restricted to fuel assemblies having initial enrichment less than or equal to 4.95 w/o U-235. The provisions of Specification 3.0.3 are not applicable.

3.9.12.b Storage in the spent fuel pool shall be further restricted by the limits specified in Table 3.9-1. The provisions of Specification 3.0.3 are not applicable.

3.9.12.c The boron concentration in the spent fuel pool shall be maintained (at all times) at greater than 2000 parts per million.

APPLICABILITY: During storage of fuel in the spent fuel pool

ACTION:

Suspend all actions involving the movement of fuel in the spent fuel pool if it is determined a fuel assembly has been placed in an incorrect location until such time as the correct storage location is determined. Move the assembly to its correct location before resumption of any other fuel movement.

Suspend all actions involving the movement of fuel in the spent fuel pool if it is determined the pool boron concentration is less than 2001 ppm, until such time as the boron concentration is increased to 2001 ppm or greater.

SURVEILLANCE REQUIREMENTS

4.9.12.a Verify all fuel assemblies to be placed in the spent fuel pool have an initial enrichment of less than or equal to 4.95 w/o U-235 by checking the assemblies' design documentation.

4.9.12.b Verify all fuel assemblies to be placed in the spent fuel pool are within the limits of Table 3.9-1 by checking the assemblies' design and burnup documentation.

4.9.12.c Verify at least once per 31 days the spent fuel pool boron concentration is greater than 2000 ppm.

4.9.12.d Verify Metamic properties are in accordance with, and are maintained within the limits of, the Metamic Coupon Sampling Program.

Table 3.9-1
SFP Loading Restrictions

Region 1
No loading restrictions other than U-235 enrichment.

Region 2
Minimum Burnup at Varying Initial U-235 Enrichment and Cooling Time (Notes 1 and 2)

Enrichment (Wt% U-235)	2.0	2.5	3.0	3.5	4.0	4.5	4.95
Cooling Time (Years)	Minimum Burnup (GWD/MTU)						
0	6.4	13.7	21.2	27.9	33.8	40.7	46.8
1	NC	NC	NC	27.1	33.0	39.5	45.8
2	NC	NC	NC	26.7	32.5	38.9	44.8
3	NC	NC	NC	26.5	32.1	38.4	44.3
4	NC	NC	NC	26.2	31.6	38.0	43.7
5	5.9	12.6	19.3	26.1	31.2	37.4	43.1
10	5.7	12.0	18.4	25.3	29.7	35.6	41.1
15	5.6	11.6	18.1	25.0	29.1	34.4	39.7
20	5.4	11.4	17.5	24.3	28.6	34.0	38.9

Region 2
Minimum Burnup versus U-235 Enrichment for Peripheral Cells
with Spent Fuel at 0 Years Cooling Time (Note 3)

Enrichment (Wt% U-235)	2.0	2.5	3.0	3.5	4.0	4.5	4.95
Minimum Burnup (GWD/MTU)	0	4.7	9.7	15.0	21.8	27.6	33.3

Rack Interface Allowances

1. Region 1 to Region 2, fresh fuel checkerboard in Region 2 is allowed. Spent fuel in Region 2 is allowed.
2. Region 2 Racks – a fresh fuel checkerboard and uniform spent fuel loading may be placed adjacent to each other in the same rack. If both patterns are placed in a single rack, no fresh fuel assembly may be placed with more than one face adjacent to a spent fuel assembly.
3. Region 2 Racks – if adjacent racks contain a checkerboard of fresh fuel assemblies, the checkerboard must be maintained across the gap, i.e., fresh fuel assemblies may not face each other across a gap.
4. Region 2 Racks – one rack may contain a checkerboard of fresh fuel and empty storage locations and the adjacent rack may contain spent fuel with no loading restrictions.

Notes: 1. Linear interpolation between burnups for a given cooling time is allowed. However, linear interpolation between cooling times is not allowed, therefore the cooling time of a given assembly must be rounded down to the nearest cooling time.

2. NC = Not Calculated, if any fuel assembly is within these limits, use 0 cooling time and interpolate for enrichments to determine loading restrictions per note 1.

3. Linear interpolation between burnups is allowed.

5.3 Fuel Storage

5.3.1 Spent Fuel Storage Rack Criticality

The spent fuel storage racks are designed and shall be maintained with:

a. Fuel assemblies stored in the spent fuel pool in accordance with Specification 3.9.12;

b. $k_{eff} \leq 0.95$ if fully flooded with 452 ppm borated water, which includes an allowance for uncertainties as described in Section 9.1 of the SAR; and

c. $k_{eff} < 1.0$ if fully flooded with unborated water, which includes an allowance for uncertainties as described in Section 9.1 of the SAR; and

d. A nominal 9.8 inch center to center distance between fuel assemblies placed in the storage racks.

5.3.2 New Fuel Storage Rack Criticality

The new fuel storage racks are designed and shall be maintained with:

a. Fuel assemblies having a maximum U-235 enrichment of 4.95 weight percent;

b. $k_{eff} \leq 0.95$ if fully flooded with unborated water, which includes an allowance for uncertainties as described in Section 9.1 of the SAR;

c. $k_{eff} \leq 0.98$ if moderated by aqueous foam, which includes an allowance for uncertainties as described in Section 9.1 of the SAR; and

d. A nominal 26 inch center to center distance between fuel assemblies placed in the storage racks.

5.3.3 Drainage

The spent fuel storage pool is designed and shall be maintained to prevent inadvertent draining of the pool below elevation 399' 10½".

5.3.4 Capacity

The spent fuel storage pool is designed and shall be maintained with a storage capacity limited to no more than 988 fuel assemblies.

6.5.17 Metamic Coupon Sampling Program

A coupon surveillance program will be implemented to maintain surveillance of the Metamic absorber material under the radiation, chemical, and thermal environment of the SFP. The purpose of the program is to establish the following:

- Coupons will be examined on a two year basis for the first three intervals with the first coupon retrieved for inspection being on or before October 31, 2009 and thereafter at increasing intervals over the service life of the inserts.

- Measurements to be performed at each inspection will be as follows:

  a. Physical observations of the surface appearance to detect pitting, swelling or other degradation,

  b. Length, width, and thickness measurements to monitor for bulging and swelling

  c. Weight and density to monitor for material loss, and

  d. Neutron attenuation to confirm the B-10 concentration or destructive chemical testing to determine the boron content.

- The provisions of SR 3.0.2 are applicable to the Metamic Coupon Sampling Program.

- The provisions of SR 3.0.3 are not applicable to the Metamic Coupon Sampling Program.

Attachment 4

2CAN030706

Changes to Technical Specification Bases Pages
For Information Only

3/4.9.9 and 3/4.9.10 WATER LEVEL-REACTOR VESSEL AND SPENT FUEL POOL WATER LEVEL

The restrictions on minimum water level ensure that sufficient water depth is available to remove 99% of the assumed 12% iodine gap activity released from the rupture of an irradiated fuel assembly. The minimum water depth is consistent with the assumptions of the accident analysis.

3/4.9.11 FUEL HANDLING AREA VENTILATION SYSTEM

The limitations on the fuel handling area ventilation system ensure that all radioactive materials released from an irradiated fuel assembly will be filtered through the HEPA filters and charcoal adsorbers prior to discharge to the atmosphere. The operation of this system and the resulting iodine removal capacity are consistent with the assumptions of the accident analyses.

Acceptable removal efficiency is shown by methyl iodide penetration of less than 5.0% when tests are performed in accordance with ASTM D3803-1989, "Standard Test Method for Nuclear-Grade Activated Carbon," at a temperature of 30°C and a relative humidity of 95%. The penetration acceptance criterion is determined by the following equation:

$$\text{Allowable Penetration} = \frac{[100\% - \text{methyl iodide efficiency for charcoal credited in accident analysis}]}{\text{safety factor of 2}}$$

Applying a safety factor of 2 is acceptable because ASTM D3803-1989 is a more accurate and demanding test than older tests.

3/4.9.12 FUEL STORAGE

The spent fuel storage racks are designed to assure that when fuel assemblies of less than or equal to ~~4.55 ± 0.05~~4.95 w/o U-235 enrichment are stored within the limits of ~~Figure 3.9.2 a~~Table 3.9-1 subcritical array with $K_{eff} \leq 0.95$ will be maintained when a concentration of ~~240~~ 452 ppm of soluble boron is present in the spent fuel water. These conditions have been verified by criticality analyses.

The requirement for 2000 ppm boron concentration is to assure the fuel assemblies will be maintained in a subcritical array with $K_{eff} \leq 0.95$ in the event of a postulated accident. Analysis has shown that, during a postulated accident with the fuel stored within the limits of this specification, that a K_{eff} of ≤ 0.95 will be maintained when the boron concentration is at or above ~~825~~ 881 ppm.

The peripheral cells are defined as those storage cells closest to the spent fuel pool wall that have fuel assemblies located in them. Therefore, if the storage cell closest to the spent fuel pool wall is kept empty, then the second storage cell from the spent fuel pool wall may be filled with lower burnup fuel meeting the requirements of Table 3.9-1.

~~The following restrictions apply to fuel assembly storage in the SFP:~~

~~Racks must be loaded using one of the five patterns shown in Figure 3.9-2. The type "A" and "C" assemblies have restrictions which are designated in Tables 1, 1-1, 2, and 2-1 of Figure 3.9-2. In any pattern, a less restrictive assembly may be substituted for another assembly within the pattern.~~

~~For adjacent patterns, both inside and between racks in the SFP, only the allowed interface configurations shown in Figure 3.9-2 may be used.~~

~~3/4.9.12 FUEL STORAGE (continued)~~

~~Holtec International MPC-32 Storage Cask~~

~~The Holtec International MPC-32 storage casks are designed to assure that when fuel assemblies of less than or equal to 4.55 ± 0.05 w/o U-235 enrichment are stored within the limits of Figure 3.9-1 a subcritical array with~~ $\cancel{K_{eff} \leq 0.95}$ ~~will be maintained with no credit for soluble boron in the spent fuel water. These conditions have been verified by criticality analyses.~~

~~The requirement for 2000 ppm boron concentration is to assure the fuel assemblies will be maintained in a subcritical array with~~ $\cancel{K_{eff} \leq 0.95}$ ~~in the event of a postulated accident were to occur during MPC-32 cask loading/unloading activities. Analysis has shown that, during a postulated accident with the fuel stored within the limits of Figure 3.9-1, that a~~ $\cancel{K_{eff}}$ ~~of~~ $\cancel{\leq 0.95}$ ~~will be maintained when the boron concentration is at or above 950 ppm.~~

~~This specification is not applicable to the cask loading pit or the SFP tilt pit when their respective gates are installed and sealed.~~