UNITED STATES NUCLEAR REGULATORY COMMISSION

NORTHERN STATES POWER COMPANY

PRAIRIE ISLAND NUCLEAR GENERATING PLANT DOCKET NO. 50-282
50-306

## REVISED REQUEST FOR AMENDMENT TO OPERATING LICENSES DPR-42 & DPR-60

## REVISION TO LICENSE AMENDMENT REQUEST DATED JULY 28, 1995 BORON CREDIT IN THE SPENT FUEL POOL

Northern States Power Company, a Minnesota corporation, requests authorization for changes to Appendix A of the Prairie Island Operating License as shown in the attachments labeled Exhibits A, B, C, D, and E. Exhibit A contains a description of the proposed changes, the reasons for requesting the changes, the supporting safety evaluations and significant hazards determinations. Exhibit B contains current and new Prairie Island Technical Specification pages marked up to show the proposed changes. Exhibit C contains the revised Technical Specification pages. Exhibit D contains a copy of the Prairie Island spent fuel pool dilution analysis. Exhibit E contains a copy of the Prairie Island spent fuel rack criticality analysis with credit for soluble boron.

This letter contains no restricted or other defense information.



NORTHERN STATES POWER COMPANY

By Joel P Sorensen

Joel P Sorensen
Plant Manager
Prairie Island Nuclear Generating Plant

On this 21st day of February 1997 before me a notary public in and for said County, personally appeared Joel P Sorensen, Plant Manager, Prairie Island Nuclear Generating Plant, and being first duly sworn acknowledged that he is authorized to execute this document on behalf of Northern States Power Company, that he knows the contents thereof, and that to the best of his knowledge, information, and belief the statements made in it are true and that it is not interposed for delay.

Marcia K LaCore

MARCIA K. LaCORE
NOTARY PUBLIC-MINNESOTA
HENNEPIN COUNTY
My Commission Expires Jan. 31, [illegible]

## Exhibit A

## Prairie Island Nuclear Generating Plant
## February 21, 1997 Revision to
## License Amendment Request Dated July 28, 1995

## Evaluation of Proposed Changes to the Technical Specifications Appendix A of Operating License DPR-42 and DPR-60

Pursuant to 10 CFR Part 50, Sections 50.59 and 50.90, the holders of Operating Licenses DPR-42 and DPR-60 hereby propose the following changes to Appendix A, Technical Specifications:

### Background

The purpose of this license amendment request is to incorporate into the Prairie Island Technical Specifications new limitations which utilize credit for soluble boron for the control of reactivity in the spent fuel pool while retaining the necessary margin of safety. The proposed changes will also eliminate the need to take credit for the spent fuel rack Boraflex neutron absorber panels in the spent fuel rack criticality analysis.

This submittal proposes to take credit for the soluble boron in the spent fuel pool water to control the subcritical condition of the spent fuel assembly array. The utilization of soluble boron, which is contained in the spent fuel pool, provides a simple, direct method of ensuring subcriticality. This control feature retains the necessary criticality safety requirements and has many benefits. Credit for soluble boron is currently used at Prairie Island for Mode 6 reactivity control in the reactor vessel, for control of reactivity during the loading of spent fuel storage casks and to compensate for a misloaded fuel assembly in the spent fuel pool.

The Prairie Island spent fuel storage racks were analyzed utilizing the Westinghouse Spent Fuel Rack Criticality Analysis Methodology described in WCAP-14416-NP-A (Reference 4). A copy of the Prairie Island specific spent fuel pool criticality analysis is attached as Exhibit E.

While the proposed license amendment proposes use of credit for soluble boron in the spent fuel pool criticality analysis, a storage configuration has been defined, as described in Exhibit E, to ensure that the spent fuel rack $K_{eff}$ will be less than 1.0 including uncertainties and tolerances on a 95\95 basis, without the presence of any soluble boron in the storage pool. Soluble boron credit is used to offset uncertainties, tolerances, and off-normal conditions and to provide subcritical margin such that the spent fuel pool $K_{eff}$ is maintained less than or equal to 0.95. In addition to reactivity credit for soluble boron, both the $K_{eff}$ calculations, 0.95 and 1.0, also take credit for the radioactive decay time of the spent fuel, and the presence of gadolinium absorber, which is mixed in the fuel pellets, and is an integral part of some fuel rods.

The Prairie Island spent fuel racks have been reanalyzed to allow storage of fuel assemblies with nominal enrichments up to 4.95 w/o U-235 in all storage cell locations using credit for checkerboarding and burnup. The analysis does not take any credit for the presence of the spent fuel rack Boraflex neutron absorber panels. Credit is taken for the presence of the integral absorber gadolinium in the fuel and for the radioactive decay time of the fuel. The following storage configurations and enrichment limits resulted from the criticality analysis:

**All Cell Storage** Fuel assemblies with nominal enrichments no greater than 1.87 w/o U-235 for Westinghouse OFA and Vantage Plus fuel and 1.77 w/o U-235 for Westinghouse STD and Exxon fuel may be stored in any cell location. Fuel assemblies with initial nominal enrichments greater than these limits must satisfy a minimum burnup requirement.

**3x3 Checkerboard** Westinghouse OFA and Vantage Plus fuel assemblies with nominal enrichments less than or equal to 4.95 w/o U-235 may be stored in the center of a 3x3 checkerboard. The surrounding fuel assemblies must have an initial nominal enrichment no greater than 1.30 w/o U-235 for Westinghouse OFA fuel and 1.20 w/o U-235 for Westinghouse STD and other Exxon fuel or must satisfy minimum burnup and decay time requirements. The surrounding enrichment limits are increased with gadolinium credit in the center assembly.

The spent fuel pool criticality analysis in Exhibit E addresses all the fuel types currently stored in the spent fuel pool and in use in the reactor at Prairie Island. The fuel types considered in the analysis include the Westinghouse Standard (STD), OFA, and Vantage Plus designs, and the Exxon fuel types used in the past at Prairie Island. The Westinghouse OFA design is equivalent to the Westinghouse Vantage Plus fuel assemblies and the Westinghouse STD design bounds the reactivity of the Exxon fuel assemblies.

A boron dilution evaluation was performed to ensure that sufficient time is available to detect and mitigate dilution of the spent fuel pool before the 0.95 $K_{eff}$ design basis is exceeded. The boron dilution evaluation included an evaluation of the following plant specific features:

- Spent Fuel Pool and Related System Features
  - Dilution Sources
  - Dilution Flow Rates
  - Boration Sources
  - Instrumentation
  - Administrative Procedures

- Piping
- Loss of Offsite Power Impact

- Boron Dilution Initiating Events

- Boron Dilution Times and Volumes

The results of the spent fuel pool boron dilution evaluation are summarized in Exhibit D. As part of that evaluation, calculations were performed to define the dilution times and volumes for the spent fuel pool. The dilution sources available were compiled and evaluated against the calculated dilution volumes, to determine the potential of a spent fuel pool boron dilution event. The evaluation shows that a large volume of water (approximately 345,000 gallons) is necessary to dilute the spent fuel pool from the proposed Technical Specification limit of 1800 ppm to a soluble boron concentration where a $K_{eff}$ of 0.95 would be approached in the spent fuel pool.

A dilution event large enough to result in a significant reduction in the spent fuel pool boron concentration would involve the transfer of a large quantity of water from a dilution source and a significant increase in spent fuel pool level which would ultimately overflow the pool. Such a large water volume turnover, and the overflow of the spent fuel pool, would be readily detected and terminated by plant personnel (Exhibit D).

In addition, because of the large quantities of water required, and the low dilution flow rates available at Prairie Island, any significant dilution of the spent fuel pool boron concentration would only occur over a long period of time (hours to days). Detection of a spent fuel pool boron dilution via level alarms and/or visual inspections would be expected long before a dilution sufficient to reduce Keff to 0.95 could occur.

The evaluations in Exhibit D, which show that the dilution of the spent fuel pool boron concentration from 1800 ppm to 750 ppm is not credible, combined with the 95/95 calculation, which shows that the spent fuel rack $K_{eff}$ will remain less than 1.0 when flooded with unborated water, provide a level of safety comparable to the conservative criticality analysis methodology required by References 1, 2 and 3.

The precedent of using soluble boron in water to provide criticality control aside from normal reactor operations has already been established. Credit for soluble boron in the spent fuel pool has been previously permitted when considering abnormal or accident conditions. Also, during refueling, soluble boron in the reactor vessel is the only direct control utilized to ensure that the reactor remains subcritical. The use of credit for soluble boron was in included in the Westinghouse Spent Fuel Rack Criticality Analysis Methodology described in WCAP-14416-NP-A (Reference 4). That methodology, which was used for the criticality analysis in Exhibit E, was accepted for use by an NRC Safety Evaluation dated October 25, 1996.

This License Amendment Request proposes revisions to the Technical Specifications associated with controlling the storage of assemblies with differing initial enrichments, burnup, decay time and Gadolinium loading. The proposed Technical Specification changes also include the addition of Limiting Conditions for Operation, Surveillance Requirements and Design Feature changes to control the boron concentration in the spent fuel pool under normal and accident conditions.

**Proposed Changes and Reasons for Changes**

The proposed changes to the Prairie Island Technical Specifications are described below, and the specific wording changes to Technical Specifications are shown in Exhibit B.

A. Proposed Changes to Technical Specification 3.8.E

Based on the results and bounding conditions of the new criticality analysis (Exhibit E) for taking credit for soluble boron in the spent fuel pool, Specification 3.8.E is revised as shown in Exhibit B.

The proposed changes to Specification 3.8.E, described below, revise the spent fuel pool storage restrictions based on a combination of fuel assembly initial enrichment, burnup and radioactive decay time of the spent fuel. A requirement to always maintain the spent fuel pool boron concentration greater than or equal to 1800 ppm is also incorporated.

Specification 3.8.E.1 and Figure TS.3.8-1

Specifications 3.8.E.1.a and b are replaced with a single specification (3.8.E.1.a) which adopts the wording of Improved Standard Technical Specification (ISTS) LCO 3.7.17 for spent fuel assembly storage. The wording of ISTS LCO 3.7.17 is modified as necessary to incorporate Prairie Island specific terminology and to add decay time as one of the parameters to be included in the use of Figures TS.3.8-1 and TS.3.8-2.

Current Figure TS.3.8-1 is replaced with new Figures TS.3.8-1 and TS.3.8-2, because the new spent fuel rack criticality analysis (Exhibit E) utilizes two figures to define what fuel assemblies may be allowed unrestricted storage in the spent fuel pool, one for Westinghouse OFA fuel and one for Westinghouse STD and Exxon fuel, versus the single figure (TS.3.8-1) utilized in the current Technical Specifications. The new figures also utilize fuel assembly radioactive decay time in addition to initial enrichment and discharge burnup to define restricted versus unrestricted storage in the spent fuel pool. A reference to both figures replaces the previous reference to Figure TS.3.8-1 in revised Specification 3.8.E.1.a.

The reference to Specification 3.8.E.1.b is eliminated from Specification 3.8.E.1.c and Specification 3.8.E.1.c is renumbered to 3.8.E.1.b. Specification 3.8.E.1.d is renumbered to 3.8.E.1.c

Specification 3.8.E.2

Specification 3.8.E.2.a is being revised to specify that the spent fuel pool boron concentration be maintained greater than or equal to 1800 ppm anytime fuel assemblies are stored in the spent fuel pool.

The existing boron concentration requirement in Specification 3.8.E.2.a was only intended to provide additional negative reactivity to compensate for a misloaded fuel assembly until a spent fuel pool verification was completed. Because the proposed revision makes the boron concentration limit applicable anytime fuel is stored in the pool, the boron concentration limit is no longer associated with the completion of a spent fuel pool verification and those portions of existing Specifications 3.8.E.2.a and 3.8.E.2.b.2 related to checkerboard storage and the performance of spent fuel pool verifications are being deleted.

Existing Specification 3.8.E.2.a also provided the means to ensure that a spent fuel pool verification was performed after the completion of fuel movements in the spent fuel pool. The completion of spent fuel pool verifications will now be ensured by the proposed spent fuel pool storage configuration surveillance requirement described below.

Based on the results of the new criticality analysis (Exhibit E), a spent fuel pool boron concentration of 1300 ppm would be adequate to maintain the spent fuel storage rack $K_{eff} < 0.95$ while compensating for the increased reactivity which could result from either a mispositioned fuel assembly or a loss of spent fuel pool cooling event. A spent fuel pool boron concentration limit of 1800 ppm has been conservatively chosen for proposed Specification 3.8.E.2.a to be consistent with the boron concentration limit for a spent fuel cask loaded with fuel in existing Specification 3.8.B.1.c.

Specification 3.8.E.2.b is being revised to eliminate the reference to the applicability of Specification 3.8.E.2.a. There is no need to state that the action in Specification 3.8.E.2.b is only applicable when Specification 3.8.E.2.a is applicable.

Specification 3.8.E.2.c, which specifies that the provisions of Specification 3.0.C are not applicable, is being retained. If the requirements of revised Specification 3.8.E.2 cannot be met during cold shutdown or refueling Specification 3.0.C would not be applicable because the reactor would already be shutdown. If the requirements of revised Specification 3.8.E.2 cannot be met with the reactor above cold shutdown, any problems with respect to the spent fuel pool boron

concentration would be independent of reactor operation and there would not be sufficient reason to require a reactor shutdown. This is consistent with the requirements for all spent fuel pool related Technical Specifications in the ISTS.

Bases for Specification 3.8.E

The bases for Specification 3.8.E are revised in accordance with the changes made to the specification as stated above. The changes to the bases are shown in Exhibit B.

B. Proposed Changes to Technical Specification Table TS.4.1-2B

In order to ensure that the boron concentration limits specified in Specification 3.8.E.2.a are met, the current surveillance requirements in Table TS.4.1-2B are revised. Table 4.1-2B, Item 13, "Spent Fuel Pit Boron Concentration", currently specifies the frequency of sampling tests at monthly or weekly. Weekly measurements are required in conjunction with Specification 3.8.B.1.c when a spent fuel cask is in the spent fuel pool (Note 7), and in conjunction with current Specification 3.8.E.2 when spent fuel verification has not been performed (Note 8).

Table TS.4.1-2B, Item 13 is revised to specify that weekly sampling is now required in all cases. The weekly frequency matches that required for the boron concentration in the refueling water storage tank. The weekly frequency is sufficient based on operating experience, and because significant changes in the boron concentration in the spent fuel pool are difficult to produce without detection, since the pool contains such a large volume (inventory) of water (Exhibit D). Soluble boron concentration reduction requires the inflow and outflow of large volumes of water which are readily detected. Pool inventory changes provide a good indication of potential boron concentration changes. The pool water inventory is monitored by level indication and alarms and by periodic operator rounds of the spent fuel pool area.

Because Table TS.4.1-2B Item 13 has been revised to routinely require weekly sampling of the spent fuel pool boron concentration, Notes 7 and 8 are unnecessary and are being deleted.

C. Proposed New Technical Specification Section 4.20

New Specification 4.20

Proposed Specification 4.20 incorporates a new surveillance requirement which will verify that the fuel assemblies in the spent fuel storage racks are stored in accordance with the requirements of Specifications 3.8.E.1, 5.6.A.1.d and 5.6.A.1.e. The surveillance is required to be completed within 7 days after the

completion of any fuel handling campaign which involves the relocation of fuel assemblies within the spent fuel pool or the addition of fuel assemblies to the spent fuel pool. The extent of a fuel handling campaign will be defined by plant administrative procedures. Examples of a fuel handling campaign would include all of the fuel handling performed during a refueling outage or associated with the placement of new fuel into the spent fuel pool.

The 7 day allowance for completion of this surveillance provides adequate time for the completion of a spent fuel pool inventory verification while minimizing the time a fuel assembly may be misloaded in the spent fuel pool. If a fuel assembly is misloaded during a fuel handling campaign, the minimum boron concentration required by Specification 3.8.E.2 will ensure that the spent fuel rack Keff remains less than or equal to 0.95 until the spent fuel pool inventory verification is performed.

Bases for New Specification 4.20

Bases are being incorporated for new Specification 4.20. The proposed bases are shown in Exhibit B.

D. Proposed Changes to Technical Specification 5.6.A

The information in Section 5.6.A is being revised as shown in Exhibit B to include the design feature elements required to take reactivity credit for the soluble boron in the spent fuel pool.

New Specification 5.6.A.1.b

A new Specification 5.6.A.1.b is being incorporated into Section 5.6.A.1 to specify that the spent fuel storage rack Keff shall be less than 1.0 if fully flooded with unborated water. The wording of the new Specification is consistent with the wording specified in the October 25, 1996 NRC Safety Evaluation for Reference 4.

Existing Specification 5.6.A.1.b

The current Specification 5.6.A.1.b is being renumbered to 5.6.A.1.c to allow for the insertion of the new Specification 5.6.A.1.b discussed above. In addition, existing Specification 5.6.A.1.b (new 5.6.A.1.c) is revised to eliminate the requirement that the spent fuel racks maintain a $K_{eff}$ of less than 0.95 when fully flooded with unborated water. The design feature is changed to include the condition of being flooded with water borated to 750 ppm. The wording of the new Specification is consistent with the wording specified in the October 25, 1996 NRC Safety Evaluation for Reference 4. A reference to the new spent fuel pool criticality analysis is also being incorporated into new Specification 5.6.A.1.c.

Existing Specifications 5.6.A.1.c and d

Current Specifications 5.6.A.1.c and 5.6.A.1.d are being renumbered to 5.6.A.1.d and 5.6.A.1.e to allow for the insertion of the new Specification 5.6.A.1.b discussed above. The phrase, "...with a combination of burnup and initial enrichment in the...", has been replaced with, "...with a combination of discharge burnup, initial enrichment and decay time in the...", in new Specifications 5.6.A.1.d and 5.6.A.1.e to add decay time as one of the parameters to be included in the use of Figures TS.3.8-1 and TS.3.8-2.

As discussed above, current Figure TS.3.8-1 is being replaced with new Figures TS.3.8-1 and TS.3.8-2. A reference to both figures has been incorporated into new Specifications 5.6.A.1.d and 5.6.A.1.e to replace the previous reference to Figure TS.3.8-1 in existing Specifications 5.6.A.1.c and 5.6.A.1.d.

New Specification 5.6.A.1.e is being revised to reference the additional Section 5.6 figures necessary to implement the checkerboard loading pattern required by the spent fuel pool criticality analysis.

Figures TS.5.6-1 through 12

Current Figure TS.5.6-1 which provides the spent fuel pool burned/fresh checkerboard cell layout, is being revised to reflect the new 3x3 checkerboard layout resulting from the new spent fuel rack criticality analysis. A new Figure TS.5.6-2, which provides the requirements for the interface between the checkerboard and the unrestricted all cell storage regions, is being added.

New Figures TS.5.6-3 through TS.5.6-12 replace existing Figure TS.5.6-2. New Figures TS.5.6-3 through TS.5.6-12 provide the minimum requirements for fuel assemblies to be used to surround the center assembly in the 3x3 checkerboard array. As discussed in Reference 4, the selection of fuel assemblies to be used for checkerboarding is a function of fuel assembly type, discharge burnup, initial enrichment, decay time and the center assembly Gadolinium loading.

Section 5.6 References

A reference to the February 1997 Prairie Island Spent Fuel Rack Criticality Analysis With Credit for Soluble Boron is added to Section 5.6.

## Safety Evaluation

The design basis for preventing criticality in the spent fuel pool is that, including uncertainties, there is a 95% probability at a 95% confidence level that the $K_{eff}$ of the fuel storage assembly array will be less than 0.95 with full density moderation. This proposed license amendment includes an exception to the additional standard condition which states that the spent fuel pool water is assumed to be unborated.

The Prairie Island spent fuel storage racks were analyzed utilizing the NRC approved Westinghouse Spent Fuel Rack Criticality Analysis Methodology described in WCAP-14416-NP-A (Reference 4). For the storage of fuel assemblies in the spent fuel storage racks, the acceptance criteria for criticality requires the effective neutron multiplication factor, $K_{eff}$, be less than or equal to 0.95, including uncertainties. The criticality analysis performed for the Prairie Island spent fuel storage racks shows that the acceptance criteria for criticality is met for the storage of 14 x14 fuel assemblies under both normal and accident conditions with soluble boron credit, no credit for the spent fuel rack Boraflex neutron absorber panels and the storage configurations and enrichment limits described above. In addition to reactivity credit for soluble boron, credit is also taken for the radioactive decay time of the spent fuel, and the presence of gadolinium absorber, which is mixed in the fuel pellets, and is an integral part of some fuel rods.

While this License Amendment Request proposes use of credit for soluble boron in the spent fuel pool criticality analysis, a storage configuration has been defined using 95/95 $K_{eff}$ calculations to ensure that the spent fuel rack $K_{eff}$ will be less than 1.0 with no credit for soluble boron or Boraflex panels in the racks, but including credit for the radioactive decay time of the spent fuel and the presence of gadolinium absorber. Soluble boron credit provides significant negative reactivity in the criticality analysis to provide subcritical margin such that the spent fuel pool $K_{eff}$ is maintained less than or equal to 0.95. Soluble boron credit and storage configuration were also used to offset the reactivity increase when ignoring the presence of the spent fuel rack Boraflex neutron absorber panels.

Revised Specifications 3.8.E.1, 5.6.A.1.d and 5.6.A.1.e continue to specify the requirements for the spent fuel rack storage configurations, the only significant changes relate to the criteria for determining the storage configuration. In addition to the current criteria based on discharge burnup and initial enrichment, fuel assembly type, decay time and Gadolinium loading will now also be used to determine the spent fuel rack storage configuration. Since the proposed spent fuel pool storage configuration limitations will be similar to those currently in the Prairie Island Technical Specifications, the new limitations will have minimal effect on normal pool operations and maintenance. The remainder of the changes to these sections are administrative in nature and are intended to clarify the specifications and/or bring them closer to conformance with the ISTS. The proposed changes in Specifications 3.8.E.1, 5.6.A.1.d and 5.6.A.1.e and proposed surveillance 4.20 will ensure that fuel is stored in

a configuration consistent with the assumptions in the criticality analysis and will ensure that the design requirements specified in proposed specifications 5.6.A.1.b and 5.6.A.1.c are met.

*Since the current Technical Specifications utilize credit for the reactivity depletion due to fuel burnup, plant operating procedures already include provisions for the independent administrative confirmation of the fuel burnup, before fuel is placed in burnup dependent storage cells. These procedural controls will be maintained under the proposed Technical Specifications. New controls necessary to ensure that independent administrative confirmation of decay time and Gadolinium loading will be incorporated into plant operating procedures prior to implementation of the license amendment allowing credit for soluble boron in the spent fuel pool criticality analysis.*

Based on the results of the new criticality analysis (Exhibit E), a spent fuel pool boron concentration of 1300 ppm would be adequate to maintain the spent fuel storage rack $K_{eff} < 0.95$ while compensating for the increased reactivity which could result from either a mispositioned fuel assembly or a loss of spent fuel pool cooling event. A spent fuel pool boron concentration limit of 1800 ppm has been conservatively chosen for proposed Specification 3.8.E.2.a to be consistent with the boron concentration limit for a spent fuel cask loaded with fuel in existing Specification 3.8.B.1.c. Since soluble boron has always been contained in the spent fuel pool, the new requirement will have minimal effect on normal pool operations and maintenance. The proposed limit of 1800 ppm will maintain the spent fuel storage rack $K_{eff} < 0.95$ when fuel is stored in accordance with the configuration specified by Specifications 5.6.A.1.d and 5.6.A.1.e.

Elimination of the Specification 3.8.E.2 requirements which helped ensure that a spent fuel pool verification was performed following the completion of fuel movements in the pool will have no impact on the safe operation of the spent fuel pool. Proposed surveillance 4.20 will provide better assurance that a spent fuel pool inventory verification is completed in a timely manner after completion of a fuel handling campaign in the spent fuel pool.

The proposed changes to spent fuel pool boron concentration sampling requirements in Table TS.4.1-2B are intended to provide periodic verification that the spent fuel pool boron concentration limits of proposed Specifications 3.8.E.2.a are being met. The proposed 7 day frequency is consistent with the requirements of the ISTS and with the current requirements for sampling during cask loading operations. Because significant reductions in spent fuel pool boron concentration will result in significant increases in pool volume or significant changes in the sources of non-borated water to the pool, any significant reductions in the pool boron concentration would be readily detected during normal operator rounds or by the pool level instrumentation. Sampling and verification of the spent fuel pool boron concentration on a 7 day frequency will provide adequate assurance that smaller and less readily identifiable boron concentration reductions are not taking place.

Spent fuel pool systems, instrumentation, and supporting systems are not modified as a result of the proposed license amendment. Operations involving spent fuel pool water cooling and cleanup do not change. *Prior to the implementation of the license amendment allowing credit for soluble boron in the spent fuel pool criticality analysis, current administrative controls on spent fuel pool boron concentration and water inventory will be evaluated and procedures will be upgraded as necessary to ensure that the spent fuel pool boron concentration is formally controlled during both normal and accident situations. The procedures will ensure that the proper provisions, precautions, and instructions to control the spent fuel pool boron concentration and water inventory are in place.*

The Prairie Island spent fuel rack criticality analysis also addressed postulated accidents in the spent fuel pool. The accidents that can occur in the spent fuel pool and their consequences are not significantly affected by taking credit for the soluble boron present in the pool water as a major subcriticality control element.

The criticality analysis confirmed that most spent fuel pool accident conditions will not result in an increase in $K_{eff}$ of the spent fuel racks. Examples of such accidents are the drop of a fuel assembly on top of a rack, between rack modules, between rack modules and the pool wall, and the drop or placement of a fuel assembly into the cask loading area. At Prairie Island, the spent fuel assembly rack configuration is such that it precludes the insertion of a fuel assembly between rack modules or between rack modules and the pool wall. A dropped fuel assembly can only land on the top of the racks or in the cask loading area.

From a criticality standpoint, the dropped fuel assembly accident assumes a fuel assembly in its most reactive condition is dropped onto the spent fuel racks. The rack structure pertinent for criticality is not excessively deformed. Previous accident analysis with unborated water showed that a dropped fuel assembly which comes to rest horizontally on top of the spent fuel rack has sufficient water separating it from the active fuel height of stored fuel assemblies to preclude neutronic interaction. For the borated water condition, the interaction is even less since the water contains boron, an additional thermal neutron absorber. The reactivity increase resulting from dropping or placing a fuel assembly into the cask loading area is bounded by the fuel assembly misload accident discussed below.

However, two accidents can be postulated which could result in an increase in reactivity. The first postulated accident would be a loss of the fuel pool cooling system. The second would be the misloading of a fuel assembly into a cell for which the restrictions on location, enrichment, burnup or decay time are not satisfied.

The loss of normal cooling to the spent fuel pool water causes an increase in the temperature of the water passing through the stored fuel assemblies. This causes a decrease in water density which would result in a decrease in reactivity when Boraflex neutron absorber panels are present in the racks. However, since Boraflex is not

considered to be present and the spent fuel pool water has a high concentration of boron, a density decrease results in a decrease in boron density which causes a positive reactivity addition.

A fuel assembly misload accident relates to the use of restricted storage locations based on fuel assembly type, initial enrichment, burnup, decay time and Gadolinium loading requirements. Special administrative controls are placed on the patterning and region loading of assemblies into these restricted locations. The misloading of a fuel assembly constitutes not meeting the enrichment, burnup or decay time requirements of that restricted location. The result of the misloading is to add positive reactivity, increasing $K_{eff}$ toward 0.95.

The amount of soluble boron required to offset each of these postulated accidents was evaluated for both the all cell and the 3x3 checkerboard storage configurations. That evaluation established the amount of soluble boron necessary to ensure that the spent fuel rack $K_{eff}$ will be maintained less than or equal to 0.95 should a loss of spent fuel pool cooling or a fuel assembly misload occur. The amount of soluble boron necessary to mitigate either of these events has been included in the spent fuel pool boron concentration limit contained in proposed Specification 3.8.E.2.a. Based on the double contingency principle, the margin for accident conditions included in the Specification 3.8.E.2.a boron concentration limit does not have to account for both a loss of cooling event and a misload event occurring at the same time.

The radiological consequences of a dropped assembly accident in the spent fuel pool do not change because of the presence of soluble boron in the spent fuel pool water. The current USAR accident analysis (Section 14.5.1) assumes that the pool water is borated. In that analysis, a high burnup fuel assembly is dropped onto the top of the racks, all fuel rods in the dropped assembly rupture releasing the gap radioactive gases. A large fraction of the halogen gases are entrained in the pool water limiting the off-site exposures.

Calculations were performed (Exhibit D) in order to define the dilution time and volumes for the spent fuel pool. The dilution sources available at Prairie Island were compiled and evaluated against the calculated dilution volume, to determine the potential of a spent fuel pool dilution event. The evaluations show that a large volume of water (approximately 345,000 gallons) is necessary to dilute the spent fuel pool to a soluble boron concentration where criticality would be approached in the spent fuel pool.

Proposed Specification 5.6.A.1.c requires that the spent fuel rack $K_{eff}$ be less than or equal to 0.95 when flooded with water borated to 750 ppm. The dilution analysis (Exhibit D) concluded that large volumes of water are necessary to dilute the spent fuel pool water from the proposed 1800 ppm Technical Specification limit to less than the boron concentration limit of 750 ppm. The availability of such large water supplies on site is limited. In addition, the transferability of the available water supplies to the pool is very low due to the small number of possible flow paths and in many cases

impossible due to the physical arrangement of the spent fuel pool relative to the supplies.

A boron dilution event large enough to result in a significant reduction in the spent fuel pool boron concentration will involve the transfer of a large quantity of water from a dilution source and a significant increase in spent fuel pool level which would ultimately result in pool overflow. Such a large water volume turnover, and the likely overflow of the spent fuel pool, would be readily detected and terminated by plant personnel.

In addition, because of the low dilution flow rates available at Prairie Island (Exhibit D), and the large quantities of water required, any significant dilution of the spent fuel pool would only occur over a long period of time (hours to days). Detection of a spent fuel pool dilution via level alarms and/or visual inspections would be expected long before a significant dilution would occur.

Therefore, it is highly unlikely that any dilution event in the spent fuel pool could result the reduction of the spent fuel pool boron concentration to less than the 750 ppm design basis limit.

The spent fuel pool dilution analysis assumes thorough mixing of all the non-borated water added to the spent fuel pool. It is unlikely, with cooling flow and convection from the spent fuel decay heat, that thorough mixing would not occur. However, if mixing was not adequate, it would be conceivable that a localized pocket of non-borated water could form somewhere in the spent fuel pool. This possibility is addressed by the calculation in Exhibit E which shows that the spent fuel rack $K_{eff}$ will be less than 1.0 on a 95/95 basis with the spent fuel pool filled with non-borated water. Thus, even if a pocket of non-borated water formed in the spent fuel pool, $K_{eff}$ would not be expected to exceed 1.0 anywhere in the pool.

## Conclusion

The combination of the following provide a level of safety comparable to the conservative criticality analysis methodology required by References 1, 2 and 3:

1. The 95/95 $K_{eff}$ calculation, which shows that the spent fuel rack $K_{eff}$ will remain less than 1.0 when flooded with unborated water.

2. The proposed Technical Specifications which will ensure that the spent fuel pool boron concentration and storage configuration will be maintained consistent with the assumptions in the criticality analysis, thus maintaining the required margin to criticality.

3. The criticality analysis for the Prairie Island Spent fuel racks which was performed utilizing the methodology in Reference 4 and in accordance with the requirements specified in the October 25, 1996 NRC Safety Evaluation which found the methodology in Reference 4 acceptable.

In conclusion, Northern States Power believes there is reasonable assurance that the health and safety of the public will not be adversely affected by the proposed Technical Specification changes.

## Determination of Significant Hazards Considerations

The proposed changes to the Operating License have been evaluated to determine whether they constitute a significant hazards consideration as required by 10 CFR 50, Section 50.91 using the standards provided in Section 50.92. This analysis is provided below:

1. The proposed amendment will not involve a significant increase in the probability or consequences of an accident previously evaluated.

   There is no increase in the probability of a fuel assembly drop accident in the spent fuel pool when considering the presence of soluble boron in the spent fuel pool water for criticality control. The handling of the fuel assemblies in the spent fuel pool has always been performed in borated water.

   The criticality analysis showed the consequences of a fuel assembly drop accident in the spent fuel pool are not affected when considering the presence of soluble boron.

   There is no increase in the probability of the accidental misloading of spent fuel assemblies into the spent fuel pool racks when considering the presence of soluble boron in the pool water for criticality control. Fuel assembly placement will continue to be controlled pursuant to approved fuel handling procedures and will be in accordance with the Technical Specification spent fuel rack storage configuration limitations. The addition of the spent fuel pool storage configuration surveillance in proposed Specification 4.20 will provide increased assurance that a spent fuel pool inventory verification will be completed in a timely manner after completion of a fuel handling campaign in the spent fuel pool.

   There is no increase in the consequences of the accidental misloading of spent fuel assemblies into the spent fuel pool racks because criticality analyses demonstrate that the pool will remain subcritical following an accidental misloading if the pool contains an adequate boron concentration. The proposed Technical Specifications limitations will ensure that an adequate spent fuel pool boron concentration will be maintained.

There is no increase in the probability of the loss of normal cooling to the spent fuel pool water when considering the presence of soluble boron in the pool water for subcriticality control since a high concentration of soluble boron has always been maintained in the spent fuel pool water.

A loss of normal cooling to the spent fuel pool water causes an increase in the temperature of the water passing through the stored fuel assemblies. This causes a decrease in water density which would result in a decrease in reactivity when Boraflex neutron absorber panels are present in the racks. However, since Boraflex is not considered to be present, and the spent fuel pool water has a high concentration of boron, a density decrease causes a positive reactivity addition. However, the additional negative reactivity provided by the proposed 1800 ppm boron concentration limit, above that provided by the concentration required to maintain $K_{eff}$ less than or equal to 0.95 (750 ppm), will compensate for the increased reactivity which could result from a loss of spent fuel pool cooling event. Because adequate soluble boron will be maintained in the spent fuel pool water, the consequences of a loss of normal cooling to the spent fuel pool will not be increased.

Therefore, based on the conclusions of the above analysis, the proposed changes will not involve a significant increase in the probability or consequences of an accident previously evaluated.

2. <u>The proposed amendment will not create the possibility of a new or different kind of accident from any accident previously analyzed.</u>

Spent fuel handling accidents are not new or different types of accidents, they have been analyzed in Section 14.5.1 of the Updated Safety Analysis Report.

Criticality accidents in the spent fuel pool are not new or different types of accidents, they have been analyzed in the Updated Safety Analysis Report and in Criticality Analysis reports associated with specific licensing amendments for fuel enrichments up to 5.0 weight percent U-235.

The Prairie Island Technical Specifications currently contain limitations on the spent fuel pool boron concentration. Current Specification 3.8.E.2, which covers the storage of restricted fuel assemblies in an unverified condition, and Specification 3.8.B.1.c for the loading of fuel assemblies into a cask in the spent fuel pool, contain requirements for spent fuel pool boron concentration. The actual boron concentration in the spent fuel pool has always been kept at a higher value for refueling purposes. New Specification 3.8.E.2 establishes new boron concentration requirements for the spent fuel pool water consistent with the results of the new criticality analysis (Exhibit E).

Since soluble boron has always been maintained in the spent fuel pool water, and is currently required by Technical Specifications under some circumstances, the implementation of this new requirement will have little effect on normal pool operations and maintenance. The implementation of the proposed new limitations on the spent fuel pool boron concentration will only result in increased sampling to verify boron concentration. This increased sampling will not create the possibility of a new or different kind of accident.

Because soluble boron has always been present in the spent fuel pool and is required by current Technical Specifications as discussed above, a dilution of the spent fuel pool soluble boron has always been a possibility. However, it was shown in the spent fuel pool dilution evaluation (Exhibit D) that a dilution of the Prairie Island spent fuel pool which could reduce the rack $K_{eff}$ to less than 0.95 is not a credible event. Therefore, the implementation of new limitations on the spent fuel pool boron concentration will not result in the possibility of a new kind of accident.

Revised Specifications 3.8.E.1, 5.6.A.1.d and 5.6.A.1.e continue to specify the requirements for the spent fuel rack storage configurations, the only significant changes relate to the criteria for determining the storage configuration. Since the proposed spent fuel pool storage configuration limitations will be similar to those currently in the Prairie Island Technical Specifications, the new limitations will not have any significant effect on normal spent fuel pool operations and maintenance and will not create any possibility of a new or different kind of accident. Verifications will continue to be performed to ensure that the spent fuel pool loading configuration meets specified requirements.

As discussed above, the proposed changes will not create the possibility of a new or different kind of accident. There is no significant change in plant configuration, equipment design or equipment. The accident analysis in the Updated Safety Analysis Report remains bounding.

3. <u>The proposed amendment will not involve a significant reduction in the margin of safety.</u>

The Technical Specification changes proposed by this License Amendment Request and the resulting spent fuel storage operating limits will provide adequate safety margin to ensure that the stored fuel assembly array will always remain subcritical. Those limits are based on a plant specific criticality analysis (Exhibit E) performed in accordance the Westinghouse spent fuel rack criticality analysis methodology described in Reference 4.

While the criticality analysis utilized credit for soluble boron, a storage configuration has been defined using a 95/95 $K_{eff}$ calculation to ensure that the spent fuel rack $K_{eff}$ will be less than 1.0 with no soluble boron. Soluble boron

credit is used to offset uncertainties, tolerances and off-normal conditions and to provide subcritical margin such that the spent fuel pool $K_{eff}$ is maintained less than or equal to 0.95.

The loss of substantial amounts of soluble boron from the spent fuel pool which could lead to exceeding a $K_{eff}$ of 0.95 has been evaluated (Exhibit D) and shown to be not credible.

The evaluations in Exhibit D, which show that the dilution of the spent fuel pool boron concentration from 1800 ppm to 750 ppm is not credible, combined with the 95/95 calculation, which shows that the spent fuel rack $K_{eff}$ will remain less than 1.0 when flooded with unborated water, provide a level of safety comparable to the conservative criticality analysis methodology required by References 1, 2 and 3.

Therefore, the proposed changes in this license amendment will not result in a significant reduction in the plant's margin of safety.

Conclusion

Based on the evaluation above, and pursuant to 10 CFR 50, Section 50.91, Northern States Power Company has determined that operation of the Prairie Island Nuclear Generating Plant in accordance with the proposed license amendment request does not involve any significant hazards considerations as defined by NRC regulations in 10 CFR 50, Section 50.92.

**Environmental Assessment**

Northern States Power has evaluated the proposed changes and determined that:

1. The changes do not involve a significant hazards consideration,

2. The changes do not involve a significant change in the types or significant increase in the amounts of any effluents that may be released offsite, or

3. The changes do not involve a significant increase in individual or cumulative occupational radiation exposure.

Accordingly, the proposed changes meet the eligibility criterion for categorical exclusion set forth in 10 CFR Part 51 Section 51.22(c)(9). Therefore, pursuant to 10 CFR Part 51 Section 51.22(b), an environmental assessment of the proposed changes is not required.

## References

1. USNRC Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants, LWR Edition, NUREG-0800, June 1987.

2. USNRC Spent Fuel Storage Facility Design Bases (for Comment) Proposed Revision 2, 1981, Regulatory Guide 1.13.

3. ANS, Design Requirements for Light Water Reactor Spent Fuel Storage Facilities at Nuclear Power Stations, ANSI/ANS-57.2-1983.

4. WCAP-14416-NP-A, "Westinghouse Spent Fuel Rack Criticality Analysis Methodology", Revision 1, November 1996.