

Mr. Roger O. Anderson, Director
 Licensing and Management Issues
 Northern States Power Company
 414 Nicollet Mall
 Minneapolis, MN 55401

October 10, 1996

SUBJECT: PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNIT NO. 1 - ISSUANCE OF
 AMENDMENT RE: REDUCTION IN THE REQUIRED NUMBER OF IN-CORE
 DETECTORS FOR REMAINDER OF OPERATING CYCLE 18 (TAC NO. M96088)

Dear Mr. Anderson:

The Commission has issued the enclosed Amendment No. 124 to Facility Operating License No. DPR-42 for the Prairie Island Nuclear Generating Plant, Unit No. 1. The amendment consists of a change to the Technical Specifications in response to your application dated July 15, 1996, and supplemented August 22, 1996.

The amendment allows a one-time only reduction in the required number of in-core instrumentation detectors for the remainder of the Unit 1, Cycle 18 operation. Unit 1 has experienced recurrent sticking problems with several detector thimble tube locations thus far in Cycle 18. The technical specification change is needed to allow continued operation if there are any more failures of detector thimble locations before the end of the cycle. To compensate for the increased uncertainty due to the reduced number of operable detectors, the measurement uncertainty for core peaking factors will be increased whenever the required number of detectors drops to 75 percent or below. Also, Northern States Power has committed to use the thermocouple option, per Technical Specification 3.11.C, to monitor quadrant power tilt if the reactor is above 85 percent power and one excore detector is inoperable.

A copy of our related Safety Evaluation is also enclosed. The notice of issuance will be included in the Commission's biweekly Federal Register notice.

Sincerely,

Original signed by:
 Beth A. Wetzel, Project Manager
 Project Directorate III-1
 Division of Reactor Projects - III/IV
 Office of Nuclear Reactor Regulation

Docket Nos. 50-282, 50-306

Enclosures: 1. Amendment No. 124 to DPR-42
 2. Safety Evaluation

cc w/encl: See next page

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Mr. Roger O. Anderson, Director
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March 1995

DATED: October 10, 1996

AMENDMENT NO. 124 TO FACILITY OPERATING LICENSE NO. DPR-42-PRAIRIE ISLAND UNIT 1

Docket File

PUBLIC

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UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

NORTHERN STATES POWER COMPANY

DOCKET NO. 50-282

PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNIT NO. 1

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 124
License No. DPR-42

1. The Nuclear Regulatory Commission (the Commission) has found that:
 - A. The application for amendment by Northern States Power Company (the licensee) dated July 15, 1996, as supplemented August 22, 1996, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in 10 CFR Chapter I;
 - B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;
 - C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;
 - D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public;
and
 - E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.
2. Accordingly, the license is amended by changes to the Technical Specifications as indicated in the attachment to this license amendment, and paragraph 2.C.(2) of Facility Operating License No. DPR-42 is hereby amended to read as follows:

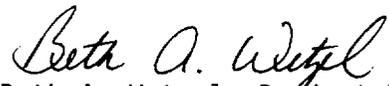
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Technical Specifications

The Technical Specifications contained in Appendix A, as revised through Amendment No. 124, are hereby incorporated in the license. The licensee shall operate the facility in accordance with the Technical Specifications.

3. This license amendment is effective as of the date of issuance and shall remain effective for the remainder of Cycle 18 only.

FOR THE NUCLEAR REGULATORY COMMISSION



Beth A. Wetzel, Project Manager
Project Directorate III-1
Division of Reactor Projects - III/IV
Office of Nuclear Reactor Regulation

Attachment: Changes to the Technical
Specifications

Date of Issuance: October 10, 1996

ATTACHMENT TO LICENSE AMENDMENT NO. 124

FACILITY OPERATING LICENSE NO. DPR-42

DOCKET NO. 50-282

Revise Appendix A Technical Specifications by removing the pages identified below and inserting the attached pages. The revised pages are identified by amendment number and contain vertical lines indicating the area of change.

REMOVE

TS 3.10-1
TS 3.10-2
TS 3.10-3
TS 3.11-1
B 3.11-1

INSERT

TS 3.10-1
TS 3.10-2
TS 3.10-3
TS 3.11-1
B 3.11-1

3.10 CONTROL ROD AND POWER DISTRIBUTION LIMITS

Applicability

Applies to the limits on core fission power distribution and to the limits on control rod operations.

Objective

To assure 1) core subcriticality after reactor trip, 2) acceptable core power distributions during POWER OPERATION, and 3) limited potential reactivity insertions caused by hypothetical control rod ejection.

SpecificationA. Shutdown Margin1. Reactor Coolant System Average Temperature > 200°F

The SHUTDOWN MARGIN shall be greater than or equal to the applicable value shown in Figure TS.3.10-1 when in HOT SHUTDOWN and INTERMEDIATE SHUTDOWN.

2. Reactor Coolant System Average Temperature ≤ 200°F

The SHUTDOWN MARGIN shall be greater than or equal to 1%Δk/k when in COLD SHUTDOWN.

3. With the SHUTDOWN MARGIN less than the applicable limit specified in 3.10.A.1 or 3.10.A.2 above, within 15 minutes initiate boration to restore SHUTDOWN MARGIN to within the applicable limit.

B. Power Distribution Limits1. At all times, except during low power PHYSICS TESTING, measured hot channel factors, F_Q^N and $F_{\Delta H}^N$, as defined below and in the bases, shall meet the following limits:

$$F_Q^N \times 1.03 \times 1.05^* \leq (F_Q^{RTP} / P) \times K(Z)$$

$$F_{\Delta H}^N \times 1.04^{**} \leq F_{\Delta H}^{RTP} \times [1 + PFDH(1-P)]$$

where the following definitions apply:

- F_Q^{RTP} is the F_Q limit at RATED THERMAL POWER specified in the CORE OPERATING LIMITS REPORT.
- $F_{\Delta H}^{RTP}$ is the $F_{\Delta H}$ limit at RATED THERMAL POWER specified in the CORE OPERATING LIMITS REPORT.
- PFDH is the Power Factor Multiplier for $F_{\Delta H}^N$ specified in the CORE OPERATING LIMITS REPORT.
- $K(Z)$ is a normalized function that limits $F_Q(z)$ axially as specified in the CORE OPERATING LIMITS REPORT.

* For Unit 1, Cycle 18, when the number of available moveable detector thimbles is greater than or equal to 50% and less than 75% of the total, the 5% measurement uncertainty shall be increased to $[5\% + (3-T/9)(3\%)]$ where T is the number of available thimbles.

** For Unit 1, Cycle 18, when the number of available moveable detector thimbles is greater than or equal to 50% and less than 75% of the total, the 4% measurement uncertainty shall be increased to $[4\% + (3-T/9)(2\%)]$ where T is the number of available thimbles.

3.10.B.1. - Z is the core height location.

- P is the fraction of RATED THERMAL POWER at which the core is operating. In the F_Q^N limit determination when $P \leq 0.50$, set $P = 0.50$.
- F_Q^N or $F_{\Delta H}^N$ is defined as the measured F_Q or $F_{\Delta H}$ respectively, with the smallest margin or greatest excess of limit.
- 1.03 is the engineering hot channel factor, F_Q^E , applied to the measured F_Q^N to account for manufacturing tolerance.
- 1.05* is applied to the measured F_Q^N to account for measurement uncertainty.
- 1.04** is applied to the measured $F_{\Delta H}^N$ to account for measurement uncertainty.

2. Hot channel factors, F_Q^N and $F_{\Delta H}^N$, shall be measured and the target flux difference determined, at equilibrium conditions according to the following conditions, whichever occurs first:

- (a) At least once per 31 effective full-power days in conjunction with the target flux difference determination, or
- (b) Upon reaching equilibrium conditions after exceeding the reactor power at which target flux difference was last determined, by 10% or more of RATED THERMAL POWER.

F_Q^N (equil) shall meet the following limit for the middle axial 80% of the core:

$$F_Q^N \text{ (equil)} \times V(Z) \times 1.03 \times 1.05^* \leq (F_Q^{RTP} / P) \times K(Z)$$

where $V(Z)$ is specified in the CORE OPERATING LIMITS REPORT and other terms are defined in 3.10.B.1 above.

3. (a) If either measured hot channel factor exceeds its limit specified in 3.10.B.1, reduce reactor power and the high neutron flux trip set-point by 1% for each percent that the measured F_Q^N or by the factor specified in the CORE OPERATING LIMITS REPORT for each percent that the measured $F_{\Delta H}^N$ exceeds the 3.10.B.1 limit. Then follow 3.10.B.3(c).
- (b) If the measured F_Q^N (equil) exceeds the 3.10.B.2 limits but not the 3.10.B.1 limit, take one of the following actions:
 1. Within 48 hours place the reactor in an equilibrium configuration for which Specification 3.10.B.2 is satisfied, or
 2. Reduce reactor power and the high neutron flux trip setpoint by 1% for each percent that the measured F_Q^N (equil) $\times 1.03 \times 1.05^* \times V(Z)$ exceeds the limit.

* For Unit 1, Cycle 18, when the number of available moveable detector thimbles is greater than or equal to 50% and less than 75% of the total, the 5% measurement uncertainty shall be increased to $[5\% + (3-T/9)(3\%)]$ where T is the number of available thimbles.

** For Unit 1, Cycle 18, when the number of available moveable detector thimbles is greater than or equal to 50% and less than 75% of the total, the 4% measurement uncertainty shall be increased to $[4\% + (3-T/9)(2\%)]$ where T is the number of available thimbles.

- 3.10.B.3. (c) If subsequent in-core mapping cannot, within a 24 hour period, demonstrate that the hot channel factors are met, the reactor shall be brought to a HOT SHUTDOWN condition with return to power authorized up to 50% of RATED THERMAL POWER for the purpose of PHYSICS TESTING. Identify and correct the cause of the out of limit condition prior to increasing THERMAL POWER above 50% of RATED THERMAL POWER. THERMAL POWER may then be increased provided F_{Q}^N or $F_{\Delta H}^N$ is demonstrated through in-core mapping to be within its limits.
- (d) If two successive measurements indicate an increase in the peak rod power $F_{\Delta H}^N$ with exposure, either of the following actions shall be taken:
1. F_{Q}^N (equil) shall be multiplied by $1.02 \times V(Z) \times 1.03 \times 1.05^{**}$ for comparison to the limit specified in 3.10.B.2, or
 2. F_{Q}^N (equil) shall be measured at least once per seven effective full power days until two successive maps indicate that the peak pin power, $F_{\Delta H}^N$, is not increasing.
4. Except during PHYSICS TESTS, and except as provided by specifications 5 through 8 below, the indicated axial flux difference for at least three operable excore channels shall be maintained within the target band about the target flux difference. The target band is specified in the CORE OPERATING LIMITS REPORT.
5. Above 90 percent of RATED THERMAL POWER:
- If the indicated axial flux difference of two OPERABLE excore channels deviates from the target band, within 15 minutes either eliminate such deviation, or reduce THERMAL POWER to less than 90 percent of RATED THERMAL POWER.
6. Between 50 and 90 percent of RATED THERMAL POWER:
- a. The indicated axial flux difference may deviate from the target band for a maximum of one* hour (cumulative) in any 24-hour period provided that the difference between the indicated axial flux difference about the target flux difference does not exceed the envelope specified in the CORE OPERATING LIMITS REPORT.
 - b. If 6.a is violated for two OPERABLE excore channels then the THERMAL POWER shall be reduced to less than 50% of RATED THERMAL POWER and the high neutron flux setpoint reduced to less than 55% of RATED THERMAL POWER.

*May be extended to 16 hours during incore/excore calibration.

** For Unit 1, Cycle 18, when the number of available moveable detector thimbles is greater than or equal to 50% and less than 75% of the total, the 5% measurement uncertainty shall be increased to $[5\% + (3-T/9)(3\%)]$ where T is the number of available thimbles.

3.11 CORE SURVEILLANCE INSTRUMENTATION

Applicability

Applies to the OPERABILITY of the moveable detector instrumentation system and the core thermocouple instrumentation system.

Objective

To specify OPERABILITY requirements for the moveable detector and core thermocouple systems.

Specification

- A. The moveable detector system shall be OPERABLE following each refueling so that the power distribution can be confirmed. If the moveable detector system is degraded to the extent that less than 75% of the detector thimbles are available, the measurement error allowance due to incomplete mapping shall be substantiated by the licensee.
- B. A minimum of 2 moveable detector thimbles per quadrant*, and sufficient detectors, drives, and readout equipment to map these thimbles, shall be operable during recalibration of the excore axial offset detection system per Specification 4.1. If this OPERABILITY for recalibration of excore nuclear instruments when required by Specification 4.1 cannot be achieved, power shall be limited to 90% of RATED THERMAL POWER until recalibration is completed in accordance with this specification.
- C. A minimum of 4 thermocouples or 2 moveable detectors per quadrant shall be operable for readout if the reactor is operated above 85% of RATED THERMAL POWER with one excore nuclear power channel inoperable (see Specification 3.10.C.4).
- D. The provisions of specification 3.0.C are not applicable.

* For Unit 1, Cycle 18, when the number of available moveable detector thimbles is greater than or equal to 50% and less than 75% of the total, there should be a minimum of two thimbles available per quadrant, where quadrant includes both horizontal-vertical quadrants and diagonally-bounded quadrants (eight individual quadrants in total).

3.11 CORE SURVEILLANCE INSTRUMENTATION

Bases

The moveable detector system is used to measure the core fission power density distribution. A power map made with this system following each fuel loading will confirm the proper fuel arrangement within the core. The moveable detector system is designed with substantial redundancy so that part of the system could be out of service without reducing the value of a power map. If the system is severely degraded, large measurement uncertainty factors must be applied. The uncertainty factors would necessarily depend on the operable configuration.

Two detector thimbles per quadrant are sufficient to provide data for the normalization of the excore detector system's axial power offset feature.

For Unit 1, Cycle 18, when the number of available moveable detector thimbles is greater than or equal to 50% and less than 75% of the total, the requirements are modified to require a minimum of two thimbles available per quadrant, where quadrant includes both horizontal-vertical quadrants and diagonally-bounded quadrants (eight individual quadrants in total). This requirement arises from the use of random thimble deletion events as the basis for the Westinghouse analysis. As a result of random failures, distribution of remaining thimbles would be relatively uniform, while systematic failure could result in large areas of the core being uninstrumented. In order to apply the error correction developed in the Westinghouse analysis, and to establish the bounds of applicability of the peaking factor uncertainties, coverage is required in each of the eight quadrants defined above.

The core thermocouples provide an independent means of measuring the balance of power among the core quadrants. If one excore power channel is out of service, it is prudent to have available an independent means of determining the quadrant power balance.

The moveable detector system and the thermocouple system are not integral parts of the reactor protection system. These systems are, rather, surveillance systems which may be required in the event of an abnormal occurrence such as a power tilt or a control rod misalignment. Since such occurrences cannot be predicted a priori, it is prudent to have the surveillance systems in an OPERABLE state.



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION
RELATED TO AMENDMENT NO. 124 TO FACILITY OPERATING LICENSE NO. DPR-42
NORTHERN STATES POWER COMPANY
PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNIT NO. 1

1.0 INTRODUCTION

By letter dated July 15, 1996, and supplemented August 22, 1996, the Northern States Power Company (NSP or the licensee) requested an amendment to the Technical Specifications (TS) appended to Facility Operating License No. DPR-42 for the Prairie Island Nuclear Generating Plant, Unit No. 1. The proposed amendment would reduce the number of required in-core detectors necessary for continued operation for the remainder of Cycle 18 only.

The Prairie Island Unit 1 Movable Incore Detection System (MIDS) contains a total of 36 instrumentation thimbles in the core. TS 3.11.A requires that at least 75 percent of the detector thimbles be operable with a minimum of two detector thimbles per quadrant when performing a flux map to ensure compliance with the peaking factor requirements of TS 3.10.B. The surveillance requirements of Specification 3.10.B.2 require that the peaking factors must be determined to be within limits at least once per 31 effective full power days. Due to the increase in incore detector thimble failures at Prairie Island Unit 1 during Cycle 18 thus far, Northern States Power has proposed a change that will allow plant operation with the number of operable detector thimbles reduced to a minimum of 50 percent. To compensate for the increased uncertainty as the number of operable detector thimbles is reduced, the measurement uncertainty for F_{AH} and F_Q will be increased whenever the number of detectors is between 27 and 18. Changes are also proposed to TS 3.11.B to clarify the requirements for the number of detector thimbles required per core quadrant when the number of available detector thimbles is less than 75 percent.

During the last few cycles the moveable incore detectors have had sticking problems which resulted in the thimbles not being accessible. Because of these problems the Unit 1 thimbles were cleaned following Cycle 15 and six thimbles were replaced and the slip clutches were either rebuilt or replaced at the end of Cycle 16. Following Cycle 17, 35 of the 36 thimbles were eddy-current tested successfully. However, when the first map for Cycle 18 was taken, only 29 thimbles were accessible. Up to 32 were accessible for some maps, but for the last several maps only 29 have been accessible.

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2.0 EVALUATION

Essentially all pressurized-water reactor (PWR) TS contain a requirement for operability of 75 percent of the in-core detector locations for mapping of the core power distribution. On a number of occasions, for various reasons, failures of detector thimbles in operating PWRs have approached or exceeded 25 percent, and relaxation of the 75 percent requirement has been permitted for the remainder of the affected operating cycle.

In-core detector data is used to calculate power peaking factors which are used to verify compliance with fuel performance limits. As the number of inoperable detector segments increases, the uncertainties in the power distribution calculation increase. The requirement for maintaining 75 percent of the detector thimbles available provides for a reasonable number of failures of the in-core detectors while encouraging licensees to strive for maintaining the system as near to 100 percent available as possible. TS 3.11A allows continued use of the movable in-core detector system with less than 75 percent of the thimbles available if the measurement error allowance due to incomplete flux mapping is substantiated.

The licensee submitted an analysis performed by the vendor, Westinghouse, which assessed the impacts of a reduction to a minimum of 18 of the 36 movable detector thimbles for Prairie Island Unit 1, Cycle 18. The analysis indicated that additional uncertainties of 2 percent for $F_{\Delta H}^N$ and 3 percent for F_q^N are appropriate when the number of instrumented assemblies is reduced from 36 to 18. The additional uncertainties should be applied linearly from below 75 percent to greater than 50% detector thimble locations. In addition the Westinghouse analysis assumed random deletion of the thimbles. If the thimbles were systematically deleted from use, the calculated peaking factor uncertainties would not apply. Thus there is an additional requirement that when the number of detector locations is less than 75 percent, there should be a minimum of two thimbles available per quadrant, where quadrant includes both horizontal-vertical quadrants and diagonally bounded quadrants (eight quadrants in all). This requirement improves the ability to distinguish between random and systemic thimble deletion events and establishes the bounds of applicability of the peaking factor uncertainties.

The licensee has provided the results of core maps for Cycle 18. These show that there is currently approximately 5 percent margin to the $F_{\Delta H}^N$ TS limit and approximately 9.5 percent margin to the F_q^N TS limit. Since the unit does not load follow and the peaking factors normally tend to decrease with burnup, we would expect the margin to increase from now till the end of the cycle.

Another safety concern relating to degradation of in-core mapping ability is the ability to detect anomalous conditions in the core. One of these is inadvertent loading of a fuel assembly into an improper position. Since this is a loading problem, it is not of concern for the remainder of the operating cycle. Furthermore, review of the Cycle 18 startup physics test results showed very good agreement between predictions and measurements, thus giving more assurance that the core is as designed. Other anomalous conditions are conceived to produce either an axial or radial effect, which would cause either a change in quadrant tilt ratio or axial offset ratio. These are

monitored by the excore detectors and would help identify problems not fully detectable with reduced in-core mapping capability. Furthermore, the core exit thermocouples in the reactor provide a useful supplement to the in-core detectors to detect problems.

According to TS 3.11.C, if one of the power range neutron flux detectors (excore detectors) is inoperable, power operation above 85 percent may continue if quadrant tilt is monitored by the in-core detectors or by the core exit thermocouples. During operation with fewer than 75 percent of the incore detectors operable, the licensee has indicated that the thermocouple option would be the one chosen.

Our review of the suitability of operation of the Prairie Island Unit 1 reactor for the remainder of Cycle 18 with a reduced number of movable in-core thimbles locations to as few as 50 percent indicated adequate margin exists at this time in Cycle 18 and sufficiently increased uncertainty allowances have been made to ensure that TS peaking factor limits will be met. In addition, there are adequate supplemental indicators of anomalous conditions to preclude an unsafe condition from escaping detection in the absence of full in-core detector mapping capability.

3.0 TECHNICAL SPECIFICATION CHANGES

3.1 TS 3.10.B.1, 3.10.B.2, 3.10.B.3.b.1, and 3.10.B.3.d.1

The changes increase the measurement uncertainty for F_o^N and F_{AH}^N when the number of operable in-core detector thimbles is between 75 percent (27) and 50 percent (18) of the total number of detectors. The change in the uncertainty has been justified and is therefore acceptable.

3.2 TS 3.11.B

The change adds a footnote that states that for Unit 1 Cycle 18, with greater than 50 percent and less than 75 percent detector thimbles available, the two thimble per quadrant requirement must be met for each of the four horizontal-vertical quadrants and the four diagonally bounded quadrants (eight individual quadrants in total). The proposed change was added to establish the bounds of applicability of the evaluation and is acceptable.

3.3 Conclusions

Based on the staff evaluation in Section 2.0 above, the staff concludes that the proposed TS changes are acceptable. The licensee has agreed to use the thermocouple option if one excore detector is inoperable and there are fewer than 75 percent of the in-core detector thimbles available. These changes are for the remainder of Cycle 18 only.

4.0 STATE CONSULTATION

In accordance with the Commission's regulations, the Minnesota State official was notified of the proposed issuance of the amendment. The State official had no comments.

5.0 ENVIRONMENTAL CONSIDERATION

The amendment changes a requirement with respect to installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20. The NRC staff has determined that the amendment involves no significant increase in the amounts, and no significant change in the types, of any effluents that may be released offsite, and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding that the amendment involves no significant hazards consideration and there has been no public comment on such finding (61 FR 40024). Accordingly, the amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the issuance of the amendment.

6.0 CONCLUSION

The Commission has concluded, based on the considerations discussed above, that: (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

Principal Contributor: Margaret S. Chatterton

Date: October 10, 1996