NMC
Committed to Nuclear Excellence

Nuclear Management Company, LLC
Prairie Island Nuclear Generating Plant
1717 Wakonade Dr. East • Welch MN 55089

January 25, 2002

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

PRAIRIE ISLAND NUCLEAR GENERATING PLANT
Docket Nos. 50-282 License Nos. DPR-42
50-306 DPR-60

F_Q^A Methodology and Shutdown Margin During Physics Tests Methodology

By letter dated December 11, 2000, Prairie Island submitted proposed Improved Technical Specifications (ITS). In support of certain of the proposed specifications, two new methodologies were developed. These two new methodologies are described in detail in Attachments 1 and 2.

Attachment 1 discusses the method by which the required Shutdown Margin (SDM) during PHYSICS TESTS initiated in MODE 2 shall be established for Prairie Island. PHYSICS TEST Exception – MODE 2 was incorporated in Prairie Island proposed ITS, specification 3.1.8. One requirement of the proposed specification is that the SDM remain within the limits provided in the Core Operating Limits Report (COLR) during the performance of the PHYSICS TESTS. The purpose of Attachment 1 is to describe the method by which the SDM limit during physics testing is established for inclusion within the COLR.

Attachment 2 discusses the method by which a factor, F_Q^A, is to be determined. F_Q^A is the factor to increase $F_Q^W(Z)$ in the event measurement indicates that the maximum over z $\left[\frac{F_Q^C(Z)}{K(Z)}\right]$ has increased since the previous evaluation of $F_Q^C(Z)$. Proposed ITS specification 3.2.1, Heat Flux Channel Factor, ($F_Q(Z)$), requires that, when measurements indicate that the maximum over z of $\left[\frac{F_Q^C(Z)}{K(Z)}\right]$ has increased since the

A001

NUCLEAR MANAGEMENT COMPANY, LLC

previous evaluation of $F_Q^C(Z)$, either:

(1) a factor – F_Q^A, specified in the COLR – must be applied to increase $F_Q^W(Z)$, or
(2) flux map measurements must be taken every 7 effective full power days (EFPD).

After application of F_Q^A, $F_Q^W(Z)$ must meet the limits specified in the COLR. If this requirement is not met, flux map measurements must be taken every 7 EFPD until the maximum over z $\left[\frac{F_Q^C(Z)}{K(Z)}\right]$ has not increased, rather than every 31 EFPD as is normally required. Attachment 2 describes the method by which F_Q^A is determined.

Prairie Island seeks NRC approval of the two methodologies described in Attachments 1 and 2 in support of our conversion to ITS.

In this letter we have made no new Nuclear Regulatory Commission commitments. Please contact Jeff Kivi (651-388-1121) if you have any questions related to this letter.

Mano K. Nazar
Site Vice President
Prairie Island Nuclear Generating Plant

c: Regional Administrator - Region III, NRC
Senior Resident Inspector, NRC
NRR Project Manager, NRC
J E Silberg

Attachments:

1. NAD-PI-003, "Prairie Island Nuclear Power Plant Required Shutdown Margin During Physics Tests," Revision 0.
2. NAD-PI-004, "Prairie Island Nuclear Power Plant $F_Q^W(Z)$ Penalty with Increasing $\left[\frac{F_Q^C(Z)}{K(Z)}\right]$ Trend," Revision 0.

NMC
Committed to Nuclear Excellence

Prairie Island Nuclear Power Plant

Required Shutdown Margin During Physics Tests

NAD-PI-003
Revision 0

January, 2001

Nuclear Management Company
Nuclear Analysis and Design

Prairie Island Nuclear Generating Plant

Required Shutdown Margin during Physics Tests

NAD-PI-003

Revision 0

January, 2001

Prepared by: ______________________ Date: 1/16/2001
Keith G. Dehnbostel

Reviewed by: ______________________ Date: 1-16-2001
H. Oley Nelson

Approved by: ______________________ Date: 1/16/2001
Cliff A. Bonneau

ABSTRACT

This document is a Topical Report describing the method by which the required Shutdown Margin (SDM) during PHYSICS TESTS initiated in MODE 2 shall be established for the Prairie Island Nuclear Generating Plant.

LEGAL NOTICE

TABLE OF CONTENTS

1.0 INTRODUCTION 5

2.0 BACKGROUND 5

3.0 METHODOLOGY 5

4.0 BASES 5

5.0 SUMMARY 6

6.0 REFERENCES 6

1.0 INTRODUCTION

This document discusses the method by which the required Shutdown Margin (SDM) during PHYSICS TESTS initiated in MODE 2 shall be established for the Prairie Island Nuclear Generating Plant.

2.0 BACKGROUND

As part of the change to Improved Standard Technical Specifications (ISTS) for Prairie Island, specification 3.1.8: PHYSICS TESTS Exceptions – MODE 2 was incorporated. One requirement of this specification is that the SDM remain within the limits provided in the Core Operating Limits Report (COLR) during the performance of the PHYSICS TESTS. The purpose of this document is to discuss the method by which the SDM limit during physics testing is established for inclusion within the COLR.

3.0 METHODOLOGY

For the ISTS, the required SDM during physics testing will be set as 0.5% Δk. This SDM value will be used to determine the limiting reactor configuration allowed during physics testing. The limiting configuration will take into account Rod Cluster Control Assembly (RCCA) positions, reactor thermal power and Reactor Coolant System (RCS) loop average temperature as allowed by specification 3.1.8: PHYSICS TESTS Exceptions – MODE 2. From the limiting reactor configuration, the ability must be maintained to take the reactor 0.5% Δk subcritical in the event of a reactor trip in which all RCCAs that are not inserted or partially inserted drop into the reactor core with the exception of the single RCCA of highest reactivity worth, which is assumed to be fully withdrawn. The required SDM, 0.5% Δk, shall be incorporated within the COLR and the reactor shall never be taken to a more limiting configuration during physics testing.

4.0 BASES

The basis for incorporating a restriction on the allowed reactor configuration during physics testing is to ensure that there is sufficient trippable reactivity to bring the reactor to a subcritical condition at any point during physics testing even if the highest worth RCCA is fully withdrawn. There is no specific event or accident that is being protected against for which a specific shutdown margin is required. The purpose of physics testing is to ensure that the operating characteristics of the core are consistent with the design predictions and that the core can be operated as designed. A value of 0.5% Δk shutdown margin was chosen to provide additional margin in ensuring that the reactor can be taken subcritical in the event of a reactor trip by action of the control rods alone if the highest worth RCCA remains fully withdrawn.

When determining the limiting reactor configuration, consideration is given to the range of thermal power and RCS temperature allowed by specification 3.1.8 since these two parameters may slightly impact SDM. Consideration is also given to the range of control rod patterns allowed during physics testing. For example, when RCCA worths are measured by the boration/dilution technique, all control bank RCCAs may be fully inserted in the reactor core. The shutdown bank RCCAs may also be slightly inserted to return the reactor to a critical configuration if the RCS boron concentration has been slightly over-diluted during the control bank measurements.

5.0 SUMMARY

The required SDM during physics testing will be set as 0.5% Δk. The required SDM shall be incorporated within the COLR and the reactor shall never be taken to a more limiting configuration throughout physics testing.

6.0 REFERENCES

1) NSPNAD-8101-A (latest approved revision), Qualification of Reactor Physics Methods for Application to Prairie Island, October 2000

NMC
Committed to Nuclear Excellence

Prairie Island Nuclear Power Plant

$F_Q^W(Z)$ Penalty with Increasing $\left[\frac{F_Q^C(Z)}{K(Z)}\right]$ Trend

NAD-PI-004
Revision 0

January, 2001

Nuclear Management Company
Nuclear Analysis and Design

Prairie Island Nuclear Generating Plant

$F_Q^W(Z)$ Penalty with Increasing $\left[\dfrac{F_Q^C(Z)}{K(Z)}\right]$ Trend

NAD-PI-004

Revision 0

January, 2001

Prepared by: Keith G. Dennbostel Date: 1/16/2001

Reviewed by: H. O. Nelson

H. Oley Nelson Date: 1-16-2001

Approved by: Clifford Bonneau

Cliff A. Bonneau Date: 1/17/01

ABSTRACT

This document is a Topical Report describing the method by which a factor, $F_Q{}^A$, is determined. $F_Q{}^A$ is the factor to increase $F_Q^W(Z)$ in the event measurement indicates that the maximum over z $\left[\frac{F_Q^C(Z)}{K(Z)}\right]$ has increased since the previous evaluation of $F_Q^C(Z)$.

LEGAL NOTICE

TABLE OF CONTENTS

1.0 INTRODUCTION 5

2.0 BACKGROUND 5

3.0 METHODOLOGY 5

4.0 BASES 6

5.0 SUMMARY 7

6.0 REFERENCES 7

1.0 INTRODUCTION

This document discusses the method by which a factor, hereafter referred to as F_Q^A, shall be determined. F_Q^A is the factor to increase $F_Q^W(Z)$ in the event measurement indicates that the maximum over z $\left[\frac{F_Q^C(Z)}{K(Z)}\right]$ has increased since the previous evaluation of $F_Q^C(Z)$.

2.0 BACKGROUND

Improved Standard Technical Specification (ISTS) 3.2.1: Heat Flux Hot Channel Factor ($F_Q(Z)$) requires that when measurements indicate that the maximum over z of $\left[\frac{F_Q^C(Z)}{K(Z)}\right]$ has increased since the previous evaluation of $F_Q^C(Z)$, either a factor F_Q^A, specified in the Core Operating Limits Report (COLR), must be applied to increase $F_Q^W(Z)$ or flux map measurements must be taken every 7 Effective Full Power Days (EFPD). After application of F_Q^A, $F_Q^W(Z)$ must meet the limits specified in the COLR. If this requirement is not met, flux map measurements must be taken every 7 EFPD until the maximum over z $\left[\frac{F_Q^C(Z)}{K(Z)}\right]$ has not increased, rather than every 31 EFPD as is normally required. The purpose of this document is to discuss the method by which the factor F_Q^A shall be determined.

3.0 METHODOLOGY

The computer model and reactor physics methodology that will be used to determine F_Q^A shall be consistent with that in Reference 1, or another approved methodology. The approach will have two parts. First, a bounding percentage increase at a 95%/95% level of confidence in the maximum over z $\left[\frac{F_Q^C(Z)}{K(Z)}\right]$ will be determined. The bounding percentage increase will be determined using historical data at approximately 31 day intervals from at least 3 completed cycles. Second, for each upcoming cycle, the percentage increase in the maximum F_Q nuclear prediction $(F_Q^P(Z))$ will be calculated over approximately 31 EFPD intervals from the Beginning of the Cycle (BOC) until the End of the Cycle (EOC). The greater of the two values, one based on historical data, and one based on the predicted change in the maximum $F_Q^P(Z)$ shall be used to set F_Q^A. F_Q^A shall be reported in the COLR. The F_Q^A reported in the COLR may vary with cycle exposure. The maximum $F_Q^P(Z)$ values may be taken from a predictive cycle depletion from BOC to EOC assuming nominal operating conditions.

4.0 BASES

The basis for increasing the $F_Q^W(Z)$ by an additional factor, $F_Q{}^A$, based on observed changes in $\left[\frac{F_Q^C(Z)}{K(Z)}\right]$ between flux maps lies in the requirement that flux maps be taken only once every 31 EFPD. The concern is that if $\left[\frac{F_Q^C(Z)}{K(Z)}\right]$ shows an increasing trend between two successive flux maps, it may increase by such an amount during the next 31 EFPD that $F_Q^W(Z)$ could exceed the $F_Q(Z)$ limit prior to the taking of the next map. Applying the factor $F_Q{}^A$ to $F_Q^W(Z)$ based on the maximum expected increase in $F_Q^P(Z)$ should ensure that the COLR limit on $F_Q(Z)$ will not be exceeded prior to the taking of the next map. Furthermore, establishing a minimum value for $F_Q{}^A$ based on historical changes in the maximum over z of $\left[\frac{F_Q^C(Z)}{K(Z)}\right]$ adds conservatism to the calculation of $F_Q{}^A$.

Using $F_Q^P(Z)$ prior to the application of any calculated V(Z) penalty to determine the factor $F_Q{}^A$ is consistent with the plant monitoring the trend in $\left[\frac{F_Q^C(Z)}{K(Z)}\right]$ to determine whether to apply the factor $F_Q{}^A$.

The V(Z) factor is applied to $\left[\frac{F_Q^C(Z)}{K(Z)}\right]$ to account for variations from steady state operation. The concern over increasing trends in $\left[\frac{F_Q^C(Z)}{K(Z)}\right]$ is in regard to the base nuclear $F_Q(Z)$ prior to application of the V(Z) factor. Use of 31 EFPD in the calculation of the factor $F_Q{}^A$ is consistent with the maximum period allowed between flux maps and will therefore provide for the maximum observed increase in $F_Q^P(Z)$ between flux maps.

5.0 SUMMARY

A factor F_Q^A will be calculated which is the amount by which $F_Q^W(Z)$ will be increased if the maximum over z of $\left[\frac{F_Q^C(Z)}{K(Z)}\right]$ increases for any two consecutive measurements. F_Q^A will be determined by considering both increases in the maximum over z of $\left[\frac{F_Q^C(Z)}{K(Z)}\right]$ from previous cycles and also increases in $F_Q^P(Z)$, the maximum F_Q nuclear prediction, over approximately 31 EFPD operating periods from BOC until EOC for the cycle of interest. F_Q^A may vary with cycle exposure. F_Q^A shall be included in the COLR.

6.0 REFERENCES

1) NSPNAD-8101-A (latest approved revision), Qualification of Reactor Physics Methods for Application to Prairie Island, October 2000