GE Nuclear Energy

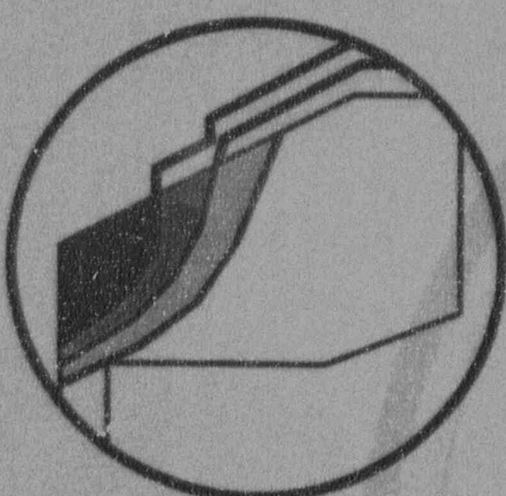
175 Curtner Avenue
San Jose, CA 95125

NEDO-32339
Supplement 4
Class 1
October 1995
With Errata 2/26/96 and 4/19/96 Incorporated

Licensing Topical Report

Reactor Stability Long-Term Solution: Enhanced Option I-A

Generic Technical Specifications



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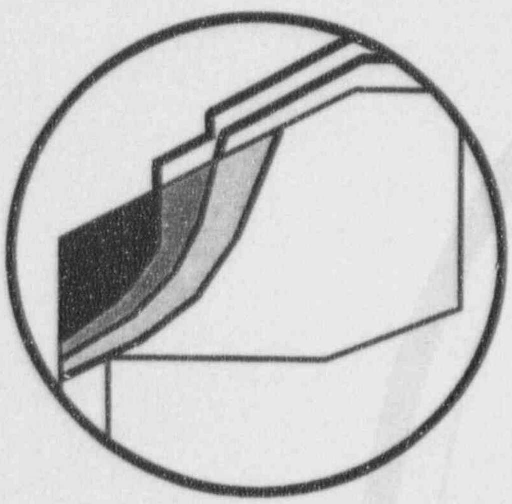

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Reactor Stability Long-Term Solution:
Enhanced Option I-A
Generic Technical Specifications

Errata 11/18/96

Prepared for the
Boiling Water Reactor Owners' Group

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Contents of this Report

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ABSTRACT

The Enhanced Option I-A (E1A) stability long-term solution takes a preventive approach to compliance with General Design Criterion 12. The licensing basis methodology of the E1A stability solution consists of stability regions defined on the reactor core power and flow operating domain which exclude and restrict operation under conditions anticipated to be susceptible to reactor instability. Features of the solution require the modification of existing Technical Specifications. Changes to the Standard Technical Specifications and associated Bases required for implementation of the solution are presented. Features of the solution which do not require changes to the Technical Specifications are identified.

ACRONYMS AND ABBREVIATIONS

APRM	Average Power Range Monitor
BWR	Boiling Water Reactor
BWROG	Boiling Water Reactor Owners' Group
CFR	Code of Federal Regulations
COLR	Core Operating Limits Report
DR	**Decay Ratio**
E1A	Enhanced Option I-A
FCBB	Fraction of Core Boiling Boundary
FCTR	Flow Control Trip Reference
FRE	Flow Reduction Event
GDC	General Design Criterion
LOFH	Loss of Feedwater Heating
LCO	Limiting Condition for Operation
LPRM	Local Power Range Monitor
MCPR	Minimum Critical Power Ratio
PBDS	Period Based Detection System
RPS	Reactor Protection System
RREA	**Restrictive Region Entry Alarm**
SLO	Single Loop Operations
STS	Standard Technical Specifications
TS	Technical Specification

1. INTRODUCTION

1.1 Background

The Enhanced Option I-A (E1A) stability long-term solution description and licensing methodology are documented in Licensing Topical Report NEDO-32339-A (Reference 1). The E1A solution takes a preventive approach to compliance with General Design Criterion (GDC) 12. Reactor instability prevention is accomplished by a combination of licensing and defense-in-depth features. These features are fully described in Reference 1. The implementation of some of these features require changes to existing plant-specific Technical Specifications (TS). Conceptual changes to the improved Standard TS (References 2 and 3) were presented in Appendix D of Reference 1.

The purpose of this supplement to NEDO-32339 is to provide changes to the improved Standard Technical Specifications (STS) which have been optimized for implementation of the E1A solution. These optimized STS changes supersede the conceptual TS presented in Appendix D of Reference 1. The optimized changes to the STS and the associated Bases were prepared to conform with the format and scope of the STS (References 2 and 3) and the NRC final policy statement on TS improvements (Reference 4). The optimized TS and Bases changes are intended to be referenced in plant-specific TS submittals.

1.2 General Approach

Generation of the optimized STS for the E1A stability solution was initiated by identification of all E1A features described in Reference 1 which require changes to the STS. Features not requiring changes to the STS were noted and the methods used to ensure the availability of these features identified. Changes to the STS were then prepared along with a complete Bases discussion for required features. These changes to the STS and Bases were prepared to conform to the format and scope of the STS, the NRC final policy statement and reactor operational objectives. Each of the E1A solution features which require changes to the STS is discussed in Section 2.1. Consistent with the final policy statement

and the format and scope of the STS, the purpose of each change to the STS is provided in the Bases for the TS.

During the development of the optimized STS several issues required resolution of conflicting objectives. Resolution was reached by establishing positions consistent with the E1A solution approach of preventing instability and providing progressive defense-in-depth protection. These issues, the positions established, and justification for these positions are discussed in Section 2.2.

Features of the E1A stability long-term solution which are not included in the TS are identified in Section 2.3. Requirements for these features are to be included in owner controlled documents.

1.3 Summary

Progressive licensing and defense-in-depth features are incorporated in the E1A stability solution. These features provide substantial protection from anticipated and unanticipated reactor state conditions and transients that may otherwise result in reactor instability. The licensing features provide the necessary protection to comply with GDC-12. The defense-in-depth features which exist in a backup role to the licensing features, provide additional assurance for prevention of reactor instability.

Optimized changes to the STS were prepared for the E1A stability long-term solution and include the addition of two new Limiting Condition for Operation (LCO) specifications for "Fraction of Core Boiling Boundary (FCBB)" and "Period Based Detection System (PBDS)." Specifically, the new FCBB LCO requires a minimum core average boiling elevation with Average Power Range Monitor (APRM) flow biased setpoints "Setup" prior to operation in the Restricted Region. The new PBDS LCO places restrictions on operation in the Monitored Region and the Restricted Region.

Modifications to the STS include changes and additions to existing LCOs for "Reactor Protection System Instrumentation" and "Recirculation Loops Operating." Specifically, the "Reactor Protection System Instrumentation" LCO is modified to accommodate functional performance testing of the E1A Flow Control

Trip Reference (FCTR) card. Additionally, it is modified to replace an existing footnote with one that indicates APRM flow biased setpoints are specified in the Core Operating Limits Report (COLR). The original footnote in this LCO referenced the APRM flow biased setpoints for Single Loop Operation (SLO). The existing "Recirculation Loops Operating" LCO is changed to indicate that during SLO, applicable APRM flow biased setpoints are specified in the COLR. This existing LCO is also changed by deleting the footnote that identifies this LCO as one which may be modified with resolution of the stability issue.

The optimized changes to Section 3 of the STS are presented in Appendix A with associated changes to the Bases presented in Appendix B.

2. TECHNICAL SPECIFICATION IMPLEMENTATION

2.1 Solution Features

The E1A stability long-term solution prevents neutronic/thermal hydraulic instability and thereby ensures conformance with GDC-12. Prevention of instability is maintained by limiting reactor operation, including conditions resulting from unexpected transients, to prescribed power and flow conditions. The region of the reactor power and flow operating domain that must be excluded from the licensed operating domain due to the potential for neutronic/thermal hydraulic instability is designated the Exclusion Region.

A portion of the licensed operating domain, immediately adjacent to the Exclusion Region is defined as the Restricted Region. Planned operation in the Restricted Region requires implementation of stability controls prior to entry. The APRM flow biased control rod block setpoint coincides with the lower boundary of the Restricted Region and thereby provides an automatic indication of uncontrolled entry into the Restricted Region. To facilitate intentional entry into the Restricted Region once stability controls are in place, the APRM flow biased control rod block setpoint is "Setup." With the "Setup" setpoint value selected, the setpoint is elevated above the normal "non-Setup" value and entry into the Restricted Region does not result in an APRM flow biased control rod block. Operation in the Restricted Region with stability controls implemented reduces the susceptibility to neutronic/thermal hydraulic instability. The APRM flow biased scram setpoint is also elevated to preserve the margin between the rod block and scram setpoints. The E1A licensed operating domain remains unchanged with the "Setup" setpoint values selected.

The removal of the Exclusion Region from the licensed operating domain, the requirement for stability controls to operate in the Restricted Region, and the Restricted Region boundary which is defined by the APRM flow biased control rod block in the absence of stability controls are licensing features of the E1A stability solution. These licensing features are reviewed further and their impacts on the content of the STS are identified in Section 2.1.1.

In addition to the licensing features, defense-in-depth features are incorporated into the E1A stability solution. Defense-in-depth features are not required to assure conformance with GDC-12 but are introduced as backup measures to address the intricate relationship among the many parameters that influence reactor core stability. These features, which exist in a backup role to the licensing methodology, provide additional assurance for prevention of reactor instability.

Automatic defense-in-depth features include alarm annunciation upon uncontrolled entry into the Restricted Region, control room alarm upon indication of conditions consistent with imminent onset of instability as detected by the PBDS, automatic setdown of the APRM flow biased setpoints and APRM flow biased scram clamp above the Restricted Region. The impact of these automatic defense-in-depth features on the optimized TS are reviewed and discussed in Section 2.1.2.

Manual defense-in-depth features include required operator actions based on PBDS instrumentation indications and occurrence of unexpected transients. The impacts of these manual defense-in-depth features are reviewed and discussed in Sections 2.1.3 and 2.1.4.

2.1.1 Licensing Features

Enhanced Option I-A demonstrates compliance with GDC-12 solely through the use of licensing features that ensure reactor coupled neutronic/thermal hydraulic instabilities will not occur considering reasonably limiting anticipated operating conditions. In this manner, protection of the fuel Minimum Critical Power Ratio (MCPR) safety limit is assured. The licensing features are summarized in Table 2-1.

Controlled operation of a BWR is restricted to a licensed core power and flow operating domain. Operation outside this licensed operating domain may result in anticipated operational occurrences and postulated accidents being initiated from conditions beyond those assumed in the safety analysis. As a backup to the reactor operator, gross violation of this operating domain is prevented by the APRM flow biased scram function. **Prior to implementation of**

E1A t~~T~~he APRM flow biased scram function is not specifically credited in the **safety**~~accident~~ analysis.

The E1A licensing features modify the licensed core power and flow operating domain by removing the Exclusion Region and requiring implementation of stability controls upon entry into the Restricted Region. The E1A licensing methodology used to demonstrate adequate prevention of reactor instability for anticipated operational occurrences initiated from within the licensed operating domain relies on the existence of the APRM flow biased scram function **which is coincident with the Exclusion Region boundary**~~below 40% core flow~~. The**se** APRM flow biased scram setpoints ~~below 40% core flow~~ are dependent on plant specific reactor, fuel and core design parameters. No credit for the APRM flow biased scram function **where it is not coincident with the Exclusion Region boundary** ~~above 40% core flow~~ is taken in the **safety**~~accident~~ analysis.

The reactor scram generated by the E1A APRM flow biased scram function **in the Exclusion Region** ~~below 40% core flow~~ is pre-emptive and prevents power and flow conditions outside the licensed operating domain that may be susceptible to reactor instability. The E1A stability solution assures compliance with GDC-12 by the prevention of reactor instability. Therefore, demonstration that anticipated operational occurrences involving reactor instability comply with GDC-10 is not necessary. The APRM flow biased scram function **coincident with the Exclusion Region boundary**~~below 40% core flow~~ is pre-emptive and is not directly used to protect the MCPR safety limit and therefore, does not meet the criteria for inclusion in TS as a limiting safety system setting.

However, since the APRM flow biased scram function is a feature of the E1A stability solution necessary to ensure compliance with GDC-12, it is retained in the optimized TS presented in Appendix A. The allowable values for the APRM flow biased scram function are moved to the COLR as noted in Table 2-1 consistent with their use in the plant safety analysis. Placement of the APRM flow biased scram function allowable values in the COLR also facilitates the revision of the allowable values as it becomes necessary to update them due to changes in core or fuel designs which affect the boundary of the Exclusion Region and the reactor licensed operating domain.

The normal "non-Setup" APRM flow biased control rod block setpoint coincides with the lower boundary of the Restricted Region. In this way, the automatic APRM flow biased rod block assists the operator in the identification that an uncontrolled entry of the Restricted Region has occurred. Monitoring of entry in to the Restricted Region, including uncontrolled entry, is required by the FCBB specification included in Appendix A. The APRM flow biased control rod block function prior to the implementation of the E1A stability solution did not meet the criteria for inclusion in the STS. The function of the setpoint of the APRM flow biased control rod block does not change as a result of the implementation of the E1A stability solution and no change to the STS is needed as summarized in Table 2-1.

The E1A stability solution uses a limit on the core average bulk saturated boiling elevation as the required stability control for entry into the Restricted Region. This core average boiling boundary is manipulated by operator actions that affect the power distribution. The associated operating limit, FCBB, is required to be met during operation in the Restricted Region and meets Criterion 2 of the NRC final policy statement. Therefore, a new LCO is appropriately added to Section 3.2, Power Distribution Limits, as noted in Table 2-1.

2.1.2 Automatic Defense-in-Depth Features

Automatic defense-in-depth features of the E1A stability solution include alarm annunciation upon uncontrolled entry into the Restricted Region, control room alarm when conditions consistent with imminent onset of instability are detected by the PBDS, automatic setdown of the APRM flow biased setpoints, and automatic scram when the flow-biased scram clamp above the Restricted Region is exceeded. The automatic defense-in-depth features are summarized in Table 2-2.

Alarm annunciation upon entry into the Restricted Region is provided by the APRM flow biased control rod block function when the "non-Setup" setpoints are selected. The APRM rod block function is an operator aid in the identification of entry into the Restricted Region and does not meet criteria for inclusion in TS. During operation outside the Restricted Region with the setpoints "Setup" the alarm annunciation upon entry into the region is not available. However, the optimized TS of Appendix A require the FCBB limit to be met under these

conditions providing sufficient stability margin to assure instability prevention as discussed in Section 2.2.4. No changes to the STS are required as noted in Table 2-2.

The availability of a control room alarm indicating conditions consistent with the imminent onset of instability is assured by the installation and implementation of the PBDS. The PBDS has no safety function and is not credited during any FSAR design basis accident or transient analysis. However, the PBDS provides an indication of the imminent onset of neutronic/thermal hydraulic instability during operation in regions of the operating domain potentially susceptible to instability. Therefore, a new PBDS LCO is appropriately added to Section 3.3, Instrumentation, as noted in Table 2-2.

The automatic setdown of the APRM flow biased setpoints is a design feature of the FCTR card which is installed as part of the implementation of the E1A solution. The feature is entirely automatic, requires no operator interaction and is redundant to manual setpoint setdown. Appropriate testing of the feature is assured through owner controlled documentation including surveillance test procedures. No changes to the STS are required as noted in Table 2-2.

The flow biased scram clamp above the Restricted Region is a defense-in-depth feature of the E1A stability solution which provides additional protection from unanticipated combinations of events near the highest flow-control line in the Restricted Region that may result in significant degradation of stability performance. This feature is not credited in any **safety**~~accident~~ analysis, including validation of the stability region boundaries in the E1A licensing methodology. Plant-specific APRM flow biased scram setpoints appropriately include this requirement as noted in Table 2-2.

2.1.3 Response to PBDS Instrumentation Indication

Manual defense-in-depth features include operator actions in response to PBDS instrumentation indications. These actions are summarized in Table 3-3 of Reference 1. The actions required by the optimized changes to the STS of Appendix A are specified in Table 2-3 and conform to the requirements for these instrumentation indications specified in Section 3.2.4 of Reference 1.

2.1.4 Response to Transients

Manual defense-in-depth features include operator actions in response to uncontrolled entry into the Restricted Region and in response to operation in the Restricted Region following a transient initiated from within the region. The optimized STS for the E1A stability solution refines the requirements specified in Reference 1 for unexpected transients other than loss of feedwater heating (LOFH) and flow reduction event (FRE) transients. This refinement to the manual defense-in-depth features of Reference 1 is the result of the resolution of NEDO-32339-A requirements and reactor operational objectives. The basis for this refinement is discussed in Section 2.2.2

The required operator actions of the optimized TS of Appendix A when LCO Conditions are entered as a result of an unexpected LOFH or FRE are summarized in Table 2-4. These required operator actions meet the requirements specified in Sections 3.2.4 and 5.5.1 of Reference 1. The required operator actions in response to an unexpected transient other than a LOFH or FRE are also summarized in Table 2-4.

2.2 Implementation Optimization

The optimized changes to the STS presented in Appendix A required the resolution of the implementation issues listed in Table 2.5. The practical implementation of certain aspects of the E1A features required refinements to the approach described in Reference 1 to ensure consistency between analytical, operational and STS scope and format perspectives. The resolution of these issues was reached while preserving the prevention of neutronic/thermal hydraulic instability and progressive defense-in-depth protection of the E1A stability solution. The discussion of these optimization related issues are presented in this section to support implementation of the E1A stability solution features.

2.2.1 Operation with Setpoint Setup

During normal power operation outside the Restricted Region, the APRM flow biased control rod block setpoint coincides with the lower boundary of the Restricted Region. In preparation for entry into the Restricted Region, a power

distribution is achieved such that the FCBB limit is met. The APRM flow biased setpoints are then "Setup" on each FCTR card. Operation with setpoints "Setup" outside the Restricted Region is expected prior to and following planned entry into the Restricted Region.

When the FCBB limit is met during operation either inside or outside the Restricted Region, significant margin to the onset of neutronic/thermal hydraulic instability exists and all major state parameters that affect stability have relatively small impacts on stability performance. Operation outside the Restricted Region with FCBB met is generally expected to have more stability margin than operation inside the Restricted Region. Therefore actions required when operating inside the Restricted Region are conservative when applied to conditions outside the Restricted Region when FCBB is met.

To facilitate the practical implementation of the E1A stability solution, actions specified in Reference 1 for operation inside the Restricted Region are appropriate and can be applied when the APRM flow biased setpoints are "Setup."

2.2.2 Response to Transients

A significant reduction in the stability margin of the reactor can result from transients which cause large reductions in core flow and/or increases in core power. The most limiting transients, as identified in Reference 1, are the LOFH and FRE. Analyses described in Reference 1 assume reasonably conservative initial conditions and indicate that immediate post-event reactor conditions for the **specified**~~limiting~~ LOFH and FRE **transients** are significantly stable. However, since not all postulated initial conditions are bounded by the assumed initial conditions, the progressive defense-in-depth approach of the E1A stability solution requires manual actions in response to any unexpected transient.

The specific actions summarized in Table 3-3 of Reference 1 depend upon whether the PBDS is operable and whether the Restricted Region has been entered in an uncontrolled manner. When the PBDS is inoperable, the optimized TS of Appendix A implement manual defense-in-depth requirements consistent with Reference 1 and the discussion in Section 2.2.1. When the PBDS is inoperable and the APRM flow biased setpoints are not "Setup," immediate reactor scram is required following uncontrolled entry into the Restricted Region. When the PBDS

is inoperable and the APRM flow biased setpoints are "Setup," immediate initiation of action to exit the Restricted Region is required following an unexpected transient.

The optimized TS of Appendix A are consistent with the manual defense-in-depth actions required in Reference 1 when the PBDS is operable and the unexpected transient is of the limiting LOFH or FRE type. Unexpected transients other than a LOFH and FRE have a small effect on the stability margin of the reactor and must initiate near the Restricted Region boundary in order to result in an uncontrolled entry of the region. The optimized TS of Appendix A do not explicitly require immediate initiation of actions to exit the Restricted Region following an uncontrolled entry due to an unexpected transient provided the transient is not of the limiting LOFH or FRE type and the PBDS is operable. The availability of the significant defense-in-depth which exists when the PBDS is operable and the limited reduction in stability margin of non-limiting transients justifies this refinement to the manual features of the E1A stability solution described in Reference 1.

Also, no significant reduction in stability margin can occur due to an unexpected transient when initiated from initial conditions inside the Restricted Region (with the FCBB limit met). The optimized TS of Appendix A do not explicitly require immediate initiation of actions to exit the Restricted Region following an unexpected transient other than a LOFH and FRE when initiated from within the Restricted Region. The limited reduction in stability margin and the significant defense-in-depth which exists when the PBDS is operable justifies this refinement to the Reference 1 manual features.

Continued operation in the Restricted Region following an unexpected transient other than a LOFH and FRE is permitted by the optimized TS of Appendix A when the PBDS is operable. Clarification of the conditions under which it is appropriate to continue operation within the Restricted Region with the FCBB not met is provided in the Bases for Action A.1 of Specification 3.2.5. The Bases describes the need for prompt action to restore the FCBB to within limit following an uncontrolled entry into the Restricted Region due to a transient other than a LOFH or FRE. Efforts to restore FCBB within limit are appropriate if operation prior to entry was consistent with planned entry or the potential for entry

as demonstrated by FCBB being monitored and known not to significantly exceed the limit.

This Bases clarification reflects the expectation that operation near the Restricted Region boundary will normally only occur during reactor maneuvers when the need for operation in the Restricted Region may be anticipated and FCBB is known. The Bases for Action A.1 of Specification 3.2.5 further clarifies that actions to exit the Restricted Region are appropriate whenever the FCBB cannot be expected to be restored in a prompt manner and encompasses both the uncontrolled entry into the Restricted Region as a result of an unexpected transient other than a LOFH and FRE and operation in the Restricted Region following an unexpected transient other than a LOFH and FRE initiated from within the Restricted Region.

2.2.3 Flow Biased Rod Block

The original function of the APRM flow biased control rod block does not change with implementation of the E1A stability solution. The **existing** APRM flow biased control rod block serves as an operator aid in identifying operating conditions approaching the **APRM flow biased scram setpoints**~~boundary of the licensed operating domain~~. As an operator aid, the flow biased control rod block function does not meet the criteria of the NRC final policy statement for inclusion in TS.

The E1A stability solution modifies the FCTR card to allow operator selection of either "non-Setup" or "Setup" values for the APRM flow biased control rod block and scram setpoints. The lower and upper boundaries of the Restricted Region coincide with the "non-Setup" and "Setup" control rod block **setpoint** values, respectively. The Restricted Region is maintained as an E1A licensing feature and is defined in the COLR.

Operation with the setpoints "Setup" provides the operator with assistance in the identification of operating conditions approaching the boundary of the licensed operating domain and preserves the original function. Operation with the "non-Setup" setpoints results in the APRM rod block preventing unintentional entry into the Restricted Region by control rod withdrawal and annunciation of the APRM rod block alarm upon entry into the Restricted Region. **Uncontrolled**

entry into the Restricted Region with setpoints at their "non-Setup" values results in the Restricted Region Entry Alarm (RREA). A valid RREA is confirmed by observing that the operating conditions (e.g., thermal power and core flow) are reasonably consistent with entry to the Restricted Region. This confirmation may include assessment that rapidly changing conditions during a transient (e.g., due to a recirculation pump trip) could reasonably result in entry into the Restricted Region. These functions of the modified FCTR card serve as operator aids and the APRM flow biased control rod block function continues to fail to meet criteria for inclusion in TS.

2.2.4 Setup Setdown Control

In the discussion of the APRM flow biased trip setpoints in Section 6.1.5 of Reference 1, it is stated that TS would require setdown of the setpoints upon exit from the Restricted Region. The optimized changes of Appendix A do not include a general requirement to setdown the setpoints. Rather, the FCBB stability control is required to be met while operating outside the Restricted Region with the APRM flow biased setpoints "Setup." Operation with the FCBB limit met maintains significant stability margin. Operation outside the Restricted Region with the FCBB limit met generally has greater stability margin than operation inside the Restricted Region and significant stability margin is thereby maintained when operating with the setpoints "Setup."

The automatic setpoint setdown defense-in-depth feature discussed in Section 2.1 is not impacted by manual setpoint setdown. Furthermore, the automatic setdown prevents operation with the setpoints "Setup" after a specified value above the Restricted Region is exceeded.

Operation with power distributions necessary to meet the FCBB limit are generally not consistent with the distributions normally established during power operation outside the Restricted Region. Therefore, operation with setpoints "Setup" will be limited as much as practical due to the effects on plant operation. In addition, the Bases provided for Reactor Protection System (RPS) Function 2.b in Appendix B specifically states that the "Setup" value is intended only for planned and intentional operation in the Restricted Region.

The TS requirement that FCBB be met while operating outside the Restricted Region with the APRM flow biased setpoints "Setup" provides significant stability margin. Therefore, under these conditions, a general TS requirement for manual setpoint setdown is not needed to prevent instability. However, a specific requirement to return the setpoints to the "non-Setup" values is included in Action B.2 of LCO 3.2.5. This action is required to be completed when Condition B of LCO 3.2.5 is entered upon occurrence of a LOFH or FRE. The LOFH and FRE transients are anticipated operational occurrences with the greatest potential to impact the available stability margin and may cause the FCBB limit to not be met. Returning the setpoints to the "non-Setup" values is consistent with the progressive defense-in-depth approach of the E1A stability solution following unexpected transients of these limiting types.

2.2.5 Monitored Region Operation

In Sections 3.2.4.2 and 5.5.2 of Reference 1 it is stated that with the PBDS inoperable, entry into the Monitored Region is allowed for the purpose of reactor shutdown provided that during power descension in the Monitored Region, the FCBB limit is met. This provision was included to enable controlled reactor shutdown which is anticipated to require entry into the Monitored Region for some plants implementing the E1A stability solution. However, LCO 3.0.4 of the STS provides for the entry into the Applicability of a Specification without the LCO met for the purpose of reactor shutdown. Therefore, specific and explicit TS consideration of entry into the Monitored Region for the purpose of reactor shutdown is not necessary.

Power descensions which must traverse the Monitored Region normally require control rod insertion and recirculation drive flow reductions. Control rod insertions are specifically identified as an acceptable means of exiting regions since stability performance is generally improved. Meeting the FCBB limit in the Monitored Region provides sufficient assurance of adequate stability performance, to the degree that even with the PBDS inoperable, reductions in recirculation flow as a means of power descension in the Monitored Region are acceptable. The Bases for Action C.1 of LCO 3.3.1.3 in Appendix B, therefore, specifically identifies that reductions in recirculation flow for the purpose of exiting the Monitored Region are appropriate provided the FCBB limit is met within the

previous 15 minutes. This Bases discussion provides the operator with information which can be used to preserve the progressive defense-in-depth approach of the E1A stability solution despite the need to traverse the Monitored Region if the PBDS is inoperable during a controlled reactor shutdown.

2.2.6 PBDS Operability

The Restricted Region and the Monitored Region are the only regions of the licensed operating domain that are postulated to be susceptible to neutronic/thermal hydraulic instability. Requirements for an instrument to function in an operating mode other than one in which it is required to function are not included in TS. Therefore, the PBDS is required to be operable only during operation in the Restricted Region and the Monitored Region.

The progressive defense-in-depth approach of the E1A stability solution includes conservative manual actions in the event an unexpected transient results in operation in the Restricted Region or the Monitored Region when the PBDS is inoperable. The conservative actions when the PBDS is inoperable include scram upon uncontrolled entry into the Restricted Region when the APRM flow biased setpoints are not "Setup" and immediate initiation of actions to exit the Monitored Region. These actions effectively increase the size of the Exclusion Region to include the Restricted Region and the Monitored Region. When the PBDS is inoperable during operation outside the Restricted Region and the Monitored Region, the required actions result in a conservative outcome consistent with the E1A stability solution emphasis on prevention of reactor instability.

2.3 Remaining Solution Components

The COLR is an owner controlled document referenced by individual TS that address core operating limits. The optimized TS presented in Appendix A for the E1A stability solution references the COLR for the Allowable Values of the APRM flow biased scram setpoint and the definitions of the Monitored and Restricted Regions. The Allowable Values of the APRM flow biased scram function corresponding to the applicable alternate trip reference function and accounting for the power based trip reference adjustment include "Setup" and

"non-Setup" values for both single and dual recirculation loop operating conditions. The analytical methods used to determine core operating limits reported in the COLR and referenced by TS are reviewed and approved by the NRC.

Other features of the E1A stability solution are included in owner controlled documents other than the COLR. These features include the APRM flow biased control rod block values identified in Section 2.1.1 and the use of the **Restricted Region Entry Alarm**~~rod block alarm~~ as indication of uncontrolled entry into the Restricted Region. The value at which automatic setdown of the APRM flow biased setpoints from the "Setup" values to the "non-Setup" values which is described in Section 2.1, is also contained in an owner controlled document.

Additional information contained in owner controlled documents includes information necessary for the proper operation of the PBDS. This information includes the process of setting appropriate values for the period tolerance and corner frequency described in Reference 1. Setpoints for the **PBDS** High-High **Decay Ratio (DR)** and High **DR** ~~PBDS~~ alarms are also specified in owner controlled documents.

Table 2-1: E1A Licensing Features TS Impact

Operating State	**E1A Licensing Feature**	**Accomplished By**	**Technical Specification Impact**
Entry into Exclusion Region	Automatic Scram	APRM Flow Biased Scram	Specify Flow Biased Scram (setpoints listed in COLR)
Controlled Entry into Restricted Region ~~by Control Rod Withdrawal~~	**Control** ~~Automatic~~ Rod Block **Setpoints**	APRM Flow Biased Rod Block	Rod Block not in STS. (Restricted Region **boundary** specified in COLR)
Controlled Operation in Restricted Region	Stability Controls	FCBB limit	Add FCBB Specification

Table 2-2: E1A Automatic Defense-in-Depth Features TS Impact

Operating State	E1A Automatic Defense-in-Depth Feature	Accomplished By	Technical Specification Impact
Uncontrolled Entry into Restricted Region	Restricted Region Entry Alarm	APRM Flow Biased Control Rod Block Alarm	None
PBDS High-High DR Alarm	Control Room Alarm	PBDS Card Features	Add PBDS Specification
Operation at High Core Flow	Automatic Setpoint Setdown	FCTR Card Features	None
Operation above the Restricted Region	Automatic Scram	APRM Flow Biased Scram Clamp	Included in Flow Biased Scram Setpoint

Table 2-3: E1A Response to PBDS Instrumentation Indication TS Impact

Operating State	PBDS Operable	Optimized STS Action	Governing Specification
Operation in Restricted Region or Monitored Region with PBDS High-High **DR** Alarm	Yes	Immediate Manual Scram	PBDS
Controlled Operation in Restricted Region (with setpoints "Setup")	No	Immediately Initiate Action to Exit Region	PBDS
Operation in Monitored Region	No	Initiate Action to Exit Region within 15 Minutes	PBDS

Table 2-4: E1A Response to Transients TS Impact

Operating State	PBDS Operable	Transient	Optimized STS Action	Governing Specification
Uncontrolled Entry into Restricted Region	No	Any	Immediate Manual Scram	PBDS
	Yes	LOFH or FRE	Immediately Initiate Action to Exit Region	FCBB
		Other than LOFH and FRE	Restore FCBB within Limit	FCBB
Operation in Restricted Region following transient initiated from within the Restricted Region	No	Any	Immediately Initiate Action to Exit Region	PBDS
	Yes	LOFH or FRE	Immediately Initiate Action to Exit Region	FCBB
		Other than LOFH and FRE	Restore FCBB within Limit	FCBB

Table 2-5: E1A TS Optimization Issues

Issue	Description
1.	Actions specified for operation inside the Restricted Region are appropriate when operating with Allowable Value "Setup" outside the Restricted Region. Refer to Section 2.2.1
2.	Operator Response to unexpected transient is based on potential severity of the event <u>only</u> when significant defense-in-depth exists (PBDS Operable). Refer to Section 2.2.2
3.	**Restricted Region boundary is specified in the COLR.** APRM flow biased rod block setpoints **and the Restricted Region Entry Alarm** are documented in owner controlled documents ~~and the role as an automatic Restricted Region Entry Alarm is preserved~~. Refer to Section 2.2.3
4.	Setdown of "Setup" Allowable Values is generally administratively controlled. Refer to Section 2.2.4
5.	Entry into the Monitored Region with PBDS inoperable for the purpose of reactor shutdown or exit by controlled flow reduction does not require explicit technical specification allowance. Refer to Section 2.2.5
6.	PBDS operability outside the Monitored and Restricted Regions is not required. Refer to Section 2.2.6

3. REFERENCES

1. Licensing Topical Report, "Reactor Stability Long-Term Solutions: Enhanced Option I-A," NEDO-32339-A, GE Nuclear Energy, July 1995.

2. NUREG-1433 Revision 1, "Standard Technical Specifications, General Electric Plants, BWR/4," April 1995.

3. NUREG-1434 Revision 1, "Standard Technical Specifications, General Electric Plants, BWR/6," April 1995.

4. NRC "Final Policy Statement on Technical Specifications Improvements for Nuclear Power Reactors," 10CFR50, July 22, 1993.

APPENDIX A: E1A Generic Technical Specifications

Appendix A contains the optimized TS for the E1A stability solution in the STS format. Two new LCOs, 3.2.5 Fraction of Core Boiling Boundary (FCBB) and 3.3.1.3 Period Based Detection System (PBDS), are added to the STS. Two existing LCOs, 3.3.1.1 RPS Instrumentation and 3.4.1 Recirculation Loops Operating, are modified and only the affected portions are presented. Changes have been made to the Surveillance Requirements and Table 3.3.1.1-1 of LCO 3.3.1.1, and the LCO and Actions of LCO 3.4.1. The two entirely new LCOs are presented in plain text for clarity. Otherwise, additions to the STS are underlined and deletions are indicated by strikeouts.

3.2 POWER DISTRIBUTION LIMITS

3.2.5 Fraction of Core Boiling Boundary (FCBB)

LCO 3.2.5 The FCBB shall be $\leq$ 1.0.

APPLICABILITY: THERMAL POWER and core~~recirculation drive~~ flow in the Restricted Region as specified in the COLR,
MODE 1 when RPS Function 2.b, APRM Flow Biased Simulated Thermal Power–High, Allowable Value is "Setup" as specified in the COLR.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. FCBB not within limit for reasons other than an unexpected loss of feedwater heating or unexpected reduction in core flow.	A.1 Restore FCBB to within limit.	2 hours

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
B. Required Action and associated Completion Time of Condition A not met. <u>OR</u> --------NOTE--------- Required Action B.1 and Required Action B.2 shall be completed if this Condition is entered due to an unexpected loss of feedwater heating or unexpected reduction in core flow. --------------------- FCBB not within limit due to an unexpected loss of feedwater heating or unexpected reduction in core flow.	B.1 Initiate action to exit the Restricted Region. <u>AND</u> B.2 Initiate action to return APRM Flow Biased Simulated Thermal Power--High Allowable Value to "non-Setup" value.	Immediately Immediately following exit of Restricted Region

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.2.5.1	------------------NOTE------------------ Not required to be performed until 15 minutes after entry into the Restricted Region if entry was the result of an unexpected transient. -- Verify FCBB ≤ 1.0.	24 hours <u>AND</u> Once within 15 minutes following unexpected transient

SURVEILLANCE REQUIREMENTS (continued)

	SURVEILLANCE	FREQUENCY
SR 3.3.1.1.3	~~Adjust the channel to conform to a calibrated flow signal.~~ [Reviewer's Note: Upon implementation of the Enhanced Option I-A Stability Solution, this SR is superseded by 3.3.1.1.18. As a result, the SRs should be renumbered.]	~~7 days~~
SR 3.3.1.1.4	------------------NOTE------------------ Not required to be performed when entering MODE 2 from MODE 1 until 12 hours after entering MODE 2. --- Perform CHANNEL FUNCTIONAL TEST.	 7 days
SR 3.3.1.1.5	Perform CHANNEL FUNCTIONAL TEST	7 days
SR 3.3.1.1.6	Verify the source range monitor (SRM) and intermediate range monitor (IRM) channels overlap.	Prior to withdrawing SRMs from the fully inserted position

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.3.1.1.11	------------------NOTES------------------ 1. Neutron detectors are excluded. 2. For Function 2.a, not required to be performed when entering MODE 2 from MODE 1 until 12 hours after entering MODE 2. 3. For Function 2.b, the digital components of the flow control trip reference cards are excluded. --- Perform CHANNEL CALIBRATION.	184 days
SR 3.3.1.1.12	Perform CHANNEL FUNCTIONAL TEST.	[18] months
SR 3.3.1.1.13	------------------NOTES------------------ 1. Neutron detectors are excluded. 2. For Function 1, not required to be performed when entering MODE 2 from MODE 1 until 12 hours after entering MODE 2. --- Perform CHANNEL CALIBRATION.	[18] months
SR 3.3.1.1.14	Verify the APRM Flow Biased Simulated Thermal Power−High time constant is ≤ [7]seconds.	[18] months

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.3.1.1.15	Perform LOGIC SYSTEM FUNCTIONAL TEST.	[18] months
SR 3.3.1.1.16	Verify Turbine Stop Valve—Closure and Turbine Control Valve Fast Closure, Trip Oil Pressure—Low Functions are not bypassed when THERMAL POWER is ≥ [30]% RTP.	[18] months
SR 3.3.1.1.17	------NOTES------ 1. Neutron detectors are excluded. 2. For Function 5 "n" equals 4 channels for the purpose of determining the STAGGERED TEST BASIS Frequency. ------------ Verify the RPS RESPONSE TIME is within limits.	[18] months on a STAGGERED TEST BASIS
SR 3.3.1.1.18	Adjust the flow control trip reference card to conform to reactor flow. [Reviewer's Note: Upon implementation of the Enhanced Option I-A Stability Solution this SR supersedes SR 3.3.1.1.3. The SRs should be renumbered in order of decreasing frequency in conformance with the Writer's Guide.]	Once within 7 days after reaching equilibrium conditions following refueling outage

Table 3.3.1.1-1 (page 1 of 3)
Reactor Protection System Instrumentation

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	REQUIRED CHANNELS PER TRIP SYSTEM	CONDITIONS REFERENCED FROM REQUIRED ACTION D.1	SURVEILLANCE REQUIREMENTS	ALLOWABLE VALUE
1. Intermediate Range Monitors					
a. Neutron Flux—High	2	[3]	G	SR 3.3.1.1.1 SR 3.3.1.1.4 SR 3.3.1.1.6 SR 3.3.1.1.7 SR 3.3.1.1.13 SR 3.3.1.1.15	≤ [120/125] divisions of full scale
	5(a)	[3]	H	SR 3.3.1.1.1 SR 3.3.1.1.5 SR 3.3.1.1.13 SR 3.3.1.1.15	≤ [120/125] divisions of full scale
b. Inop	2	[3]	G	SR 3.3.1.1.4 SR 3.3.1.1.15	NA
	5(a)	[3]	H	SR 3.3.1.1.5 SR 3.3.2.2.15	NA
2. Average Power Range Monitors					
a. Neutron Flux—High, Setdown	2	[2]	G	SR 3.3.1.1.1 SR 3.3.1.1.4 SR 3.3.1.1.7 SR 3.3.1.1.8 SR 3.3.1.1.11 SR 3.3.1.1.15	≤ [20]% RTP
b. Flow Biased Simulated Thermal Power—High	1	[2]	F	SR 3.3.1.1.1 SR 3.3.1.1.2 ~~SR 3.3.1.1.3~~ SR 3.3.1.1.8 SR 3.3.1.1.9 SR 3.3.1.1.11 SR 3.3.1.1.14 SR 3.3.1.1.15 SR 3.3.1.1.17 SR 3.3.1.1.18	~~≤ [0.58 W + 62]% RTP and ≤ [115.5]% RTP(b)~~ (b)

(continued)

(a) With any control rod withdrawn from a core cell containing one or more fuel assemblies.

(b) ~~[0.58 W + 62% - 0.58 DW]RTP~~Allowable Values specified in the COLR. ~~[Single Loop operation Allowable Values apply when reset for single loop operation per LCO 3.4.1, "Recirculation Loops Operating."]~~

Reviewer's Note: Function 2.b is not associated with a limiting safety system setting. Allowable Values for Function 2.b are derived from associated operating limits reported in the COLR. The operating limits are based on the licensed operating domain established for cycle specific fuel and core design characteristics.

3.3 INSTRUMENTATION

3.3.1.3 Period Based Detection System (PBDS)

LCO 3.3.1.3 One channel of PBDS instrumentation shall be OPERABLE.

<u>AND</u>

Each OPERABLE channel of PBDS instrumentation shall not indicate High-High DR Alarm.

APPLICABILITY: THERMAL POWER and core~~recirculation drive~~ flow in the Restricted Region specified in the COLR.
THERMAL POWER and core flow in the Monitored Region specified in the COLR.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Any OPERABLE PBDS channel indicating High-High DR Alarm.	A.1 Place the reactor mode switch in the shutdown position.	Immediately

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
B. Required PBDS channel inoperable while in the Restricted Region.	B.1 --------NOTE---------- Only applicable if RPS Function 2.b, APRM Flow Biased Simulated Thermal Power–High, Allowable Value is "Setup". ---------------------- Initiate action to exit the Restricted Region.	Immediately
	OR	
	B.2 Place the reactor mode switch in the shutdown position.	Immediately
C. Required PBDS channel inoperable while in the Monitored Region.	C.1 Initiate action to exit the Monitored Region.	15 minutes

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.3.1.3.1	Verify each OPERABLE channel of PBDS instrumentation not in High-High DR Alarm.	12 hours
SR 3.3.1.3.2	Perform CHANNEL CHECK.	12 hours
SR 3.3.1.3.3	Perform CHANNEL FUNCTIONAL TEST.	24 months

3.4 REACTOR COOLANT SYSTEM (RCS)

3.4.1 Recirculation Loops Operating

LCO 3.4.1 Two recirculation loops with matched flows shall be in operation.

[OR

One recirculation loop may be in operation provided the following limits are applied when the associated LCO is applicable:

a. LCO 3.2.1, "AVERAGE PLANAR LINEAR HEAT GENERATION RATE (APLHGR)," single loop operation limits [specified in the COLR];

b. LCO 3.2.2, "MINIMUM CRITICAL POWER RATIO (MCPR)," single loop operation limits [specified in the COLR]; and

c. LCO 3.3.1.1, "Reactor Protection System (RPS) Instrumentation," Function 2.b (Average Power Range Monitors Flow Biased Simulated Thermal Power-High), Allowable Value ~~of Table 3.3.1.1-1 is reset~~ for single loop operation as specified in the COLR.]

APPLICABILITY: MODES 1 and 2.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A* Requirements of the LCO not met.	A.1 Satisfy the requirements of the LCO.	24 hours

* ~~Pending resolution of stability issue.~~

(continued)

APPENDIX B: E1A Generic Bases

Appendix B contains the changes to the Bases for the optimized STS presented in Appendix A. The Bases for the two entirely new LCOs, 3.2.5 Fraction of Core Boiling Boundary (FCBB) and 3.3.1.3 Period Based Detection System (PBDS), are added to the STS. The Bases for two existing LCOs, 3.3.1.1 RPS Instrumentation and 3.4.1 Recirculation Loops Operating, are modified and only the affected portions are presented. Changes have been made to the Bases for Surveillance Requirements and Table 3.3.1.1-1 of LCO 3.3.1.1, and the Bases for the LCO and Actions of LCO 3.4.1. The Bases for the two entirely new LCOs are presented in plain text for clarity. Otherwise, additions to the Bases are underlined and deletions are indicated by strikeouts.

B 3.2 POWER DISTRIBUTION LIMITS

B 3.2.5 Fraction of Core Boiling Boundary (FCBB)

BASES

BACKGROUND

General Design Criterion 12 requires protection of fuel thermal safety limits from conditions caused by neutronic/ thermal hydraulic instability. Neutronic/thermal hydraulic instabilities result in power oscillations which could result in exceeding the MCPR Safety Limit (SL). The MCPR SL ensures that at least 99.9% of the fuel rods avoid boiling transition during normal operation and during an anticipated operational occurrence (AOO) (refer to the Bases for SL 2.1.1.2).

The FCBB is the ratio of the power generated in the lower 4 feet of the active reactor core to the power required to produce bulk saturated boiling of the coolant entering the fuel channels. The value of 4 feet above the bottom of the active fuel is set as the boiling boundary limit based on analysis described in Section 9 of Reference 1. The boiling boundary limit is established to ensure that the core will remain stable during normal reactor operations in the Restricted Region of the power and flow map defined in the COLR which may otherwise be susceptible to neutronic/thermal hydraulic instabilities and therefore the MCPR SL remains protected.

Planned operation in the Restricted Region is accommodated by manually establishing the "Setup" values for the APRM flow-biased Simulated Thermal Power—High scram and control rod block functions. The "Setup" Allowable Values of the APRM Flow-Biased Thermal Power—High Function (refer to LCO 3.3.1.1, Table 3.3.1.1-1, Function 2.b.) are consistent with assumed operation in the Restricted Region with FCBB ≤ 1.0. Operation with the "Setup" values enables entry into the Restricted Region without a control rod block that would otherwise occur. Plant operation with the "Setup" values is limited as much as practical due to the effects on plant operation required to meet the FCBB limit.

APPLICABLE SAFETY ANALYSES

The analytical methods and assumptions used in establishing the boiling boundary limit are presented in Section 9 of Reference 1. Operation with the FCBB ≤ 1.0 (i.e., a bulk saturated boiling boundary ≥ 4 feet) is expected to ensure that operation within the Restricted Region will not result

(continued)

APPLICABLE SAFETY ANALYSES (continued)

in neutronic/thermal hydraulic instability due to either steady-state operation or as the result of an AOO which initiates and terminates entirely within the Restricted Region. Analysis also confirms that AOOs initiated from outside the Restricted Region (i.e., without an initial restriction on FCBB) which terminate in the Restricted Region are not expected to result in instability. The types of transients specifically evaluated are loss of flow and coolant temperature decrease which are limiting for the onset of instability (Ref. 1).

Although the onset of instability does not necessarily occur if the FCBB is greater than 1.0 in the Restricted Region, bulk saturated boiling at the 4 foot boiling boundary limit has been adopted to preclude neutronic/thermal hydraulic instability during operation in the Restricted Region. The effectiveness of this limit is based on the demonstration (Ref. 1) that with the limit met large margin to the onset of neutronic/thermal hydraulic instability exists and all major state parameters that affect stability have relatively small impacts on stability performance.

The FCBB satisfies Criterion 2 of the NRC Policy Statement.

LCO

Requiring FCBB ≤ 1.0 ensures the bulk coolant boiling boundary is ≥ 4 feet from the bottom of the active core. Analysis (Ref. 1) has shown that for anticipated operating conditions of core power, core flow, axial and radial power shapes, and inlet enthalpy, a boiling boundary of 4 feet ensures variations in these key parameters do not have a significant impact on stability performance.

Neutronic/thermal hydraulic instabilities result in power oscillations which could result in exceeding the MCPR Safety Limit (SL). The MCPR SL ensures that at least 99.9% of the fuel rods avoid boiling transition during normal operation and during an AOO (refer to the Bases for SL 2.1.1.2).

APPLICABILITY

The FCBB limit is used to prevent core conditions necessary for the onset of instability and thereby preclude neutronic/thermal hydraulic instability while operating in the Restricted Region defined in the COLR.

The boundary of the Restricted Region in the Applicability of this LCO is analytically established in terms of thermal

(continued)

APPLICABILITY (continued)

power and core flow. The Restricted Region is defined by the APRM Flow Biased Simulated Thermal Power - High Control Rod Block setpoints, which are a function of reactor recirculation drive flow. The Restricted Region Entry Alarm (RREA) signal is generated by the Flow Control Trip Reference (FCTR) card using the APRM Flow Biased Simulated Thermal Power - High Control Rod Block setpoints. As a result, the RREA is coincident with the Restricted Region boundary when the setpoints are not "Setup," and provides indication of entry into the Restricted Region. However, APRM Flow Biased Simulated Thermal Power - High Control Rod Block signals provided by the FCTR card, that are not coincident with the Restricted Region boundary, do not generate a valid RREA. The Restricted Region boundary for this LCO Applicability is specified in the COLR.

The FCBB limit is also used to ensure that core conditions, while operating with "Setup" values, remain consistent with analyzed transients initiated from inside and outside the Restricted Region.

When the APRM Flow Biased Simulated Thermal Power - High Control Rod Block setpoints are "Setup" the applicable setpoints used to generate the RREA are moved to the interior boundary of the Restricted Region to allow controlled operation within the Restricted Region. While the setpoints are "Setup" the Restricted Region boundary remains defined by the normal APRM Flow Biased APRM Simulated Thermal Power - High Control Rod Block setpoints.

Parameters such as reactor power and core flow available at the reactor controls, may be used to provide immediate confirmation that entry into the Restricted Region could reasonably have occurred.

Operation outside the Restricted Region is not susceptible to neutronic/thermal hydraulic instability when applicable thermal power distribution limits such as MCPR are met.

(continued)

BASES

ACTIONS

A.1

If FCBB is not within the required limit, core conditions necessary for the onset of neutronic/hydraulic thermal instability may result. Therefore, prompt action should be taken to restore the FCBB to within the limit such that the stability of the core can be assured. Following uncontrolled entry into the Restricted Region, prompt restoration of FCBB within limit can be expected if FCBB is known to not significantly exceed the limit. Therefore, efforts to restore FCBB within limit following an uncontrolled entry into the Restricted Region are appropriate if operation prior to entry was consistent with planned entry or the potential for entry was recognized as demonstrated by FCBB being monitored and known to not significantly exceed the limit. Actions to exit the Restricted Region are appropriate when FCBB can not be expected to be restored in a prompt manner.

Actions to restart an idle recirculation loop, withdraw control rods or reduce recirculation flow may result in approaching unstable reactor conditions and are not allowed to be used to comply with this Required Action. The 2 hour Completion Time is based on engineering judgment as to a reasonable time to restore the FCBB to within limit. The 2 hour Completion Time is acceptable based on the availability of the PBDS per Specification 3.3.1.3, "Period Based Detection System" and the low probability of a neutronic/thermal hydraulic instability event.

B.1 and B.2

Changes in reactor core state conditions resulting from an unexpected loss of feedwater heating or reduction in core flow (e.g., any unexpected reduction in feedwater temperature, recirculation pump trip, [recirculation pump run back, recirculation pump down shift to slow speed, or flow control valve closure]) require immediate initiation of action to exit the Restricted Region and return the APRM Flow Biased Simulated Thermal Power—High Function (refer to LCO 3.3.1.1, Table 3.3.1.1-1, Function 2.b.) to the "non-Setup" value. Condition B is modified by a Note that specifies that Required Actions B.1 and B.2 must be completed if this Condition is entered due to an unexpected loss of feedwater heating or reduction in core flow. The completion of Required Actions B.1 and B.2 is required even though FCBB may be calculated and determined to be within

(continued)

ACTIONS

B.1 and B.2 (continued)

limit. Core conditions continue to change after an unexpected loss of feedwater heating or reduction in core flow due to transient induced changes with the potential that the FCBB may change and the limit not be met. The potential for changing core conditions, with FCBB not met, is not consistent with operation in the Restricted Region or with the APRM Flow Biased Simulated Thermal Power–High Function "Setup". Therefore, actions to exit the Restricted Region and return the APRM Flow Biased Simulated Thermal Power–High Function to the "non-Setup" value are required to be completed in the event Condition B is entered due to an unexpected loss of feedwater heating or an unexpected reduction in core flow.

If oOperator actions to restore the FCBB to within limit are not successful within the specified Completion Time of Condition A, reactor operating conditions may be changing and may continue to change such that core conditions necessary for the onset of neutronic/thermal hydraulic instability may be met. Therefore, in the event the Required Action and associated Completion Time of Condition A is not met, immediate action to exit the Restricted Region and return the APRM Flow Biased Simulated Thermal Power–High Function to the "non-Setup" value is required.

Exit of the Restricted Region can be accomplished by control rod insertion and/or recirculation flow increases. Actions to restart an idle recirculation loop, withdraw control rods or reduce recirculation flow may result in approaching unstable reactor conditions and are not allowed to be used to comply with this Required Action. The time required to exit the Restricted Region will depend on existing plant conditions. Provided efforts are begun without delay and continued until the Restricted Region is exited, operation is acceptable.

(continued)

BASES (continued)

SURVEILLANCE REQUIREMENTS

SR 3.2.5.1

Verifying FCBB ≤ 1.0 is required to ensure the reactor is operating within the assumptions of the safety analysis. The boiling boundary limit is established to ensure that the core will remain stable during normal reactor operations in the Restricted Region of the power and flow map defined in the COLR which may otherwise be susceptible to neutronic/thermal hydraulic instabilities.

FCBB is required to be verified every 24 hours while operating in the Restricted Region defined in the COLR. The 24 hour Frequency is based on both engineering judgment and recognition of the slow rate of change in power distribution during normal operation.

The second Frequency requires FCBB to be within the limit within 15 minutes following an unexpected transient. The verification of the FCBB is required as a result of the possibility that the unexpected transient results in the limit not being met. The 15 minute frequency is based on both engineering judgment and the availability of the PBDS to provide the operator with information regarding the potential imminent onset of neutronic/thermal hydraulic instability. The 15 minute Frequency for this SR is not to be used to delay entry into Condition B following an unexpected reduction in feedwater heating, recirculation pump trip, [recirculation pump run back, recirculation pump down shift to slow speed, or significant flow control valve closure (small changes in flow control valve position are not considered significant)].

This Surveillance is modified by a Note which allows 15 minutes to verify FCBB following entry into the Restricted Region if the entry was the result of an unexpected transient (i.e., an unintentional or unplanned change in core thermal power or core flow). The 15 minute allowance is based on both engineering judgment and the availability of the PBDS to provide the operator with information regarding the potential imminent onset of neutronic/thermal hydraulic instability. The 15 minute allowance of the Note is not to be used to delay entry into Condition B if the entry into the Restricted Region was the result of an unexpected reduction in feedwater heating, recirculation pump trip, [recirculation pump run back, recirculation pump down shift to slow speed, or significant flow control valve closure (small changes in flow control valve position are not considered significant)].

(continued)

BASES (continued)

REFERENCES	1.	NEDO 32339-A, "Reactor Stability Long Term Solution: Enhanced Option I-A," July 1995.

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY (continued)

2.b. Average Power Range Monitor Flow Biased Simulated Thermal Power—High

The Average Power Range Monitor Flow Biased Simulated Thermal Power—High Function monitors neutron flux to approximate the THERMAL POWER being transferred to the reactor coolant. The APRM neutron flux is electronically filtered with a time constant representative of the fuel heat transfer dynamics to generate a signal proportional to the THERMAL POWER in the reactor. The trip level is varied as a function of recirculation drive flow ~~(i.e., at lower core flows, the setpoint is reduced proportional to the reduction in power experienced as core flow is reduced with a fixed control rod pattern) but~~ and is clamped at an upper limit that is always lower than the Average Power Range Monitor Fixed Neutron Flux—High Function Allowable Value. The Average Power Range Monitor Flow Biased Simulated Thermal Power—High Function provides a general definition of the licensed core power/core flow operating domain. ~~provides protection against transients where THERMAL POWER increases slowly (such as the loss of feedwater heating event) and protects the fuel cladding integrity by ensuring that the MCPR SL is not exceeded. During these events, the THERMAL POWER increase does not significantly lag the neutron flux response and, because of a lower trip setpoint, will initiate a scram before the high neutron flux scram. For rapid neutron flux increase events, the THERMAL POWER lags the neutron flux and the Average Power Range Monitor Fixed Neutron Flux—High Function will provide a scram signal before the Average Power Range Monitor Flow Biased Simulated Thermal Power—High Function setpoint is exceeded.~~

The Average Power Range Monitor Flow Biased Simulated Thermal Power - High Function is not associated with a limiting safety system setting. Operating limits established for the licensed operating domain are used to develop the Average Power Range Monitor Flow Biased Simulated Thermal Power - High Function Allowable Values to provide pre-emptive reactor scram and prevent gross violation of the licensed operating domain. Operation outside the licensed operating domain may result in anticipated operational occurrences and postulated accidents being initiated from conditions beyond those assumed in the safety analysis. Operation within the licensed operating domain also ensures compliance with General Design Criterion 12.

(continued)

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY

2.b. Average Power Range Monitor Flow Biased Simulated Thermal Power–High (continued)

General Design Criterion 12 requires protection of fuel thermal safety limits from conditions caused by neutronic/thermal hydraulic instability. Neutronic/thermal hydraulic instabilities result in power oscillations which could result in exceeding the MCPR SL.

The area of the core power and flow operating domain susceptible to neutronic/thermal hydraulic instability is affected by the value of Fraction of Core Boiling Boundary (LCO 3.2.5, FCBB). "Setup" and normal ("non-Setup") Average Power Range Monitor Flow Biased Simulated Thermal Power–High Function Allowable Values are specified in the COLR. The normal ("non-Setup") value provides protection against neutronic/thermal hydraulic instability by preventing operation in the susceptible area of the operating domain when operating outside the Restricted Region specified in the COLR with the FCBB limit not required to be met. When the "Setup" value is selected, meeting the FCBB limit provides protection against instability.

"Setup" and "non-Setup" values are selected by operator manipulation of a Setup button on each flow control trip reference card. Selection of the "Setup" value is intended only for planned operation in the Restricted Region as specified in the COLR. Operation in the Restricted Region with the Average Power Range Monitor Flow Biased Simulated Thermal Power–High Function "Setup" requires the FCBB limit to be met and is not generally consistent with normal power operation.

The Average Power Range Monitor Flow Biased Simulated Thermal Power–High Function uses a trip level generated by the flow control trip reference card based on recirculation loop drive flow. ~~The P~~proper **trip level generation as a function**~~representation~~ of drive flow requires~~as indication of core flow is ensured through~~ drive flow alignment. This is accomplished by selection of appropriate dip switch positions on the flow control trip reference cards (Refer to SR 3.3.1.1.18). Changes in the core flow to drive flow functional relationship may vary over the core flow operating range. These changes can result from both gradual changes in recirculation system and core components over the reactor life time as well as specific maintenance performed on these components (e.g., jet pump cleaning).

(continued)

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY

2.b. Average Power Range Monitor Flow Biased Simulated Thermal Power–High (continued)

The APRM System is divided into two groups of channels with four APRM inputs to each trip system. The system is designed to allow one channel in each trip system to be bypassed. Any one APRM channel in a trip system can cause the associated trip system to trip. Four channels of Average Power Range Monitor Flow Biased Simulated Thermal Power–High with two channels in each trip system arranged in a one-out-of-two logic are required to be OPERABLE to ensure that no single instrument failure will preclude a scram from this Function on a valid signal. In addition, to provide adequate coverage of the entire core, at least 11 LPRM inputs are required for each APRM channel, with at least two LPRM inputs from each of the four axial levels at which the LPRMs are located. Each APRM channel receives two total drive flow signals representative of total core flow.

The total drive flow signals are generated by four flow units, two of which supply signals to the trip system A APRMs, while the other two supply signals to the trip system B APRMs. Each flow unit signal is provided by summing up the flow signals from the two recirculation loops. To obtain the most conservative reference signals, the total flow signals from the two flow units (associated with a trip system as described above) are routed to a low auction circuit associated with each APRM. Each APRM's auction circuit selects the lower of the two flow unit signals for use as the scram trip reference for that particular APRM. Each required Average Power Range Monitor Flow Biased Simulated Thermal Power–High channel only requires an input from one OPERABLE flow unit, since the individual APRM channel will perform the intended function with only one OPERABLE flow unit input. However, in order to maintain single failure criteria for the Function, at least one required Average Power Range Monitor Flow Biased Simulated Thermal Power–High channel in each trip system must be capable of maintaining an OPERABLE flow unit signal in the event of a failure of an auction circuit, or a flow unit, in the associated trip system (e.g., if a flow unit is inoperable, one of the two required Average Power Range Monitor Flow Biased Simulated Thermal Power–High channels in the associated trip system must be considered inoperable). The THERMAL POWER time constant of $<$ 7 seconds is based on the fuel heat transfer dynamics and provides a signal proportional to the THERMAL POWER.

(continued)

BASES

APPLICABLE SAFETY ANALYSES, LCO, and APPLICABILITY

2.b. Average Power Range Monitor Flow Biased Simulated Thermal Power-High (continued)

~~The clamped Allowable Value is based on analyses that take credit for the Average Power Range Monitor Flow Biased Simulated Thermal Power-High Function for the mitigation of the loss of feedwater heating event. The THERMAL POWER time constant of < 7 seconds is based on the fuel heat transfer dynamics and provides a signal proportional to the THERMAL POWER.~~

The Average Power Range Monitor Flow Biased Simulated Thermal Power-High Function is required to be OPERABLE in MODE 1 when there is the possibility of ~~generating excessive THERMAL POWER~~ neutronic/thermal hydraulic instability. The potential to exceed ~~and potentially exceeding~~ the SL applicable to high pressure and core flow conditions (MCPR SL), which provides fuel cladding integrity protection, exists if neutronic/thermal hydraulic instability can occur. During MODES 2 and 5, other IRM and APRM Functions provide protection for fuel cladding integrity.

(continued)

BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.3.1.1.3

The Average Power Range Monitor Flow Biased Simulated Thermal Power—High Function uses the recirculation loop drive flows to vary the trip setpoint. This SR ensures that the total loop drive flow signals from the flow units used to vary the setpoint is appropriately compared to a calibrated flow signal and, therefore, the APRM Function accurately reflects the required setpoint as a function of flow. Each flow signal from the respective flow unit must be ≤ 105% of the calibrated flow signal. If the flow unit signal is not within the limit, one required APRM that receives an input from the inoperable flow unit must be declared inoperable.

The Frequency of 7 days is based on engineering judgment, operating experience, and the reliability of this instrumentation.

[Reviewer's Note: Upon implementation of the Enhanced Option I-A Stability Solution this SR is deleted. As a result, the remaining SRs should be renumbered.]

(continued)

SURVEILLANCE REQUIREMENTS (continued)

SR 3.3.1.1.11 and SR 3.3.1.1.13

A CHANNEL CALIBRATION is a complete check of the instrument loop and the sensor. This test verifies that the channel responds to the measured parameter within the necessary range and accuracy. CHANNEL CALIBRATION leaves the channel adjusted to account for instrument drifts between successive calibrations consistent with the plant specific setpoint methodology.

Note 1 states that neutron detectors are excluded from CHANNEL CALIBRATION because they are passive devices, with minimal drift, and because of the difficulty of simulating a meaningful signal. Changes in neutron detector sensitivity are compensated for by performing the 7 day calorimetric calibration (SR 3.3.1.1.2) and the 1000 MWD/T LPRM calibration against the TIPs (SR 3.3.1.1.8). A second Note is provided that requires the APRM and IRM SRs to be performed within 12 hours of entering MODE 2 from MODE 1. Testing of the MODE 2 APRM and IRM Functions cannot be performed in MODE 1 without utilizing jumpers, lifted leads, or movable links. This Note allows entry into MODE 2 from MODE 1 if the associated Frequency is not met per SR 3.0.2. Twelve hours is based on operating experience and in consideration of providing a reasonable time in which to complete the SR. Note 3 states that the digital components of the flow control trip reference card are excluded from CHANNEL CALIBRATION of Function 2.b, Average Power Range Monitor Flow Biased Simulated Thermal Power—High. The analog output potentiometers of the flow control trip reference card are not excluded. The flow control trip reference card has an automatic self-test feature which periodically tests the hardware which performs the digital algorithm. Exclusion of the digital components of the flow control trip reference card from CHANNEL CALIBRATION of Function 2.b is based on the conditions required to perform the test and the likelihood of a change in the status of these components not being detected.

The Frequency of SR 3.3.1.1.11 is based upon the assumption of a 184 day calibration interval in the determination of the magnitude of equipment drift in the setpoint analysis. The Frequency of SR 3.3.1.1.13 is based upon the assumption of an 18 month calibration interval in the determination of the magnitude of equipment drift in the setpoint analysis.

(continued)

BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.3.1.1.18

The Average Power Range Monitor Flow Biased Simulated Thermal Power—High Function uses a trip level generated by the flow control trip reference card based on the recirculation loop drive flow. The drive flow is adjusted by a digital algorithm according to selected drive flow alignment dip switch settings. This SR sets the flow control trip reference card to ensure the drive flow alignment used results in the appropriate trip level being generated from the digital components of the card.

The Frequency of once following a refueling outage is based on the expectation that any change in the core flow to drive flow functional relationship during power operation would be gradual and that maintenance on recirculation system and core components which may impact the relationship is expected to be performed during refueling outages. The completion time of 7 days after reaching equilibrium conditions is based on plant conditions required to perform the test and engineering judgment of the time required to collect and analyze the necessary flow data and the time required to adjust and check the adjustment of each flow control trip reference card. The completion time of 7 days after reaching equilibrium conditions is acceptable based on the low probability of a neutronic/hydraulic instability event.

(continued)

B 3.3 INSTRUMENTATION

B 3.3.1.3 Period Based Detection System (PBDS)

BASES

BACKGROUND

General Design Criterion 12 requires protection of fuel thermal safety limits from conditions caused by neutronic/thermal hydraulic instability. Neutronic/thermal hydraulic instabilities can result in power oscillations which could result in exceeding the MCPR Safety Limit (SL). The MCPR SL ensures that at least 99.9% of the fuel rods avoid boiling transition during normal operation and during an anticipated operational occurrence (AOO) (refer to the Bases for SL 2.1.1.2).

The PBDS provides the operator with an indication that conditions consistent with a significant degradation in the stability performance of the reactor core has occurred and the potential for imminent onset of neutronic/thermal hydraulic instability may exist. Indication of such degradation is cause for the operator to initiate an immediate reactor scram if the reactor is being operated in either the Restricted Region or Monitored Region. The Restricted Region and Monitored Region are defined in the COLR.

The PBDS instrumentation of the Neutron Monitoring System consists of two channels. Each of the PBDS channels includes input from [8] local power range monitors (LPRMs) within the reactor core. These inputs are continually monitored by the PBDS for variations in the neutron flux consistent with the onset of neutronic/thermal hydraulic instability. Each channel includes separate local indication, but share a common control room High-High DR Alarm. While, this LCO specifies OPERABILITY requirements only for one monitoring and indication channel of the PBDS, if both are OPERABLE, a High-High DR Alarm from either channel results in the need for the operator to take actions.

The primary PBDS component is a card in the Neutron Monitoring System with analog inputs and digital processing. The PBDS card has an automatic self-test feature to periodically test the hardware circuit. The self-test functions are executed during their allocated portion of the executive loop sequence. Any self-test failure indicating loss of critical function results in a control room alarm. The inoperable condition is also displayed by an indicating

(continued)

BASES

BACKGROUND (continued)

light on the card front panel. A manually initiated internal test sequence can be actuated via a recessed push button. This internal test consists of simulating alarm and inoperable conditions to verify card OPERABILITY. Descriptions of the PBDS are provided in References 1 and 2.

Actuation of the PBDS High-High DR Alarm is not postulated to occur due to neutronic/thermal hydraulic instability outside the Restricted Region and the Monitored Region. Periodic perturbations can be introduced into the thermal hydraulic behavior of the reactor core from external sources such as recirculation system components and the pressure and feedwater control systems. These perturbations can potentially drive the neutron flux to oscillate within a frequency range expected for neutronic/thermal hydraulic instability. The presence of such oscillations would be recognized by the period based algorithm of the PBDS and potentially result in a High-High DR Alarm. Actuation of the PBDS High-High DR Alarm outside the Restricted Region and the Monitored Region would indicate the presence of a source external to the reactor core and are not indications of neutronic/thermal hydraulic instability.

APPLICABLE SAFETY ANALYSES

Analysis, as described in Section 4 of Reference 1, confirms that AOOs initiated from outside the Restricted Region without stability control and from within the Restricted Region with stability control are not expected to result in neutronic/thermal hydraulic instability. The stability control applied in the Restricted Region (refer to LCO 3.2.5, "Fraction of Core Boiling Boundary (FCBB)") is established to prevent neutronic/thermal hydraulic instability during operation in the Restricted Region. Operation in the Monitored Region is only susceptible to instability under hypothetical operating conditions beyond those analyzed in Reference 1. The types of transients specifically evaluated are loss of flow and coolant temperature decrease which are limiting for the onset of instability.

The initial conditions assumed in the analysis are reasonably conservative and the immediate post-event reactor conditions are significantly stable. However, these assumed initial conditions do not bound each individual parameter which impacts stability performance (Ref. 1). The PBDS instrumentation provides the operator with an indication

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APPLICABLE SAFETY ANALYSES (continued)

that conditions consistent with a significant degradation in the stability performance of the reactor core has occurred and the potential for imminent onset of neutronic/thermal hydraulic instability may exist. Such conditions are only postulated to result from events initiated from initial conditions beyond the conditions assumed in the safety analysis (refer to Section 4, Ref. 1).

The PBDS has no safety function and is not assumed to function during any FSAR design basis accident or transient analysis. However, the PBDS provides the only indication of the imminent onset of neutronic/thermal hydraulic instability during operation in regions of the operating domain potentially susceptible to instability. Therefore, the PBDS is included in the Technical Specifications.

LCO

One PBDS channel is required to be OPERABLE to monitor reactor neutron flux for indications of imminent onset of neutronic/thermal hydraulic instability. OPERABILITY requires the ability for the operator to be immediately alerted to a High-High **DR** Alarm. This is accomplished by the instrument channel control room alarm. The LCO also requires reactor operation be such that the High-High **DR** Alarm is not actuated by any OPERABLE PBDS instrumentation channel.

APPLICABILITY

At least one of two PBDS instrumentation channels is required to be OPERABLE during operation in either the Restricted Region or the Monitored Region specified in the COLR. Similarly, operation with the PBDS High-High **DR** Alarm of any OPERABLE PBDS instrumentation channel is not allowed in the Restricted Region or the Monitored Region. Operation in these regions is susceptible to instability (refer to the Bases for LCO 3.2.5 and Section 4 of Ref. 1). OPERABILITY of at least one PBDS instrumentation channel and operation with no indication of a PBDS High-High **DR** Alarm from any OPERABLE PBDS instrumentation channel is therefore required during operation in these regions.

The boundary of the Restricted Region in the Applicability of this LCO is analytically established in terms of thermal power and core flow. The Restricted Region is defined by the APRM Flow Biased Simulated Thermal Power - High Control Rod Block setpoints, which are a function of reactor recirculation drive flow. The Restricted Region Entry Alarm

(continued)

APPLICABILITY (continued)

(RREA) signal is generated by the Flow Control Trip Reference (FCTR) card using the APRM Flow Biased Simulated Thermal Power - High Control Rod Block setpoints. As a result, the RREA is coincident with the Restricted Region boundary when the setpoints are not "Setup," and provides indication of entry into the Restricted Region. However, APRM Flow Biased Simulated Thermal Power - High Control Rod Block signals provided by the FCTR card, that are not coincident with the Restricted Region boundary, do not generate a valid RREA. The Restricted Region boundary for this LCO Applicability is specified in the COLR.

When the APRM Flow Biased Simulated Thermal Power - High Control Rod Block setpoints are "Setup" the applicable setpoints used to generate the RREA are moved to the interior boundary of the Restricted Region to allow controlled operation within the Restricted Region. While the setpoints are "Setup" the Restricted Region boundary remains defined by the normal APRM Flow Biased APRM Simulated Thermal Power - High Control Rod Block setpoints.

Parameters such as reactor power and core flow available at the reactor controls, may be used to provide immediate confirmation that entry into the Restricted Region could reasonably have occurred.

The Monitored Region in the Applicability of this LCO is analytically established in terms of thermal power and core flow. However, unlike the Restricted Region boundary the Monitored Region boundary is not specifically monitored by plant instrumentation to provide automatic indication of region entry. Therefore, the Monitored Region boundary is defined in terms of thermal power and core flow. The Monitored Region boundary for this LCO Applicability is specified in the COLR.

Operation outside the Restricted Region and the Monitored Region is not susceptible to neutronic/thermal hydraulic instability even under extreme postulated conditions.

(continued)

BASES (continued)

ACTIONS

A.1

If at any time while in the Restricted Region or Monitored Region, an OPERABLE PBDS instrumentation channel indicates a valid High-High **DR** Alarm, the operator is required to initiate an immediate reactor scram. Verification that the High-High **DR** Alarm is valid may be performed without delay against another output from a PBDS card observable from the reactor controls in the control room prior to the manual reactor scram. This provides assurance that core conditions leading to neutronic/thermal hydraulic instability will be mitigated. This Required Action and associated Completion Time does not allow for evaluation of circumstances leading to the High-High **DR** Alarm prior to manual initiation of reactor scram.

B.1 and B.2

Operation with the APRM Flow Biased Simulated Thermal Power-High Function (refer to LCO 3.3.1.1, Table 3.3.1.1-1, Function 2.b.) "Setup" requires the stability control applied in the Restricted Region (refer to LCO 3.2.5) to be met. Requirements for operation with the stability control met are established to prevent reactor thermal hydraulic instability during operation in the Restricted Region. With the required PBDS channel inoperable, the ability to monitor conditions indicating the potential for imminent onset of neutronic/thermal hydraulic instability as a result of unexpected transients is lost. Therefore, action must be immediately initiated to exit the Restricted Region. **While the APRM Flow Biased Simulated Thermal Power - High Control Rod Block setpoints are "Setup," operation in the Restricted Region may be confirmed by use of plant parameters such as reactor power and core flow available at the reactor controls.**

Exit of the Restricted Region can be accomplished by control rod insertion and/or recirculation flow increases. Actions to restart an idle recirculation loop, withdraw control rods or reduce recirculation flow may result in unstable reactor conditions and are not allowed to be used to comply with this Required Action.

The time required to exit the Restricted Region will depend on existing plant conditions. Provided efforts are begun without delay and continued until the Restricted Region is exited, operation is acceptable based on the low probability of a transient which degrades stability performance

(continued)

ACTIONS

B.1 and B.2 (continued)

occurring simultaneously with the required PBDS channel inoperable.

Required Action B.1 is modified by a Note that specifies that initiation of action to exit the Restricted Region only applies if the APRM Flow Biased Simulated Thermal Power—High Function is "Setup". Operation in the Restricted Region without the APRM Flow Biased Simulated Thermal Power-High Function "Setup" indicates uncontrolled entry into the Restricted Region. Uncontrolled entry is consistent with the occurrence of unexpected transients, which, in combination with the absence of stability controls being met may result in significant degradation of stability performance.

When the APRM Flow Biased Simulated Thermal Power - High Control Rod Block setpoints are not "Setup" uncontrolled entry into the Restricted Region is identified by receipt of a valid RREA. Immediate confirmation that the RREA is valid and indicates an actual entry into the Restricted Region may be performed without delay. Immediate confirmation constitutes observation that plant parameters immediately available at the reactor controls (e.g., reactor power and core flow) are reasonably consistent with entry into the Restricted Region. This immediate confirmation may also constitute recognition that plant parameters are rapidly changing during a transient (e.g., a recirculation pump trip) which could reasonably result in entry into the Restricted Region.

For uncontrolled entry into the Restricted Region~~Under these conditions~~ with the required PBDS instrumentation channel inoperable, the ability to monitor conditions indicating the potential for imminent onset of neutronic/thermal hydraulic instability is lost and continued operation is not justified. Therefore, Required Action B.2 requires immediate reactor scram.

C.1

In the Monitored Region the PBDS High-High DR Alarm provides indication of degraded stability performance. Operation in the Monitored Region is susceptible to neutronic/thermal hydraulic instability under postulated conditions exceeding those previously assumed in the safety analysis. With the

(continued)

ACTIONS

C.1 (continued)

required PBDS channel inoperable, the ability to monitor conditions indicating the potential for imminent onset of neutronic/thermal hydraulic instability is lost. Therefore, action must be initiated to exit the Monitored Region.

Actions to restart an idle recirculation loop, withdraw control rods or reduce recirculation flow may result in approaching unstable reactor conditions and are not allowed to be used to comply with this Required Action. Exit of the Monitored Region is accomplished by control rod insertion and/or recirculation flow increases. However, actions which reduce recirculation flow are allowed provided the Fraction of Core Boiling Boundary (FCBB) is recently (within 15 minutes) verified to be ≤ 1.0. Recent verification of FCBB being met, provides assurance that with the PBDS inoperable, planned decreases in recirculation drive flow should not result in significant degradation of core stability performance.

The specified Completion Time of 15 minutes ensures timely operator action to exit the region consistent with the low probability that reactor conditions exceed the initial conditions assumed in the safety analysis. The time required to exit the Monitored Region will depend on existing plant conditions. Provided efforts are begun within 15 minutes and continued until the Monitored Region is exited, operation is acceptable based on the low probability of a transient which degrades stability performance occurring simultaneously with the required PBDS channel inoperable.

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SURVEILLANCE REQUIREMENTS

SR 3.3.1.3.1

During operation in the Restricted Region or the Monitored Region the PBDS High-High DR Alarm is relied upon to indicate conditions consistent with the imminent onset of neutronic/ thermal hydraulic instability. Verification every 12 hours provides assurance of the proper indication of the alarm during operation in the Restricted Region or the Monitored Region. The 12 hour Frequency supplements less formal, but more frequent, checks of alarm status during operation.

SR 3.3.1.3.2

Performance of the CHANNEL CHECK every 12 hours ensures that a gross failure of instrumentation has not occurred. This CHANNEL CHECK is normally a comparison of the PBDS indication to the state of the annunciator, as well as comparison to the same parameter on the other channel if it is available. It is based on the assumption that the instrument channel indication agrees with the immediate indication available to the operator, and that instrument channels monitoring the same parameter should read similarly. Deviations between the instrument channels could be an indication of instrument component failure. A CHANNEL CHECK will detect gross channel failure; thus, it is key to verifying the instrumentation continues to operate properly between each CHANNEL FUNCTIONAL TEST. Agreement criteria are determined by the plant staff based on a combination of the channel instrument uncertainties, including indication and readability.

The 12 hour Frequency is based on operating experience that demonstrates channel failure is rare. The CHANNEL CHECK supplements less formal, but more frequent, checks of

(continued)

BASES

SURVEILLANCE REQUIREMENTS

SR 3.3.1.3.2 (continued)

channels during normal operational use of the displays associated with the channels required by the LCO.

SR 3.3.1.3.3

A CHANNEL FUNCTIONAL TEST is performed for the PBDS to ensure that the entire system will perform the intended function. The CHANNEL FUNCTIONAL TEST for the PBDS includes manual initiation of an internal test sequence and verification of appropriate alarm and inop conditions being reported.

Performance of a CHANNEL FUNCTIONAL TEST at a Frequency of 24 months verifies the performance of the PBDS and associated circuitry. The Frequency considers the plant conditions required to perform the test, the ease of performing the test, and the likelihood of a change in the system or component status. The alarm circuit is designed to operate for over 24 months with sufficient accuracy on signal amplitude and signal timing considering environment, initial calibration and accuracy drift (Ref. 2).

REFERENCES

1. NEDO 32339-A, "Reactor Stability Long Term Solution: Enhanced Option I-A," July 1995.

2. NEDO-32339, Supplement 2, "Reactor Stability Long Term Solution: Enhanced Option I-A Solution Design," April 1995.