(continued)

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(continued)

(continued)

3.3 INSTRUMENTATION

3.3.1.3 Oscillation Power Range Monitor (OPRM) Instrumentation

LCO 3.3.1.3 Four channels of the OPRM instrumentation shall be OPERABLE. Each OPRM channel Period Based Algorithm (Sp) Allowable ~~Value shall be less than or equal to 1.09 at a confirmation~~ count permissive (Np) of 10.

APPLICABILITY: Thermal Power $\geq$ 25% RTP.

ACTIONS:

-------------------------------NOTE-------------------------------
Separate Condition entry is allowed for each channel.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One or more required channels inoperable.	A.1 Place channel in trip.	30 days
	<u>OR</u>	
	A.2 Place associated RPS trip system in trip.	30 days
	<u>OR</u>	
	A.3 Initiate alternate method to detect and suppress thermal hydraulic instability oscillations.	30 days
B. OPRM trip capability not maintained.	B.1 Initiate alternate method to detect and suppress thermal hydraullic instability oscillations.	12 hours
	<u>AND</u>	
	B.2 Restore OPRM trip capability	120 days
C. Required Action and associated Completion Time not met.	C.1 Reduce THERMAL POWER < 25% RTP.	4 hours

SURVEILLANCE REQUIREMENTS

------------------------------------NOTE------------------------------------

When a channel is placed in an inoperable status solely for performance of required Surveillances, entry into associated Conditions and Required Actions may be delayed for up to 6 hours provided the OPRM System maintains trip capability.

SURVEILLANCE		FREQUENCY
SR 3.3.1.3.1	Perform CHANNEL FUNCTIONAL TEST.	184 days
SR 3.3.1.3.2	Calibrate the local power range monitors.	1000 MWD/MT average core exposure
SR 3.3.1.3.3	------------------NOTE------------------ Neutron detectors are excluded. -- Perform CHANNEL CALIBRATION.	24 months
SR 3.3.1.3.4	Perform LOGIC SYSTEM FUNCTIONAL TEST	24 months
SR 3.3.1.3.5	Verify OPRM is not bypassed when THERMAL POWER is ≥ 30% RTP and core flow ≤ 60 MLb/Hr.	24 months
SR 3.3.1.3.6	------------------NOTE------------------ Neutron detectors are excluded. -- Verify the RPS RESPONSE TIME is within limits.	24 months on a STAGGERED TEST BASIS

B 3.3 INSTRUMENTATION

B 3.3.1.3 Oscillation Power Range Monitor (OPRM)

BASES

BACKGROUND

General Design Criterion 10 (GDC 10) requires the reactor core and associated coolant, control, and protection system to be designed with appropriate margin to assure that acceptable fuel design limits are not exceeded during any condition of normal operation including the effects of anticipated operational occurrences. Additionally, GDC 12 requires the reactor core and associated coolant control and protection systems to be designed to assure that power oscillations which can result in conditions exceeding acceptable fuel design limits are either not possible or can be reliably and readily detected and suppressed. The OPRM System provides compliance with GDC 10 and GDC 12, thereby providing protection from exceeding the fuel MCPR safety limit.

References 1, 2, and 3 describe three separate algorithms for detecting stability related oscillations: the period based detection algorithm, the amplitude based algorithm, and the growth rate algorithm. The OPRM System hardware implements these algorithms in microprocessor based modules. These modules execute the algorithms based on LPRM inputs and generate alarms and trips based on these calculations. These trips result in tripping the Reactor Protection System (RPS) when the appropriate RPS trip logic is satisfied, as described in the Bases for LCO 3.3.1.1, "RPS Instrumentation." Only the period based detection algorithm is used in the safety analysis (Ref. 1, 2, 6 & 7). The remaining algorithms provide defense-in-depth and additional protection against unanticipated oscillations.

The period based detection algorithm detects a stability-related oscillation based on the occurrence of a fixed number of consecutive LPRM signal period confirmations followed by the LPRM signal amplitude exceeding a specified setpoint. Upon detection of a stability related oscillation, a trip is generated for that OPRM channel.

The OPRM System consists of four OPRM trip channels, each channel consisting of two OPRM modules. Each OPRM module receives input from LPRMs. Each OPRM module also receives

(continued)

BASES

BACKGROUND (continued)

input from the Neutron Monitoring System (NMS) average power range monitor (APRM) power and flow signals to automatically enable the trip function of the OPRM module.

Each OPRM module is continuously tested by a self-test function. On detection of any OPRM module failure, either a trouble alarm or INOP alarm is activated. The OPRM module provides an INOP alarm when the self-test feature indicates that the OPRM module may not be capable of meeting its functional requirements.

APPLICABLE SAFETY ANALYSES

It has been shown that BWR cores may exhibit thermal-hydraulic reactor instabilities in high power and low flow portions of the core power to flow operating domain. GDC 10 requires the reactor core and associated coolant control and protection systems to be designed with appropriate margin to assure that acceptable fuel design limits are not exceeded during any condition of normal operation, including the effects of anticipated operational occurrences. GDC 12 requires assurance that power oscillations which can result in conditions exceeding acceptable fuel design limits are either not possible or can be reliably and readily detected and suppressed. The OPRM System provides compliance with GDC 10 and GDC 12 by detecting the onset of oscillations and suppressing them by initiating a reactor scram. This assures that the MCPR safety limit will not be violated for anticipated oscillations.

The OPRM Instrumentation satisfies Criterion 3 of the NRC Policy Statement.

LCO

Four channels of the OPRM System are required to be OPERABLE to ensure that stability related oscillations are detected and suppressed prior to exceeding the MCPR safety limit. Only one of the two OPRM modules' period based detection algorithm is required for OPRM channel OPERABILITY. The minimum number of LPRMs required OPERABLE to maintain an OPRM channel OPERABLE is consistent with the minimum number of LPRMs required to maintain the APRM system OPERABLE per LCO 3.3.1.1.

(continued)

BASES

LCO (continued)

The Allowable Value for the OPRM Period Based Algorithm setpoint (Sp) is derived from the Analytic Limit corrected for instrument and calibration errors (Ref. 9 & 10).

APPLICABILITY

The OPRM instrumentation is required to be OPERABLE in order to detect and suppress neutron flux oscillations in the event of thermal-hydraulic instability. As described in References 1, 2, and 3, the power/core flow region protected against anticipated oscillations is defined by THERMAL POWER ≥ 30% RTP and core flow ≤ 60 Mlb/Hr. The OPRM trip is required to be enabled in this region, and the OPRM must be capable of enabling the trip function as a result of anticipated transients that place the core in that power/flow condition. Therefore, the OPRM is required to be OPERABLE with THERMAL POWER ≥ 25% RTP and at all core flows while above that THERMAL POWER. It is not necessary for the OPRM to be operable with THERMAL POWER < 25% RTP because transients from below this THERMAL POWER are not anticipated to result in power that exceeds 30% RTP.

ACTIONS

A Note has been provided to modify the ACTIONS related to the OPRM instrumentation channels. Section 1.3, Completion Times, specifies that once a Condition has been entered subsequent divisions, subsystems, components, or variables expressed in the Condition discovered to be inoperable or not within limits will not result in separate entry into the Condition. Section 1.3 also specifies that Required Actions of the Condition continue to apply for each additional failure with Completion Times based on initial entry into the Condition. However, the Required Actions for inoperable OPRM instrumentation channels provide appropriate compensatory measures for separate inoperable channels. As such, a Note has been provided that allows separate Condition entry for each inoperable OPRM instrumentation channel.

<u>A1, A2 and A3</u>

Because of the reliability and on-line self-testing of the OPRM instrumentation and the redundancy of the RPS design, an allowable out of service time of 30 days has been shown

(continued)

BASES

ACTIONS

A1, A2 and A3 (continued)

to be acceptable (Ref. 7) to permit restoration of any inoperable channel to OPERABLE status. However, this out of service time is only acceptable provided the OPRM instrumentation still maintains OPRM trip capability (refer to Required Actions B.1 and B.2). The remaining OPERABLE OPRM channels continue to provide trip capability (see Condition B) and provide operator information relative to stability activity. The remaining OPRM modules have high reliability. With this high reliability, there is a low probability of a subsequent channel failure within the allowable out of service time. In addition, the OPRM modules continue to perform on-line self-testing and alert the operator if any further system degradation occurs.

If the inoperable channel cannot be restored to OPERABLE status within the allowable out of service time, the OPRM channel or associated RPS trip system must be placed in the tripped condition per Required Actions A.1 and A.2. Placing the inoperable OPRM channel in trip (or the associated RPS trip system in trip) would conservatively compensate for the inoperability, provide the capability to accommodate a single failure and allow operation to continue. Alternately, if it is not desired to place the OPRM channel (or RPS trip system) in trip (e.g., as in the case where placing the inoperable channel in trip would result in a full scram), the alternate method of detecting and suppression thermal hydraulic instability oscillations is required (Required Action A.3). This alternate method is described in Reference 5. It consists of increased operator awareness and monitoring for neutron flux oscillations when operating in the region where oscillations are possible. If indications of oscillation, as described in Reference 5 are observed by the operator, the operator will take the actions described by procedures which include initiating a manual scram of the reactor.

B.1 and B.2

Required action B.1 is intended to ensure that appropriate actions are taken if multiple, inoperable, untripped OPRM channels within the same RPS trip system result in not maintaining OPRM trip capability. OPRM trip capability is

(continued)

BASES

ACTIONS

B.1 and B.2 (continued)

considered to be maintained when sufficient OPRM channels are OPERABLE or in trip (or the associated RPS trip system is in trip), such that a valid OPRM signal will generate a trip signal in both RPS trip systems (this would require both RPS trip systems to have at least one OPRM channel OPERABLE or the associated RPS trip system in trip).

Because of the low probability of the occurrence of an instability, 12 hours is an acceptable time to initiate the alternate method of detecting and suppression thermal hydraulic instability oscillations described in Action A.3 above. The alternate method of detecting and suppressing thermal hydraulic instability oscillations would adequately address detection and mitigation in the event of instability oscillations. Based on industry operating experience with actual instability oscillations, the operator would be able to recognize instabilities during this time and take action to suppress them through a manual scram. In addition, the OPRM System may still be available to provide alarms to the operator if the onset of oscillations were to occur. Since plant operation is minimized in areas where oscillations may occur, operation for 120 days without OPRM trip capability is considered acceptable with implementation of the alternate method of detecting and suppression thermal hydraulic instability oscillations.

C.1

With any Required Action and associated Completion Time not met, THERMAL POWER must be reduced to < 25% RTP within 4 hours. Reducing THERMAL POWER to < 25% RTP places the plant in a condition where instabilities are not likely to occur. The 4 hours is reasonable, based on operating experience, to reduce THERMAL POWER < 25% RTP from full power conditions in an orderly manner and without challenging plant systems.

SURVEILLANCE REQUIREMENTS

SR 3.3.1.3.1

A CHANNEL FUNCTIONAL TEST is performed to ensure that the entire channel will perform the intended function. A Frequency of 184 days provides an acceptable level of system

(continued)

BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.3.1.3.1

average availability over the Frequency and is based on the reliability of the channel. (Ref. 7)

SR 3.3.1.3.2

LPRM gain settings are determined from the local flux profiles measured by the Traversing Incore Probe (TIP) System. This establishes the relative local flux profile for appropriate representative input to the OPRM System. The 1000 MWD/MT Frequency is based on operating experience with LPRM sensitivity changes.

SR 3.3.1.3.3

A CHANNEL CALIBRATION 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. Calibration of the channel provides a check of the internal reference voltage and the internal processor clock frequency. It also compares the desired trip setpoints with those in processor memory. Since the OPRM is a digital system, the internal reference voltage and processor clock frequency are, in turn, used to automatically calibrate the internal analog to digital convertors. As noted, 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 1000 MWD/MT LPRM calibration using the TIPs (SR 3.3.1.3.2).

The Frequency of 24 months is based upon the assumption of the magnitude of equipment drift provided by the equipment supplier. (Ref. 7)

SR 3.3.1.3.4

The LOGIC SYSTEM FUNCTIONAL TEST demonstrates the OPERABILITY of the required trip logic for a specific channel.. The functional testing of control rods, in LCO

(continued)

BASES

SURVEILLANCE REQUIREMENTS

SR 3.3.1.3.4 (continued)

3.1.3, "Control Rod OPERABILITY", and scram discharge volume (SDV) vent and drain valves, in LCO 3.1.8, "Scram Discharge Volume (SDV) Vent and Drain Valves", overlaps this Surveillance to provide complete testing of the assumed safety function. The OPRM self-test function may be utilized to perform this testing for those components that it is designed to monitor.

The 24 month Frequency is based on engineering judgement, reliability of the components and operating experience.

SR 3.3.1.3.5

This SR ensure that trips initiated from the OPRM System will not be inadvertently bypassed when THERMAL POWER is ≥ 30% RTP and core flow is ≤ 60 MLb/Hr. This normally involves calibration of the bypass channels. Adequate margins for the instrument setpoint methodology are incorporated into the actual setpoints (Reference 7).

If any bypass channel setpoint is nonconservative (i.e., the OPRM module is bypassed at ≥ 30% RTP and core flow is ≤ 60 MLB/Hr), then the affected OPRM module is considered inoperable. Alternatively, the bypassed channel can be manually placed in the conservative position (Manual Enable). If placed in the manual enable condition, this SR is met and the module is considered OPERABLE.

The 24 month Frequency is based on engineering judgment and reliability of the components.

SR 3.3.1.3.6

This SR ensure that the individual channel response times are less than or equal to the maximum values assumed in the safety analysis (Ref. 6) The OPRM self-test function may be utilized to perform this testing for those components it is designed to monitor. The LPRM amplifier cards inputting to the OPRM are excluded from the OPRM response time testing. The RPS RESPONSE TIME acceptance criteria are included in Reference 8.

(continued)

BASES

SURVEILLANCE REQUIREMENTS

SR 3.3.1.3.6 (continued)

As noted, neutron detectors are excluded from RPS RESPONSE TIME testing because the principles of detector operation virtually ensure an instantaneous response time. RPS RESPONSE TIME tests are conducted on an 24 month STAGGERED TEST BASIS. This Frequency is based upon operating experience, which shows that random failures of instrumentation components causing serious response time degradation, but not channel failure, are infrequency occurrences.

REFERENCES

1. NEDO-31960-A, "BWR Owners Group Long-Term Stability Solutions Licensing Methodology", November 1995.
2. NEDO 31960-A, Supplement 1, "BWR Owners Group Long-Term Stability Solutions Licensing Methodology", November 1995.
3. NRC Letter, A. Thadani to L. A. England, "Acceptance for Referencing of Topical Reports NEDO-31960, Supplement 1, 'BWR Owners Group Long-Term Stability Solutions Licensing Methodology', July 12, 1994.
4. Generic Letter 94-02, "Long-Term Solutions and Upgrade of Interim Operating Recommendations for Thermal-Hydraulic Instabilities in Boiling Water Reactors", July 11, 1994.
5. BWROG Letter BWROG-9479, "Guidelines for Stability Interim Corrective Action", June 6, 1994.
6. NEDO-32465-A, "BWR Owners Group Reactor Stability Detect and Suppress Solutions Licensing Basis Methodology and Reload Applications", August 1996.
7. CENPD-400-P-A, Rev. 01, "Generic Topical Report for the ABB Option III Oscillation Power Range Monitor (OPRM)", May 1995.
8. FSAR, Table 7.3-28.

BASES

REFERENCES (continued)

9. NFE-1-11-003, "Unit 1 Cycle 11 Stability Option III Analyses"

10. EC-078-1010, "Oscillation Power Range Monitor (OPRM) Period Based Algorithm (Sp) Technical Specification Limit Value".

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 ~~with a THERMAL POWER/core flow condition outside of Regions I and II of Figure 3.4.1-1~~.

<u>OR</u>

One recirculation loop may be in operation provided the following limits are applied when the associated LCO is applicable: ~~with a THERMAL POWER/core flow condition outside of Regions I and II of Figure 3.4.1-1~~.

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;

c. LCO 3.2.3, "LINEAR HEAT GENERATION RATE (LHGR)," single loop operation limits specified in the COLR, and

d. 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.

e. Recirculation pump speed is ≤ 80%.

-------------------------------------Note-------------------------------------
Required limit and setpoint resets for single recirculation loop operation may be delayed for up to 12 hours after transition from two recirculation loop operation to single recirculation loop operation.

APPLICABILITY: MODES 1 and 2.

ACTIONS

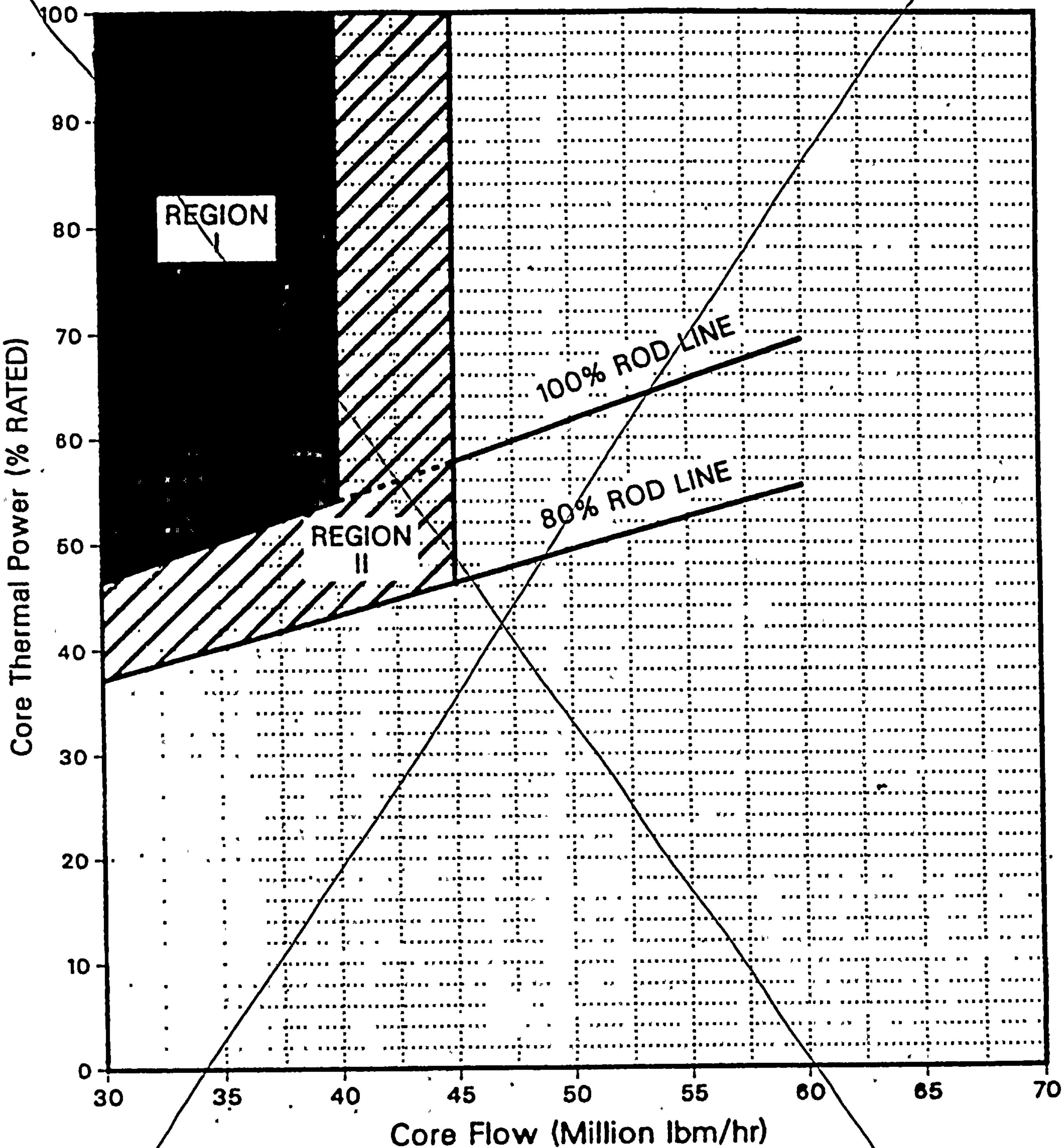
CONDITION	REQUIRED ACTION	COMPLETION TIME
A. ~~Total core flow as a function of THERMAL POWER within Region I of Figure 3.4.1-1~~. ~~OR~~ No recirculation loops operating while in MODE 1	A.1 Place reactor mode switch in the shutdown position.	Immediately
~~B.~~ --------~~NOTE~~---------- ~~Only applicable when in Region II of Figure 3.4.1-1~~ --------------------- ~~Two or more APRM readings oscillating with one or more oscillating ≥ 10% of RTP peak-to-peak.~~ ~~OR~~ ~~Two or more LPRM upscale alarms activating and deactivating with a period ≥ 1 second and ≤ 5 seconds.~~ ~~OR~~ ~~Sustained LPRM oscillations > 10 w/cm² peak-to-peak with a period ≥ 1 second and ≤ 5 seconds.~~ ~~OR~~	~~B.1 Place the reactor mode switch in the shutdown position.~~	~~Immediately~~ ~~(continued)~~

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
~~B. (continued)~~ ~~Less than 50% of required LPRM upscale alarms OPERABLE~~		
~~C. Total core flow as a function of THERMAL POWER within Region II of Figure 3.4.1-1.~~	~~C.1 Initiate action to restore total core flow as a function of THERMAL POWER outside of Region II.~~	~~Immediately~~
B ~~D.~~ Recirculation loop flow mismatch not within limits.	B ~~D~~.1 Declare the recirculation loop with lower flow to be "not in operation."	2 hours
C ~~E~~. No recirculation loops in operation while in MODE 2 OR Single Recirculation Loop required limits and setpoints not established within required time.	C ~~E~~.1 Be in MODE 3.	12 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.4.1.1	--------------------NOTE------------------- Not required to be performed until 24 hours after both recirculation loops are in operation. --- Verify recirculation loop jet pump flow mismatch with both recirculation loops in operation is: a. ≤ 10 million lbm/hr when operating at < 75 million lbm/hr total core flow; and b. ≤ 5 million lbm/hr when operating at ≥ 75 million lbm/hr total core flow.	24 hours
~~SR 3.4.1.2~~	~~Verify total core flow as a function of THERMAL POWER is outside of Region I and II of Figure 3.4.1-1.~~	~~24 hours~~
SR 3.4.1.~~3~~ 2	--------------------NOTE------------------- Only required to be met during single loop operations. --- Verify recirculation pump speed is within the limit specified in the LCO.	24 hours



~~Figure 3.4.1-1~~

~~Thermal Power Stability Restrictions~~

B 3.4 REACTOR COOLANT SYSTEM (RCS)

B 3.4.1 Recirculation Loops Operating

BASES

BACKGROUND

The Reactor Coolant Recirculation System is designed to provide a forced coolant flow through the core to remove heat from the fuel. The forced coolant flow removes more heat from the fuel than would be possible with just natural circulation. The forced flow, therefore, allows operation at significantly higher power than would otherwise be possible. The recirculation system also controls reactivity over a wide span of reactor power by varying the recirculation flow rate to control the void content of the moderator. The Reactor Coolant Recirculation System consists of two recirculation pump loops external to the reactor vessel. These loops provide the piping path for the driving flow of water to the reactor vessel jet pumps. Each external loop contains one variable speed motor driven recirculation pump, a motor generator (MG) set to control pump speed and associated piping, jet pumps, valves, and instrumentation. The recirculation pump, piping, and valves are part of the reactor coolant pressure boundary and are located inside the drywell structure. The jet pumps are reactor vessel internals.

The recirculated coolant consists of saturated water from the steam separators and dryers that has been subcooled by incoming feedwater. This water passes down the annulus between the reactor vessel wall and the core shroud. A portion of the coolant flows from the vessel, through the two external recirculation loops, and becomes the driving flow for the jet pumps. Each of the two external recirculation loops discharges high pressure flow into an external manifold, from which individual recirculation inlet lines are routed to the jet pump risers within the reactor vessel. The remaining portion of the coolant mixture in the annulus becomes the suction flow for the jet pumps. This flow enters the jet pump at suction inlets and is accelerated by the driving flow. The drive flow and suction flow are mixed in the jet pump throat section. The total flow then passes through the jet pump diffuser section into the area below the core (lower plenum), gaining sufficient head in the process to drive the required flow upward through the core. The subcooled water enters the bottom of the fuel channels and contacts the fuel cladding, where heat

(continued)

BASES

BACKGROUND (continued)

is transferred to the coolant. As it rises, the coolant begins to boil, creating steam voids within the fuel channel that continue until the coolant exits the core. Because of reduced moderation, the steam voiding introduces negative reactivity that must be compensated for to maintain or to increase reactor power. The recirculation flow control allows operators to increase recirculation flow and sweep some of the voids from the fuel channel, overcoming the negative reactivity void effect. Thus, the reason for having variable recirculation flow is to compensate for reactivity effects of boiling over a wide range of power generation without having to move control rods and disturb desirable flux patterns.

Each recirculation loop is manually started from the control room. The MG set provides regulation of individual recirculation loop drive flows. The flow in each loop is manually controlled.

APPLICABLE SAFETY ANALYSES

The operation of the Reactor Coolant Recirculation System is an initial condition assumed in the design basis loss of coolant accident (LOCA) (Ref. 1). During a LOCA caused by a recirculation loop pipe break, the intact loop is assumed to provide coolant flow during the first few seconds of the accident. The initial core flow decrease is rapid because the recirculation pump in the broken loop ceases to pump reactor coolant to the vessel almost immediately. The pump in the intact loop coasts down relatively slowly. This pump coastdown governs the core flow response for the next several seconds until the jet pump suction is uncovered (Ref. 1). The analyses assume that both loops are operating at the same flow prior to the accident. However, the LOCA analysis was reviewed for the case with a flow mismatch between the two loops, with the pipe break assumed to be in the loop with the higher flow. While the flow coastdown and core response are potentially more severe in this assumed case (since the intact loop starts at a lower flow rate and the core response is the same as if both loops were operating at a lower flow rate), a small mismatch has been determined to be acceptable based on engineering judgement. The recirculation system is also assumed to have sufficient flow coastdown characteristics to maintain fuel thermal margins during abnormal operational transients (Ref. 2), which are analyzed in Chapter 15 of the FSAR.

(continued)

BASES

APPLICABLE SAFETY ANALYSES (continued)

Plant specific LOCA analyses have been performed assuming only one operating recirculation loop. These analyses have demonstrated that, in the event of a LOCA caused by a pipe break in the operating recirculation loop, the Emergency Core Cooling System response will provide adequate core cooling, provided that the LHGR limit for SPC 9x9-2 fuel and GE lead use assemblies and the APLHGR limit for SPC ATRIUM™-10 fuel is modified.

The transient analyses of Chapter 15 of the FSAR have also been performed for single recirculation loop operation and demonstrate sufficient flow coastdown characteristics to maintain fuel thermal margins during the abnormal operational transients analyzed provided the MCPR requirements are modified. During single recirculation loop operation, modification to the Reactor Protection System (RPS) average power range monitor (APRM) instrument setpoints is also required to account for the different relationships between recirculation drive flow and reactor core flow. The APLHGR, LHGR, and MCPR setpoints for single loop operation are specified in the COLR. The APRM flow biased simulated THERMAL POWER setpoint is in LCO 3.3.1.1, "Reactor Protection System (RPS) Instrumentation." In addition, a restriction on recirculation pump speed is incorporated to address reactor vessel internals vibration concerns and assumptions in the event analysis.

~~General Design Criterion 10 (GDC 10) requires that the reactor core be designed with appropriate margin to assure that fuel design limits will not be exceeded during any condition of normal operation including anticipated operational occurrences. GDC 12 requires assurance that power oscillations which can result in conditions exceeding specified acceptable fuel design limits are either not possible or can be reliably and readily detected and suppressed. The ACTIONS in this section ensure compliance with GDC 12, thereby providing protection from exceeding the fuel MCPR safety limit.~~

~~BWR cores may exhibit thermal-hydraulic reactor instabilities in high power and low flow portions of the core power to flow operating domain. GDC 12 requires assurance that power oscillations which can result in conditions exceeding specified acceptable fuel design limits are either not possible or can be reliably and readily detected and suppressed. This LCO and associated ACTIONS~~

(continued)

BASES

APPLICABLE SAFETY ANALYSIS (continued)

~~ensure compliance with GDC 12 by establishing conservative boundaries that limit the impact of thermal-hydraulic instabilities.~~

~~This LCO and ACTIONS establish power/flow regions and associated requirements and restrictions consistent with references 3 and 4 and provide a conservative boundary for plant operation to ensure compliance with GDC 12 and that thermal-hydraulic instabilities are avoided.~~

Recirculation loops operating satisfies Criterion 2 of the NRC Policy Statement (Ref. 5).

LCO

Two recirculation loops are required to be in operation with their flows matched within the limits specified in SR 3.4.1.1 to ensure that during a LOCA caused by a break of the piping of one recirculation loop the assumptions of the LOCA analysis are satisfied. With the limits specified in SR 3.4.1.1 not met, the recirculation loop with the lower flow must be considered not in operation. With only one recirculation loop in operation, modifications to the required APLGHR limits (LCO 3.2.1, "AVERAGE PLANAR LINEAR HEAT GENERATION RATE"), LHGR limits (LCO 3.2.3, "LINEAR HEAT GENERATION RATE (LHGR)"), MCPR limits (LCO 3.2.2, "MINIMUM CRITICAL POWER RATIO (MCPR)"), and APRM Flow Biased Simulated Thermal Power—High setpoint (LCO 3.3.1.1) may be applied to allow continued operation consistent with the safety analysis assumptions. Furthermore, restrictions are placed on recirculation pump speed to ensure the initial assumption of the event analysis are maintained.

~~In addition, during two-loop and single-loop operation, the combination of core flow and THERMAL POWER must be outside of LCORegion I or II of Figure 3.4.1-1 to limit the impact of core thermal hydraulic oscillations. The plant is operated in conformance with the recommendations in NRC Bulletin 88-07, Supplement 1, (Ref. 4). These operating restrictions provide a high degree of confidence that reactor instabilities will not occur or will not be of sufficient severity to violate the MCPR safety limit.~~

(continued)

BASES

LCO (continued)

The LCO is modified by a Note that allows up to 12 hours to establish the required limits and setpoints after a change from two recirculation loops operation to single recirculation loop operation. If the limits and setpoints are not in compliance with the applicable requirements at the end of the this period, the ACTIONS required by the applicable specifications must be implemented. This time is provided to stabilize operation with one recirculation loop by: limiting flow in the operating loop, limiting total THERMAL POWER; ~~monitor APRM and local power range monitor (LPRM) neutron flux noise levels;~~ and, fully implementing and confirming the required limit and setpoint modifications.

APPLICABILITY

In MODES 1 and 2, requirements for operation of the Reactor Coolant Recirculation System are necessary since there is considerable energy in the reactor core and the limiting design basis transients and accidents are assumed to occur.

In MODES 3, 4, and 5, the consequences of an accident are reduced and the coastdown characteristics of the recirculation loops are not important.

ACTIONS

A.1

When operating ~~in Region I of Figure 3.4.1-1 or~~ with no recirculation loops operating in MODE 1, the potential for thermal-hydraulic oscillations is greatly increased ~~and sufficient margin may not be available for operator response to suppress potential thermal-hydraulic oscillations. Therefore, the reactor mode switch must be immediately placed in the shutdown position. Action is taken immediately to place the plant in a condition where any potential for thermal-hydraulic instabilities will be terminated. The requirements are consistent to those of Reference 4.~~

Insert 1

(continued)

INSERT 1

Although this transient is protected for expected modes of oscillation by the OPRM system, when operable per LCO 3.3.1.3 (References 3 and 4), the prudent response to the natural circulation condition is to preclude potential thermal-hydraulic oscillations by immediately placing the mode switch in the shutdown position.

BASES

ACTIONS (continued)

B.1

When operating in Region II of Figure 3.4.1-1 with indications that thermal hydraulic oscillations are occurring as defined in the ACTION, or when less than 50% of the required LPRM upscale alarms are OPERABLE the potential for thermal-hydraulic oscillations is greatly increased and sufficient margin may not be available for operator response to suppress potential thermal-hydraulic oscillations. The number and location of LPRM strings in each zone assure that with 50% or more of the associated LPRM upscale alarms OPERABLE sufficient monitoring capability is available to detect core wide and regional oscillations.

LPRM upscale alarms are required to detect reactor core thermal-hydraulic instability events. The criteria for determining which LPRM upscale alarms are required is based on assignment of these alarms to designated core zones. These core zones consist of the level A, B, and C alarms in 4 or 5 adjacent LPRM strings. The number and location of LPRM strings in each zone assure that with 50% or more of the associated LPRM upscale alarms OPERABLE sufficient monitoring capability is available to detect core wide and regional oscillations. Operating plant instability data is used to determine the specific LPRM strings assigned to each zone.

The ACTION to place the reactor mode switch in shutdown immediately is necessary since the probability of thermal-hydraulic oscillations is greatly increased if in CONDITION B. Without the monitoring capability, control rods must be inserted to terminate any potential for undetected thermal-hydraulic instabilities.

C.1

When operating in Region II of Figure 3.4.1-1, the potential for thermal-hydraulic oscillations is increased and sufficient margin may not be available for operator response to suppress potential thermal-hydraulic oscillations. Therefore, action must be initiated immediately to restore operation outside of Regions II of Figure 3.4.1-1. This can be accomplished by either decreasing THERMAL POWER with control rod insertion or increasing core flow by increasing recirculation pump speed. The starting of a recirculation

(continued)

BASES

ACTIONS

~~C-1 (continued)~~

pump will not be used ~~as a means to enter~~ the required Regions because the starting ~~of a recirculation pump with~~ the plant operating ~~above~~ the 80% rod line is prohibited due ~~to potential~~ ~~instability~~ problems.

B ~~D~~-1

Recirculation loop flow must match within required limits when both recirculation loops are in operation. If flow mismatch is not within required limits, matched flow must be restored within 2 hours. If matched flows are not restored, the recirculation loop with lower flow must be declared "not in operation." Should a LOCA occur with recirculation loop flow not matched, the core flow coastdown and resultant core response may not be bounded by the LOCA analyses. Therefore, only a limited time is allowed prior to imposing restrictions associated with single loop operation. Operation with only one recirculation loop satisfies the requirements of the LCO and the initial conditions of the accident sequence.

The 2 hour Completion Time is based on the low probability of an accident occurring during this time period, providing a reasonable time to complete the Required Action, and considering that frequent core monitoring by operators allows abrupt changes in core flow conditions to be quickly detected.

These Required Actions do not require tripping the recirculation pump in the lowest flow loop when the mismatch between total jet pump flows of the two loops is greater than the required limits. However, in cases where large flow mismatches occur, low flow or reverse flow can occur in the low flow loop jet pumps, causing vibration of the jet pumps. If zero or reverse flow is detected, the condition should be alleviated by changing recirculation pump speed to re-establish forward flow or by tripping the pump.

C ~~E~~.1

With no recirculation loops in operation while in MODE 2 or if after going to single loop operations the required limits and setpoints cannot be established, the plant must be brought to MODE 3, where the LCO does not apply within

(continued)

BASES

ACTIONS

C-1 (continued)

12 hours. In this condition, the recirculation loops are not required to be operating because of the reduced severity of DBAs and minimal dependence on the recirculation loop coastdown characteristics. The allowed Completion Time of 12 hours is reasonable to reach MODE 3 from full power conditions in an orderly manner without challenging plant systems.

SURVEILLANCE REQUIREMENTS

SR 3.4.1.1

This SR ensures the recirculation loops are within the allowable limits for mismatch. At low core flow (i.e., < 75 million lbm/hr), the MCPR requirements provide larger margins to the fuel cladding integrity Safety Limit such that the potential adverse effect of early boiling transition during a LOCA is reduced. A larger flow mismatch can therefore be allowed when core flow is < 75 million lbm/hr. The recirculation loop jet pump flow, as used in this Surveillance, is the summation of the flows from all of the jet pumps associated with a single recirculation loop.

The mismatch is measured in terms of core flow. If the flow mismatch exceeds the specified limits, the loop with the lower flow is considered inoperable. The SR is not required when both loops are not in operation since the mismatch limits are meaningless during single loop or natural circulation operation. The Surveillance must be performed within 24 hours after both loops are in operation. The 24 hour Frequency is consistent with the Surveillance Frequency for jet pump OPERABILITY verification and has been shown by operating experience to be adequate to detect off normal jet pump loop flows in a timely manner.

~~SR 3.4.1.2~~

~~This SR ensures the combination of core flow and THERMAL POWER are within required limits to prevent uncontrolled thermal hydraulic oscillations by ensuring the recirculation loops are within the limits established by Figure 3.4.1-1. At low recirculation flows and high reactor power,~~

(continued)

BASES

SURVEILLANCE REQUIREMENTS

SR 3.4.1.2 (continued)

the reactor exhibits increased susceptibility to thermal-hydraulic instability. Figure 3.4.1-1 is based on guidance provided in References 3 and 4 which also provided the guidance on how to respond to operation in these conditions. The 24 hour Frequency is based on operating experience and the operator's inherent knowledge of the current reactor status, including significant changes in THERMAL POWER and core flow to ensure the requirements are constantly met.

SR 3.4.1.~~3~~2

As noted, this SR is only applicable when in single loop operation. This SR ensures the recirculation pump limit is maintained. The 24 hour Frequency is based on operating experience and the operators inherent knowledge of the current reactor status.

REFERENCES

1. FSAR, Section 6.3.3.7.

2. FSAR, Section 5.4.1.4.

INSERT 2

3. GE Service Information Letter No. 380, "BWR Core Thermal Hydraulic Stability," Revision 1, February 10, 1984.

4. NRC Bulletin 88-07, Supplement 1, "Power Oscillations in Boiling Water Reactors (BWRs)," December 30, 1988.

5. Final Policy Statement on Technical Specifications Improvements, July 22, 1993 (58 FR 39132).

INSERT 2

3. NEDO-31960-A "BWROG Long Term Stability Solutions Licensing Methodology," November, 1995.

4. NEDO-31960-A "BWROG Long Term Stability Solutions Licensing Methodology, Supplement 1," November, 1995.