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U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Hope Creek Generating Station
Renewed Facility Operating License No. NPF-57
NRC Docket No. 50-354

Subject: **SUPPLEMENTAL INFORMATION - LICENSE AMENDMENT REQUEST – DIGITAL POWER RANGE NEUTRON MONITORING (PRNM) SYSTEM UPGRADE (CAC NO. MF6768)**

References: 1. PSEG letter to NRC, "License Amendment Request - Digital Power Range Neutron Monitoring (PRNM) System Upgrade," dated September 21, 2015 (ADAMS Accession Nos. ML15265A224 and ML15265A225)

In the Reference 1 letter, PSEG Nuclear LLC (PSEG) submitted a license amendment request for Hope Creek Generating Station (HCGS). The proposed amendment would revise the HCGS Technical Specifications to reflect the installation of the General Electric-Hitachi (GEH) digital Nuclear Measurement Analysis and Control (NUMAC) Power Range Neutron Monitoring (PRNM) system. Reference 1 provided the Phase 1 information in accordance with Digital I&C ISG-06 Licensing Process.

Subsequent to the Phase 1 submittal PSEG has determined that three changes are required to the Technical Specification (TS) mark-up that was provided as Attachment 2 of the Phase 1 submittal (Reference 1). Specifically; changes are required to the following functions:

1. Table 2.2.1-1, Reactor Protection System Instrumentation Setpoints, Function 2.b, APRM Simulated Thermal Power-Upscale.

2. Table 3.3.6-2, Control Rod Block Instrumentation Setpoints, Function 2.a, APRM Simulated Thermal Power-Upscale.

3. Table 3.3.6-2, Control Rod Block Instrumentation Setpoints, Function 2.c, APRM Downscale.

The justification for these changes is discussed in Attachment 1 to this submittal. The TS changes are shown in Attachment 2 to this submittal. Attachment 3 to this submittal provides associated changes to the TS Bases (for information only).

PSEG has determined that the information provided in this submittal does not alter the conclusions reached in the 10 CFR 50.92 no significant hazards determination previously submitted. In addition, the information provided in this submittal does not affect the bases for concluding that neither an environmental impact statement nor an environmental assessment needs to be prepared in connection with the proposed amendment.

No new regulatory commitments are established by this submittal. The proposed changes have been reviewed by the Plant Operating Review Committee.

If you have any questions or require additional information, please do not hesitate to contact Mr. Brian Thomas at (856) 339-2022.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on June 17, 2016
(Date)

Respectfully,

Paul Davison

Paul Davison
Site Vice President
Hope Creek Generating Station

Attachments (3)

1. Justification for the Proposed Changes
2. Revised Mark-up of Proposed Technical Specification Pages
3. Revised Mark-up of Proposed Technical Specification Bases Pages

cc: Mr. D. Dorman, Administrator, Region I, NRC
Mr. T. Wengert, Project Manager, NRC
NRC Senior Resident Inspector, Hope Creek
Mr. P. Mulligan, Chief, NJBNE
Mr. L. Marabella, Corporate Commitment Tracking Coordinator
Mr. T. MacEwen, Hope Creek Commitment Tracking Coordinator

Justification for the Proposed Changes

1. Table 2.2.1-1, Reactor Protection System Instrumentation Setpoints, Function 2.b.

The changes required for the PRNM upgrade were not accurately reflected in the TS mark-up for Table 2.2.1-1 Function 2.b, APRM Simulated Thermal Power-Upscale (Reactor Protection System trip function). The correct APRM Simulated Thermal Power – Upscale setpoints were provided in NEDC-33864P Appendix P1 (Enclosure 3 of Reference 1).

The Average Power Range Monitor Scram function (2.b) varies as a function of recirculation loop drive flow (w)[1]. The effective drive flow correction term (Δw) is defined as the difference in indicated drive flow (in percent of drive flow which produces rated core flow) between two loop operation (TLO) and single loop operation (SLO) at the same core flow. Δw is based on a physical phenomenon and represents the amount of drive flow from the active loop that flows backwards through the inactive loop's jet pumps during SLO. The flow input to the APRM STP Scram function Allowable Value (AV) and Nominal Trip Set Point (NTSP) is adjusted by Δw during SLO to account for this phenomenon.

Under the GEH setpoint methodology used for Hope Creek's current design, the NTSP is set far enough away from the AV to account for channel instrument drift. Drift does not change between TLO and SLO, therefore, the difference between AV and NTSP is equal in both cases, and the TLO and SLO setpoints can be represented by a single pair of equations using a Δw offset as shown in the current Hope Creek Technical Specifications.

GEH's current setpoint methodology is described in NEDC-33864P Appendix P (Enclosure 3 of Reference 1). The methodology also accounts for increased uncertainty in the idle recirculation loop flow signal, which requires the NTSP to be further from the AV under SLO than it is under TLO. This is accomplished by reducing the power offset term, therefore[2]:

TLO AV: $0.57W_d + 61\%$
TLO NTSP: $0.57W_d + 59\%$

SLO AV: $0.57(W_d - \Delta W) + 61\%$
SLO NTSP: $0.57(W_d - \Delta W) + 58.1\%$

Consequently, the AV and NTSP for TLO and SLO can no longer be represented by a single pair of equations using the Δw flow offset term.

When the SLO mode is manually enabled the NUMAC APRM instrument applies an offset term to the flow signal. To avoid an additional action to manually adjust the power offset (from 59% to 58.1%), the SLO NTSP equation is solved for the same power offset

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1 The form of the function equation is: Setpoint = Slope x (Flow – Flow Offset) + Power Offset

2 NEDC-33864P Appendix P1 Section 3, Line items 1 and 2. In Appendix P1 'Δw' is equivalently represented as ΔW and 'w' is equivalently represented as Wd.

as the TLO NTSP equation. Using Δw = 9% yields a flow offset of 10.6% to maintain the power offset at 59%:

$0.57(W_d - 9\%) + 58.1\% \approx 0.57(W_d - 10.6\%) + 59\%$[3]

This 10.6% flow offset term is defined as the "SLO Setting Adjustment". This term is applied to the NTSP during SLO by the NUMAC APRM to both account for the 9% Δw flow offset and the increased margin required to the AV. The equations for SLO contained in the TS will be:

SLO AV: $0.57(W_d - \Delta W) + 61\%$
SLO NTSP: $0.57(W_d - SLO_{SettingAdj}) + 59\%$

Use of the SLO Setting Adjustment term simplifies the process for adjusting APRM scram and control rod block setpoints for SLO, as required by TS 3/4.4.1. Expressing the SLO Trip Setpoint in terms of SLO Setting Adjustment reflects how the NUMAC PRNM system is setup and operated.

For this reason the TS-Markup has to be revised to correctly reflect the TLO/SLO Setpoints. Function 2.b and the accompanying ** note have been appropriately revised in Attachment 2 to this submittal. The TLO and SLO equations are provided on separate lines and the Δw and SLO Setting Adjustment values (9% and 10.6%, respectively) have been inserted into the equations. In addition, the high flow clamp values have been consolidated into the individual equations.

2. **Table 3.3.6-2, Control Rod Block Instrumentation Setpoints, Function 2.a**

The discussion and justification provided in Item 1 above also applies to the APRM Simulated Thermal Power-Upscale rod block of Table 3.3.6-2 (Function 2.a). With the new PRNM system the AV and NTSP for TLO and SLO can no longer be represented by a single pair of equations.

NEDC-33864P Appendix P1 (Enclosure 3 of Reference 1) Section 3, Line items 3 and 4 provide the APRM Simulated Thermal Power-Upscale TLO and SLO values for the rod block:

TLO AV: $0.57W_d + 56\%$
TLO NTSP: $0.57W_d + 54.0\%$

SLO AV: $0.57(W_d - \Delta W) + 56\%$
SLO NTSP: $0.57(W_d - SLO_{SettingAdj}) + 54.0\%$

For the reasons discussed in Item 1, the TS-Markup has to be revised to correctly reflect the TLO/SLO Setpoints. Function 2.a and the accompanying * note have been appropriately revised (in a similar manner as described in Item 1 above) in Attachment 2 to this submittal.

[3] The actual TLO to SLO setting adjustment is 10.58 which would make the equations equal. Because the Setting Adjustment is programmed into the NUMAC equipment to one decimal place, it is rounded up to one decimal place for conservatism (i.e., 10.6).

3. Table 3.3.6-2, Control Rod Block Instrumentation Setpoints, Function 2.c.

As shown in Appendix P1, Section 3, Line item 8 (Enclosure 3 of Reference 1), the APRM Downscale rod block (TS Table 3.3.6-2 Trip Function 2.c) NTSP was changed from ≥4% rated thermal power (RTP) to ≥5% RTP based on the existing Allowable Value of ≥3% and the calibration tolerance of the APRM signals (±2% power). This was reflected in the TS markup provided in Attachment 2 of Reference 1.

PSEG is revising the APRM downscale AV from ≥3% to ≥2%. This allows the NTSP to remain at ≥4% after the NUMAC PRNM system is installed. The basis for this change is discussed below.

The APRM Downscale Trip Function as defined in TS Table 3.3.6-2 is a rod block signal and does not produce a reactor scram. Per NEDC 33086P[4], "The APRM downscale setpoint is established to assure that the APRM is on scale and operable in the RUN mode. The APRM is required to be operable when the reactor is at above [sic] the low power setpoint. The APRM downscale setpoint is not credited in any safety analysis event. There is no AL associated with this parameter. The AV is established based on engineering judgement to assure that the APRM is operable when required to function. The downscale trip setpoint has sufficient conservatism to assure that it is operable considering any measurement uncertainties." In this case it is a decreasing setpoint (i.e. mitigating action taken below the setpoint).

The APRM downscale signal serves three other functions at HCGS:

1. Inhibits the Redundant Reactivity Control System (RRCS) from initiating a feedwater runback and initiating injection of boron via Standby Liquid Control (SLC). These actions are automatically performed by RRCS after an initiating signal is received if the APRM downscale signal is not present, indicating that the reactor is not shut down and an Anticipated Transient Without Scram (ATWS) event is in progress.

2. Provides the basis for decision points in the Hope Creek ATWS Emergency Operating Procedure (HC.OP-EO.ZZ-0101A) in accordance with the guidance of the Boiling Water Reactor Owner's Group Emergency Procedure Guidelines / Severe Accident Guidelines (EPGSAG).

3. It is also used to distinguish between an Alert and a Site Area Emergency in the Hope Creek Emergency Action Levels (EAL) for ATWS events.

In all three of the above uses it is an increasing setpoint (i.e. mitigating actions are taken above the setpoint).

While there is no analytical limit associated with the APRM downscale function, there is a process limit of 0%. The overall channel uncertainty is not analyzed to guarantee that an APRM will indicate downscale when reactor power is reduced to zero, however it is highly unlikely that an APRM would fail to indicate downscale for the following reasons:

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4 Safety Analysis and Setpoints Design Basis Consideration, Revision 0 (prepared for the BWR Owners Group)

- APRM/IRM overlap is verified during startup prior to transitioning to RUN mode. This verification that the APRMs are on-scale and operable is administratively controlled via plant procedures.

- Failures during operation that would produce an APRM downscale include loss of signal failures and APRM instrument failures. A loss of signal failure eliminates uncertainties associated with the LPRM detectors. It is highly unlikely that an APRM channel will fail to detect a loss of signal with a downscale setpoint that has drifted to ≥2%. The initial engineering judgment used to set the AV as ≥3% was based on the analog APRM hardware. The NUMAC PRNM system has reduced instrument uncertainties. Therefore the reduction in AV is justified.

- Additionally, operators monitor the APRM signals during power maneuvers. A downscale condition due to a loss of input signals that fails to produce a rod block would be immediately apparent. It is also highly unlikely that this would be the only indication of a system failure due to the continuous self-tests performed by the NUMAC PRNM instruments.

The APRM downscale setpoint is not credited in any safety analysis event. There is no Analytical Limit associated with this parameter and it does not affect any safety limit. The Allowable Value is an administrative limit, while an increase to the Trip Setpoint impacts actual plant setpoints resulting in adverse changes to ATWS mitigation functions and emergency operating procedures. Moving the Allowable Value from ≥3% to ≥2% allows the existing Trip Setpoint to be maintained at ≥4%.

The reduction in AV is justified based on reduced instrument uncertainties in the NUMAC PRNM hardware. Appendix P1 of Enclosure 3 of Reference 1 has been revised to reflect this change and has been placed in the PRNM Reading Room portal.

The TS-Markup has been revised to reflect the change back to 4% for the NTSP, and to reflect the 2% AV for Function 2.c. The changes are shown in Attachment 2 to this submittal.

Revised Mark-up of Proposed Technical Specification Pages

The following Technical Specifications pages for Renewed Facility Operating License NPF-57 are affected by this change request:

Technical Specification	Page
2.2, "Limiting Safety System Settings"	2-4
3/4.3.6, "Control Rod Block Instrumentation"	3/4 3-59

e. 2-Out-Of-4 Voter	NA	NA
f. OPRM Upscale	See CORE OPERATING LIMITS REPORT	NA

TABLE 2.2.1-1

REACTOR PROTECTION SYSTEM INSTRUMENTATION SETPOINTS

FUNCTIONAL UNIT	TRIP SETPOINT	ALLOWABLE VALUES
1. Intermediate Range Monitor, Neutron Flux-High	≤ 120/125 divisions of full scale	≤ 122/125 divisions of full scale
2. Average Power Range Monitor:		
a. Neutron Flux-Upscale, (Setdown)	≤ ~~14~~ 17% of RATED THERMAL POWER	≤ 19% of RATED THERMAL POWER
b. ~~Flow Biased Simulated Thermal Power-Upscale~~		
Insert A ~~1) Flow Biased~~	~~≤ 0.57(w-Δw) + 58%** with a maximum of~~	~~≤ 0.57(w-Δw) + 61%** with a maximum of~~
~~2) High Flow Clamped~~	~~≤ 113.5% of RATED THERMAL POWER~~	~~≤ 115.5% of RATED THERMAL POWER~~
c. ~~Fixed~~ Neutron Flux-Upscale	≤ ~~118~~ 116.3% of RATED THERMAL POWER	≤ ~~120~~ 118.3% of RATED THERMAL POWER
d. Inoperative	NA	NA
3. Reactor Vessel Steam Dome Pressure - High	≤ 1037 psig	≤ 1057 psig
4. Reactor Vessel Water Level - Low, Level 3	≥ 12.5 inches above instrument zero*	≥ 11.0 inches above instrument zero
5. Main Steam Line Isolation Valve - Closure	≤ 8% closed	≤ 12% closed

*See Bases Figure B 3/4 3-1.

**The Average Power Range Monitor Scram function varies as a function of recirculation loop drive flow (w). ~~Δw is defined as the difference in indicated drive flow (in percent of drive flow which produces rated core flow) between two loop and single loop operation at the same core flow. Δw = 0 for two recirculation loop operation. Δw = 9% for single recirculation loop operation.~~

(a) When the Automated BSP Scram Regions Setpoints are implemented in accordance with Action 10 of Table 3.3.1-1, the Simulated Thermal Power-Upscale Flow Biased Setpoint will be adjusted per the CORE OPERATING LIMITS REPORT

INSERT A

(for Functional Unit 2.b)	*(Trip Setpoint)*	*(Allowable Value):*
Simulated Thermal Power – Upscale**		
1) Flow Biased – Two Recirculation Loop Operation	≤ 0.57w + 59%**[(a)] with a maximum of ≤ 113.5% of RATED THERMAL POWER	≤ 0.57w + 61 %** with a maximum of ≤ 115.5% of RATED THERMAL POWER
2) Flow Biased - Single Recirculation Loop Operation	≤ 0.57(w-10.6%) + 59%**[(a)] with a maximum of ≤ 113.5% of RATED THERMAL POWER	≤ 0.57(w-9%) + 61%** with a maximum of ≤ 115.5% of RATED THERMAL POWER

i) Low Trip Setpoint (LTSP)[b]	**	**
ii) Intermediate Trip Setpoint (ITSP)[c]	**	**
iii) High Trip Setpoint (HTSP)[d]	**	**

TABLE 3.3.6-2
CONTROL ROD BLOCK INSTRUMENTATION SETPOINTS

TRIP FUNCTION	TRIP SETPOINT	ALLOWABLE VALUE
1. ROD BLOCK MONITOR		
a. Upscale[a]		
~~i. Flow Biased~~	~~≤ 0.66 (w-Δw) + 65%*~~	~~≤ 0.66 (w-Δw) + 68%*~~
~~ii. High Flow Clamped~~	~~≤ 116%~~	~~≤ 119%~~
b. Inoperative	NA **	NA **
c. Downscale	~~≥ 5% of RATED THERMAL POWER~~	~~≥ 3% of RATED THERMAL POWER~~
2. APRM		
Insert B a. ~~Flow Biased Neutron Flux - Upscale~~	~~≤ 0.57(w-Δw) + 53%*~~	~~≤ 0.57(w-Δw) + 56%*~~
b. Inoperative	NA	NA 2%
c. Downscale	≥ 4% of RATED THERMAL POWER	≥ 3% of RATED THERMAL POWER
d. ~~Neutron Flux - Upscale, Startup~~ Simulated Thermal Power - Upscale (Setdown)	≤ 11% of RATED THERMAL POWER	≤ 13% of RATED THERMAL POWER
3. SOURCE RANGE MONITORS		
a. Detector not full in	NA	NA
b. Upscale	≤ 1.0×10^5 cps	≤ 1.6×10^5 cps
c. Inoperative	NA	NA
d. Downscale	≥ 3 cps	≥ 1.8 cps
4. INTERMEDIATE RANGE MONITORS		
a. Detector not full in	NA	NA
b. Upscale	≤ 108/125 divisions of full scale	≤ 110/125 divisions of full scale
c. Inoperative	NA	NA
d. Downscale	≥ 5/125 divisions of full scale	≥ 3/125 divisions of full scale
5. SCRAM DISCHARGE VOLUME		
a. Water Level-High (Float Switch)	109'1" (North Volume) 108'11.5" (South Volume)	109'3" (North Volume) 109'1.5" (South Volume)
6. ~~REACTOR COOLANT SYSTEM RECIRCULATION FLOW~~		
~~a. Upscale~~ Deleted	~~≤ 111% of rated flow~~	~~≤ 114% of rated flow~~
~~b. Inoperative~~	~~NA~~	~~NA~~
~~c. Comparator~~	~~≤ 10% flow deviation~~	~~≤ 11% flow deviation~~
7. REACTOR MODE SWITCH SHUTDOWN POSITION	NA	NA

** Refer to the CORE OPERATING LIMITS REPORT for these values

* The rod block function is varied as a function of recirculation loop flow (w) ~~and Δw which is defined as the difference in indicated drive flow (in percent of drive flow which produces rated core flow) between two loop and single loop operation at the same core flow~~.

a. Each upscale trip level is applicable over its specified rated power range. All RBM trips are automatically bypassed below the low power setpoint (LPSP). The upscale LTSP is applied between the LPSP and the intermediate power setpoint (IPSP). The upscale ITSP is applied between the IPSP and the high power setpoint (HPSP). The HTSP is applied above the HPSP.
b. APRM Simulated Thermal Power is ≥ 28% and < 63% RTP
c. APRM Simulated Thermal Power is ≥ 63% and < 83% RTP
d. APRM Simulated Thermal Power is ≥ 83%

INSERT B

(for Trip Function 2.a)	*(Trip Setpoint)*	*(Allowable Value):*
Simulated Thermal Power – Upscale*		
1) Flow Biased - Two Recirculation Loop Operation	≤ 0.57w + 54%* with a maximum of ≤ 108% of RATED THERMAL POWER	≤ 0.57w + 56%* with a maximum of ≤ 111 % of RATED THERMAL POWER
2) Flow Biased - Single Recirculation Loop Operation	≤ 0.57(w-10.6%) + 54%* with a maximum of ≤ 108% of RATED THERMAL POWER	≤ 0.57(w-9%) + 56%* with a maximum of ≤ 111 % of RATED THERMAL POWER

Revised Mark-up of Proposed Technical Specification Bases Pages

REACTOR PROTECTION SYSTEM INSTRUMENTATION SETPOINTS (Continued)

Average Power Range Monitor (Continued)

Because the flux distribution associated with uniform rod withdrawals does not involve high local peaks and because several rods must be moved to change power by a significant amount, the rate of power rise is very slow. Generally the heat flux is in near equilibrium with the fission rate. In an assumed uniform rod withdrawal approach to the trip level, the rate of power rise is not more than 5% of RATED THERMAL POWER per minute and the APRM system would be more than adequate to assure shutdown before the power could exceed the Safety Limit. The ~~14%~~ neutron flux trip remains active until the mode switch is placed in the Run ~~position~~. 17

The APRM trip system is calibrated using heat balance data taken during steady state conditions. Fission chambers provide the basic input to the system and therefore the monitors respond directly and quickly to changes due to transient operation for the case of the ~~Fixed~~ Neutron Flux-Upscale setpoint; i.e., for a power increase, the THERMAL POWER of the fuel will be less than that indicated by the neutron flux due to the time constants of the heat transfer associated with the fuel. For the ~~Flow-Biased~~ Simulated Thermal Power-Upscale setpoint, a time constant of 6 ± 0.6 seconds is introduced into the flow biased APRM in order to simulate the fuel thermal transient characteristics. A more conservative maximum value is used for the ~~flow biased~~ setpoint as shown in Table 2.2.1-1. Although it is part of the Hope Creek design configuration and Technical Specifications, the APRM ~~flow-biased~~ simulated thermal power scram is not credited in any Hope Creek safety licensing analyses. simulated thermal power

The APRM setpoints were selected to provide adequate margin for the Safety Limits and yet allow operating margin that reduces the possibility of unnecessary shutdown. Discussion of the Two Loop and Single Loop Operation setpoint adjustments is provided in TS Bases 3/4.4.1

3. Reactor Vessel Steam Dome Pressure-High

High pressure in the nuclear system could cause a rupture to the nuclear system process barrier resulting in the release of fission products. A pressure increase while operating will also tend to increase the power of the reactor by compressing voids thus adding reactivity. The trip will quickly reduce the neutron flux, counteracting the pressure increase. The trip setting is slightly higher than the operating pressure to permit normal operation without spurious trips. The setting provides for a wide margin to the maximum allowable design pressure and takes into account the location of the pressure measurement compared to the highest pressure that occurs in the system during a transient. This trip setpoint is effective at low power/flow conditions when the turbine control valve fast closure and turbine stop valve closure trip are bypassed. For a load rejection or turbine trip under these conditions, the transient analysis indicated an adequate margin to the thermal hydraulic limit.

3/4.3.5 REACTOR CORE ISOLATION COOLING SYSTEM ACTUATION INSTRUMENTATION

The reactor core isolation cooling system actuation instrumentation is provided to initiate actions to assure adequate core cooling in the event of reactor isolation from its primary heat sink and the loss of feedwater flow to the reactor vessel. The Surveillance Frequency is based on operating experience, equipment reliability, and plant risk and is controlled under the Surveillance Frequency Control Program. .Surveillance and maintenance outage times have been determined in accordance with NEDC-30936P-A, "BWR Owners' Group Technical Specification Improvement Methodology (With Demonstration for BWR ECCS Actuation Instrumentation)," Parts 1 and 2 and GENE-770-06-2-A. "Addendum to Bases for Changes to Surveillance Test Intervals and Allowed Out-of-Service Times for Selected Instrumentation Technical Specifications." The safety evaluation reports documenting NRC approval of NEDC-30936P-A and GENE-770-06-2-A are contained in letters to D. N. Grace from A. C. Thadani dated December 9, 1988 (Part 1), D. N. Grace to C. E. Rossi dated December 9, 1988 (Part 2), and G. J. Beck from C. E. Rossi dated September 13, 1991.

Operation with a trip set less conservative than its Trip Setpoint but within its specified Allowable Value is acceptable on the basis that the difference between each Trip Setpoint and the Allowable Value is an allowance for instrument drift specifically allocated for each trip in the safety analyses.

3/4.3.6 CONTROL ROD BLOCK INSTRUMENTATION

The control rod block functions are provided consistent with the requirements of the specifications in Section 3/4.1.4, Control Rod Program Controls and Section 3/4.2 Power Distribution Limits and Section 3/4.3 Instrumentation. The trip logic is arranged so that a trip in any one of the inputs will result in a control rod block.

Insert 2

Operation with a trip set less conservative than its Trip Setpoint but within its specified Allowable Value is acceptable on the basis that the difference between each Trip Setpoint and the Allowable Value is an allowance for instrument drift specifically allocated for each trip in the safety analyses.

Insert 3

As noted, the SR for the Reactor Mode Switch Shutdown Position functional test is not required to be performed until 1 hour after the reactor mode switch is in the shutdown position, since testing of this interlock with the reactor mode switch in any other position cannot be performed without using jumpers, lifted leads, or movable links. This allows entry into OPERATIONAL CONDITIONS 3 and 4 if the frequency is not met per SR 4.0.2. The 1 hour allowance is based on operating experience and in consideration of providing a reasonable time in which to complete the SR.

3/4.3.7 MONITORING INSTRUMENTATION

Move to page B3/4 3-5

3/4.3.7.1 RADIATION MONITORING INSTRUMENTATION

The OPERABILITY of the radiation monitoring instrumentation ensures that; (1) the radiation levels are continually measured in the areas served by the individual channels, and (2) the alarm or automatic action is initiated when the radiation level trip setpoint is exceeded; and (3) sufficient information is available on selected plant parameters to monitor and assess these variables following an accident. This capability is consistent with 10 CFR Part 50, Appendix A, General Design Criteria 19, 41, 60, 61, 63 and 64.

Discussion of the Two Loop and Single Loop Operation setpoint adjustments is provided in TS Bases 3/4.4.1

3/4.4.1 RECIRCULATION SYSTEM

The impact of single recirculation loop operation upon plant safety is assessed and shows that single loop operation is permitted if the MCPR fuel cladding Safety Limit is increased as noted by Specification 2.1.2, APRM scram and control rod block setpoints are adjusted as noted in Tables 2.2.1-1 and 3.3.6-2 respectively. APLHGR limits are decreased by the factor given in the CORE OPERATING LIMITS REPORT (COLR), LHGR limits are decreased by the factor given in the COLR, and MCPR operating limits are adjusted as specified in the COLR.

INSERT 4 →

Additionally, surveillance on the pump speed of the operating recirculation loop is imposed to exclude the possibility of excessive core internals vibration. The surveillance on differential temperatures below 38% THERMAL POWER or 50% rated recirculation loop flow is to mitigate the undue thermal stress on vessel nozzles, recirculation pump and vessel bottom head during the extended operation of the single recirculation loop mode.

An inoperable jet pump is not in itself a sufficient reason to declare a recirculation loop inoperable, but it does, in case of a design-basis-accident, increase the blowdown area and reduce the capability of reflooding the core, thus, the requirement for shutdown of the facility with a jet pump inoperable. Jet pump failure can be detected by monitoring jet pump performance on a prescribed schedule for significant degradation.

Recirculation loop flow mismatch limits are in compliance with the ECCS LOCA analysis design criteria for two recirculation loop operation. The limits will ensure an adequate core flow coastdown from either recirculation loop following a LOCA. In the case where the mismatch limits cannot be maintained during two loop operation, continued operation is permitted in a single recirculation loop mode.

In order to prevent undue stress on the vessel nozzles and bottom head region, the recirculation loop temperatures shall be within 50°F of each other prior to startup of an idle loop. The loop temperature must also be within 50°F of the reactor pressure vessel coolant temperature to prevent thermal shock to the recirculation pump and recirculation nozzles. Sudden equalization of a temperature difference > 145°F between the reactor vessel bottom head coolant and the coolant in the upper region of the reactor vessel by increasing core flow rate would cause undue stress in the reactor vessel bottom head.

ACTION 2 and 3

The APRM system is divided into four APRM channels and four 2-Out-Of-4 voter channels. Each APRM channel provides inputs to each of the four voter channels. The four voter channels are divided into two groups of two voters, with each group of two voters providing inputs to one RPS trip system. The system is designed to allow one APRM channel, but no voter channels (trip systems), to be bypassed (also refer to TS 3.3.1 Bases).

The ACTIONS maintain the requirement to reduce the APRM scram and control rod block setpoints and allowable values within four hours of entering single loop operation (SLO). Failure to lower the setpoints requires declaring the APRM channel(s) inoperable and entering the applicable LCO for scram and control rod block instrumentation and taking the actions required by the referenced specifications (TS 3.3.1 and TS 3.3.6).

INSERT 4

The Average Power Range Monitor Scram and rod block functions vary as a function of recirculation loop drive flow (w). The effective drive flow correction term (Δw) is defined as the difference in indicated drive flow (in percent of drive flow which produces rated core flow) between two loop operation (TLO) and single loop operation (SLO) at the same core flow. Δw is based on a physical phenomenon and represents the amount of drive flow from the active loop that flows backwards through the inactive loop's jet pumps during SLO. The flow input to the APRM STP Scram function Allowable Value (AV) and Nominal Trip Set Point (NTSP) is adjusted by Δw during SLO to account for this phenomenon.

The form of the function equation is: Slope x (Flow [w] – Flow Offset [Δw]) + Power Offset.

GEH's setpoint methodology is described in NEDC-33864P Appendix P, P1 and P2 (VTD 432598). The methodology also accounts for increased uncertainty in the idle recirculation loop flow signal, which requires the NTSP to be further from the AV under SLO than it is under TLO. This is accomplished by reducing the power offset term for the APRM STP-Upscale RPS Trip (Table 2.2.1-1 Function 2.b):

TLO AV: $0.57w + 61\%$
TLO NTSP: $0.57w + 59\%$

SLO AV: $0.57(w - \Delta w) + 61\%$
SLO NTSP: $0.57(w - \Delta w) + 58.1\%$

When the SLO mode is manually enabled the NUMAC APRM instrument applies an offset term to the flow signal. To avoid an additional action to manually adjust the power offset (from 59% to 58.1%), the SLO NTSP equation is solved for the same power offset as the TLO NTSP equation. Using $\Delta w = 9\%$ yields a flow offset of 10.6% to maintain the power offset at 59%:

$$0.57(w - 9\%) + 58.1\% \approx 0.57(w - 10.6\%) + 59\%$$

This 10.6% flow offset term is defined as the "SLO Setting Adjustment" (the actual value is 10.58 but it is rounded up to one decimal place for conservatism since the SLO Setting Adjustment is programmed to one decimal place in the NUMAC equipment). This term is applied to the NTSP during SLO by the NUMAC APRM to both account for the 9% Δw flow offset and the increased margin required to the AV. The Δw and SLO Setting Adjustment values have been inserted into the APRM STP-Upscale equations in Table 2.2.1-1.

This same methodology is also applied to the APRM STP-Upscale Rod Block Trip (Table 3.3.6-2 Function 2.a).

Use of the SLO Setting Adjustment simplifies the process for adjusting APRM scram and control rod block setpoints for SLO, as required by TS 3/4.4.1. Expressing the SLO Trip Setpoint in terms of SLO Setting Adjustment reflects how the NUMAC PRNM system is setup and operated.