AmerenUE
Callaway Plant

PO Box 620
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December 21, 2005

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Mail Station P1-137
Washington, D.C. 20555

ULNRC-05233

Ladies and Gentlemen:

DOCKET NUMBER 50-483
UNION ELECTRIC COMPANY
CALLAWAY PLANT
APPLICATION FOR AMENDMENT TO
FACILITY OPERATING LICENSE NPF-30

References:
1. ULNRC-05138 dated April 14, 2005
2. NRC Request for Additional Information Letter dated August 31, 2005

In Reference 1 above, AmerenUE transmitted an application for amendment to Facility Operating License Number NPF-30 for the Callaway Plant. In Reference 2, NRC requested additional information to support their review of the amendment application. Attachment 1 hereto provides the responses to those requests for additional information (RAIs). Attachment 2 provides Technical Specification Bases changes that completely replace those included with Reference 1 and reflect the response to the third and fourth questions in Attachment 1.

There are no new changes to the Evaluation provided in Reference 1. There are no new commitments contained herein.

If you have any questions on this amendment application, please contact me at (573) 676-8659, or Mr. Dave Shafer at (314) 554-3104.

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

Very truly yours,

Keith D. Young

Executed on: December 21, 2005

Keith D. Young
Manager-Regulatory Affairs

A001

GGY/

Attachments:

1 Responses to Requests for Additional Information
2 Proposed Technical Specification Bases Changes (for information only)

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ATTACHMENT 1

RESPONSES TO REQUESTS FOR ADDITIONAL INFORMATION

PROPOSED REQUEST FOR ADDITIONAL INFORMATION

RELATED TO LICENSE AMENDMENT REQUEST ON RCS BORON CONCENTRATION

UNION ELECTRIC COMPANY

CALLAWAY PLANT, UNIT 1

DOCKET NO. 50-483

By letter dated April 14, 2005, Union Electric Company (the licensee) requested Nuclear Regulatory Commission (NRC) approval for changes to the Technical Specifications (TSs) for the Callaway Plant, Unit 1 (Callaway) to add a new TS 3.1.9, "RCS Boron Limitations < 500°F," and revise TS 3.3.1, "Reactor Trip System (RTS) Instrumentation." The licensee stated that its license amendment request (LAR) would ensure that the required mitigative capability is available, in the form of adequate shutdown margin or an automatic reactor trip, for an uncontrolled rod withdrawal event that may be postulated to occur during low power or subcritical (e.g., startup) conditions.

Following an initial review of the above LAR regarding proposed TS changes to add reactor coolant system (RCS) boron limitations and RTS requirements, the NRC staff concluded that it needed additional information to complete its review of the LAR. The following questions identify the additional information needed:

1. In its LAR, the licensee described the addition of a new TS Limiting Condition for Operation (LCO) 3.1.9, "RCS Boron Limitations < 500°F." This new LCO is designed to assure the required mitigative capability is available, in the form of adequate shutdown margin, for an uncontrolled rod withdrawal event that may be postulated to occur during low power or subcritical conditions. However, a description of the methodology that will be used to determine the all rods out (ARO) critical boron concentration contained in the new LCO 3.1.9 was not provided. Since the function of the new LCO will be to ensure sufficient mitigative capability for the rod withdrawal from low power or subcritical conditions, the NRC staff requests that the licensee provide additional information describing the NRC-approved methodology that will be used to calculate the ARO critical boron concentration. (RAI Categorization Code 2.b)

Response to question 1:

The NRC-approved methodology that will be used to calculate the all rods out (ARO) critical boron concentration is the Westinghouse ANC code (WCAP-10965-P-A, "ANC: A Westinghouse Advanced Nodal Computer Code," September 1986).

2. A key component of the licensee's proposed change to add LCO 3.1.9 is the assurance of "adequate" SHUTDOWN MARGIN. In Section 4.3.1.5, "Shutdown Margins," of Callaway's Updated Final Safety Analysis Report, the licensee states that the "Minimum shutdown margin as specified in the COLR [Core Operating Limits Report] is required at any power operating conditions, in the hot standby shutdown condition, and in the cold shutdown condition." The NRC staff requests that the licensee provide additional information to describe the meaning of the term "adequate" shutdown margins as it is used in the LAR and the proposed TS bases for LCO 3.1.9 submitted with the request. Specifically, the NRC staff requests that the licensee provide additional information sufficient to demonstrate that the interpretation of adequate shutdown margins is consistent with the licensee's current licensing basis regarding shutdown margin. (RAI Categorization Code 2.b)

Response to question 2:

New LCO 3.1.9 is applicable during specified conditions in MODES 2, 3, 4, and 5. As specified in the Callaway Core Operating Limits Report (COLR), the SHUTDOWN MARGIN (SDM) shall be $\geq$ 1.3% $\Delta k/k$ in MODES 2, 3, and 4 and $\geq$ 1.0% $\Delta k/k$ in MODE 5. The Callaway Technical Specifications define SDM as the amount of reactivity by which the reactor is subcritical or would be subcritical from its present condition assuming that all rod cluster control assemblies (RCCAs) are fully inserted, except for the most reactive RCCA which is assumed to be fully withdrawn. LCO 3.1.9 requires the Reactor Coolant System (RCS) to be borated to greater than the all rods out (ARO) critical boron concentration such that if an RCCA bank withdrawal from subcritical (RWFS) accident were to occur, the core would remain subcritical with no credit given to RCCA insertion. As discussed in Standard Review Plan 15.4.1, the acceptance criteria for this transient are met if the DNBR and fuel centerline temperature limits are not exceeded. These acceptance criteria would be met since the core would remain subcritical if an RWFS accident were to occur with the RCS borated to greater than the ARO critical boron concentration. Adequate SDM for this transient is assured by borating the RCS to greater than the ARO critical boron concentration. At the ARO critical boron concentration, the negative reactivity that would normally be inserted after an accident by all of the RCCA banks need not be credited, and the core would remain subcritical even though no reactor trip signal is credited to initiate RCCA insertion. FSAR Table 4.3-3A provides typical reactivity requirements for beginning of cycle life and end of cycle life. For an RCS boron concentration that is greater than the ARO critical boron concentration, the RCCA worth must be entirely replaced by the negative reactivity provided in the form of RCS boric acid solution. In the event of a postulated RWFS accident, adequate SDM is based on assuring post-event subcriticality ($k_{eff} < 1.0$), not on maintaining the pre-event initial condition (the COLR SDM requirement) as the post-accident end state condition. This is acceptable since the SRP acceptance criteria would be met, as the core would remain subcritical, and this boration level is notably conservative since all of the negative reactivity from the four shutdown and five control banks is not credited.

3. As part of its proposed new LCO 3.1.9, the licensee included Surveillance Requirement (SR) 3.1.9.1, that states the following: "Verify RCS boron concentration is greater than the ARO critical boron concentration." The proposed surveillance test interval (STI) is 24 hours. Upon reviewing the LAR, the NRC staff was unable to determine the technical justification for the 24-hour STI. The proposed TS Bases for LCO 3.1.9 provides a passing reference to the adequacy of the 24-hour interval but does not provide sufficient information to justify its selection for the STI. Therefore, the NRC staff requests that the licensee provide additional information that supports the conclusion that a 24-hour STI is adequate for the proposed SR 3.1.9.1. (RAI Categorization Code 4.a)

Response to question 3:

SR 3.1.9.1 will be satisfied by the same RCS boron concentration sampling requirement that is used to satisfy SR 3.1.1.1 (SDM verification), which is performed on a 24-hour Frequency. The Frequency of 24 hours is based on the generally slow change in required boron concentration and the low probability of an accident occurring without the required RCS boron concentration being met. This allows time for obtaining samples and performing a boron concentration analysis. The SR 3.1.9.1 Bases will be modified to add this discussion.

4. As part of the proposed changes to TS 3.3.1, "Reactor Trip System (RTS) Instrumentation," the licensee provided revised conditions and required actions for inoperable Power Range Neutron Flux - Low channels. In the LAR and the proposed TS changes, the licensee states that one of the acceptable actions is to "place the Rod Control System [RCS] in a condition incapable of rod withdrawal." However, the LAR does not provide a description of how this condition will be met. Therefore, the NRC staff requests that the licensee provide additional information that demonstrates (1) how this condition will be satisfied and (2) that it will accomplish its intended safety function to prevent a rod withdrawal from low power or subcritical conditions. (RAI Categorization Code 2.a)

Response to question 4:

The Conditions added to new LCO 3.1.9 and to existing LCO 3.3.1 will be satisfied in one of several methods, all of which have been previously reviewed and accepted by NRC for preventing rod withdrawal. The operators will either de-energize all control rod drive mechanisms (CRDMs), or open all reactor trip breakers (RTBs), or de-energize the motor generator (MG) sets. These are the methods discussed in the TS Bases for LCO 3.3.1 Condition C, LCO 3.3.1 Condition K, LCO 3.4.5 Condition C, LCO 3.4.5 Condition D, and LCO 3.4.9 Condition A. NRC reviewed this information during the ITS conversion, Callaway Amendment 133. The corresponding 3.1.9 and 3.3.1 Bases will be modified to add this discussion.

5. A major component of the proposed LCO 3.1.9 is its applicability only to cold leg temperatures less than 500 °F for Modes 2 and 3 operations. The NRC staff was unable to determine the technical basis for the temperature limit proposed. Higher temperatures could still result in shielding of neutrons from the power range detectors resulting in a delay in the indicated power reaching the Power Range Neutron Flux - Low Trip Function setpoint, and this would result in higher peak power conditions for a rod withdrawal from low power or subcritical conditions. Therefore, the NRC staff requests that the licensee provide a technical basis for the 500 °F temperature proposed. (RAI Categorization Code 2.a)

Response to question 5:

Westinghouse evaluated the operability of the Power Range Neutron Flux (PRNF) function at reduced temperatures. Specifically, Westinghouse identified the minimum temperature at which the PRNF would still function adequately, thereby ensuring that current FSAR analyses that rely on this function during low power or subcritical conditions would continue to be bounding.

Based on plant-specific sensitivities that were run to determine the impact of reduced temperatures on the PRNF instrumentation, it has been determined that the relative response of the PRNF function at 500°F would be approximately 71% of the PRNF function's response at the plant's no-load temperature (557°F). That would mean that under the reduced temperature conditions, when the PRNF detector indicated a power of 25% RATED THERMAL POWER (which is the nominal PRNF low setting reactor trip setpoint), the actual power could be as high as 35% RATED THERMAL POWER (25 / 0.71). To this uncertainty Westinghouse added 10% margin to obtain a corresponding safety analysis PRNF setpoint of roughly 45% RATED THERMAL POWER at a reduced temperature of 500°F.

The effect of operation at a reduced temperature on core-related assumptions, such as Moderator Temperature Coefficient, Doppler feedback, axial power shape, etc., would be more than offset by the benefit in DNB space from the reduced temperature.

Westinghouse concluded that transients of the severity of those currently discussed in the FSAR, initiated from hot zero power (HZP) conditions that rely on the PRNF function for protection, would be insignificantly impacted by the increase in the PRNF safety analysis setpoint described above. This is based on the fact that the nuclear power for these events increases so rapidly that the time of reactor trip would be insignificantly affected. As such, the resulting transient would be very similar to the results presented in the FSAR. Furthermore, operation at the reduced temperature would provide additional DNB margin if explicit DNBR and fuel temperature calculations were to be performed.

Based on this, Westinghouse concluded that the PRNF function is capable of performing its safety function at temperatures as low as 500°F.

ATTACHMENT 2

PROPOSED TECHNICAL SPECIFICATION BASES CHANGES
(for information only)

BASES

REFERENCES (continued)	5.	WCAP-9272-P-A, "Westinghouse Reload Safety Evaluation Methodology Report," July 1985.
	6.	WCAP-11618, including Addendum 1, April 1989.

→ INSERT New LCO 3.1.9 Bases

B 3.1 REACTIVITY CONTROL SYSTEMS

B 3.1.9 RCS Boron Limitations < 500^0F

BASES

BACKGROUND

The control rod drive mechanisms (CRDMs) are wired into pre-selected RCCA banks, such that the RCCA banks can only be withdrawn in their proper withdrawal sequence during the normal mode of operation (i.e., not in the bank select mode). The control of the power supplied to the RCCA banks is such that no more than two RCCA banks can be withdrawn at any time.

When the RCCA banks are capable of being withdrawn from the core, i.e., power supplied to the CRDMs during an approach to criticality for reactor startup, or during maintenance and surveillance testing, there is the potential for an inadvertent RCCA bank withdrawal due to a malfunction of the control rod drive system.

Westinghouse NSAL-00-016 (Ref. 1) discussed the reactor trip functions assumed in the analysis of an Uncontrolled RCCA Bank Withdrawal from a Low Power or Subcritical Condition event (RWFS) (Ref. 2). The primary protection for an RWFS event is provided by the Power Range Neutron Flux - Low trip Function. The Source Range Neutron Flux trip Function is implicitly credited as the primary reactor trip function for an RWFS event in MODES 3, 4, or 5 since the Power Range Neutron Flux - Low trip Function is not required to be OPERABLE throughout these MODES. However, the Source Range Neutron Flux trip Function response time is listed as not applicable (Ref. 3) and that trip function is not response time tested per SR 3.3.1.16. Therefore, the Source Range Neutron Flux trip Function can not be credited to provide protection for an RWFS event in MODES 3, 4, and 5.

NSAL-00-016 also identified that the Power Range Neutron Flux - Low trip Function may not be OPERABLE at RCS temperatures significantly below the hot zero power T-avg due to calibration issues associated with shielding caused by the cold water in the downcomer region of the reactor vessel. The low RCS temperature limit for OPERABILITY of the Power Range Neutron Flux - Low trip Function is 500°F. Therefore, the Power Range Neutron Flux - Low trip Function may not provide the required protection in MODE 3 when the RCS temperature is < 500^0F, nor in MODES 4 and 5, due to the calibration issues discussed above.

Borating the RCS to greater than the all rods out (ARO) critical boron concentration when the RCCA banks are capable of being withdrawn provides sufficient SHUTDOWN MARGIN in the event of ~~an~~ RWFS transient when the RCS temperature is < 500^0F.

APPLICABLE SAFETY ANALYSES

The RCCA bank withdrawal transient addressed by this LCO is the RWFS event. An RCCA bank withdrawal event at power is also analyzed, but that event is mitigated by equipment covered by the requirements of other Technical Specifications that are applicable in MODE 1, such as the Power Range Neutron Flux - High, Power Range Neutron Flux Rate - High Positive Rate, and

BASES

APPLICABLE SAFETY ANALYSES (continued)

Overtemperature ΔT trip Functions. The RWFS event assumes a positive reactivity insertion rate that is equal to the worth obtained from the simultaneous withdrawal of the combination of the two sequential control banks with the highest combined worth moving together with 100% overlap at the maximum withdrawal speed. The RWFS event is assumed to be terminated by the Power Range Neutron Flux - Low trip Function. The Source Range Neutron Flux and Intermediate Range Neutron Flux trip Functions are also available to terminate an RWFS event, but are not explicitly credited in the safety analyses to terminate the event.

The Power Range Neutron Flux - Low trip Function is available to provide the required protection for an RWFS event when the RCS temperature is ≥ 500°F. This temperature limitation is due to calibration issues associated with shielding caused by cold water in the downcomer region of the reactor vessel. Additionally, although not explicitly analyzed in MODES 3, 4, and 5 below 500°F, the Source Range Neutron Flux trip Function is implicitly credited to provide protection for an RWFS event in these MODES.

Since there is no explicit RCCA bank withdrawal analysis that is performed in MODE 3 when the RCS temperature is below 500°F, nor in MODES 4 and 5, and the Power Range Neutron Flux - Low trip Function can not be credited to mitigate an RWFS event with the RCS temperature below 500°F, LCO 3.1.9 requires that the RCS boron concentration be greater than the ARO critical boron concentration when the Rod Control System is capable of rod withdrawal in these MODES. This requirement provides sufficient SHUTDOWN MARGIN to prevent the undesirable consequences (i.e., inadvertent criticality) that could result from an RWFS event.

RCS Boron Limitations < 500°F satisfies Criterion 2 of 10 CFR 50.36(c)(2)(ii).

LCO

This LCO requires that the boron concentration of the RCS be greater than the ARO critical boron concentration to provide adequate SHUTDOWN MARGIN in the event of an RWFS transient.

APPLICABILITY

In the event of an RWFS transient, this LCO must be applicable to provide adequate SHUTDOWN MARGIN in the following MODES and specified conditions:

- In MODE 2 with k_{eff} < 1.0 with any RCS cold leg temperature < 500°F and with the Rod Control System capable of rod withdrawal;
- In MODE 3 with any RCS cold leg temperature < 500°F and with the Rod Control System capable of rod withdrawal; and
- In MODES 4 and 5 with the Rod Control System capable of rod withdrawal.

In MODE 6 the requirements of LCO 3.1.9 are not applicable because the Rod Control System is not capable of rod withdrawal.

BASES

APPLICABILITY (continued)

When protection is required to mitigate an RWFS event while operating under specified conditions other than those above in MODES 2 and 3, LCO 3.3.1, "Reactor Trip System," assures that the Power Range Neutron Flux - Low trip Function is OPERABLE to mitigate the event.

In MODE 1 the requirements of LCO 3.1.9 are not applicable since an uncontrolled RCCA bank withdrawal event at power would be mitigated by the Power Range Neutron Flux - High trip Function, or the Power Range Neutron Flux Rate - High Positive Rate trip Function, or the Overtemperature ΔT trip Function, all of which are required to be OPERABLE by LCO 3.3.1, "Reactor Trip System."

Since this Specification has no LCO 3.0.4.c allowance, MODE 5 can not be entered from MODE 6 while not meeting the RCS boron concentration limits. The risk assessments of LCO 3.0.4.b may only be utilized for systems and components, not Criterion 2 values or parameters such as RCS boron concentration. Therefore, a risk assessment per LCO 3.0.4.b to allow MODE changes with single or multiple system/equipment inoperabilities can not be used to allow a MODE change into, or ascending within, this LCO while not meeting the RCS boron concentration limits, even if the risk assessment specifically includes consideration of RCS boron concentration.

ACTIONS

A.1

If the RCS boron concentration is not within limit, action must be taken immediately to restore the boron concentration to within limit. Borating the RCS to a boron concentration greater than the ARO critical boron concentration provides sufficient SHUTDOWN MARGIN if an RWFS event should occur. Initiating action immediately to restore the boron concentration to within limit provides assurance that the LCO requirement will be restored in a timely manner. The Completion Time is reasonable, considering the low probability of an RWFS event occurring while restoring the boron concentration to within limit. Additionally, although not explicitly credited as a primary trip function, the Source Range Neutron Flux trip Function would provide protection for an RWFS event during this period of time.

A.2

If the RCS boron concentration is not within limit, an alternate action is to make the Rod Control System incapable of rod withdrawal. This action precludes an RWFS event from occurring with an inadequate SHUTDOWN MARGIN. Initiating action immediately to make the Rod Control System incapable of rod withdrawal provides adequate assurance that the plant is promptly placed in a condition in which the boron concentration requirements of the LCO are no longer required to mitigate the consequences of an RWFS event.

INSERT 1

INSERT 1

(e.g., by de-energizing all CRDMs, by opening the RTBs, or de-energizing the motor generator (MG) sets).

BASES

ACTIONS (continued)

A.3

If the RCS boron concentration is not within limit, another alternate action is to restore all RCS cold leg temperatures to ≥ 500°F. At this RCS temperature the Power Range Neutron Flux - Low trip Function would be available to provide the necessary protection should an RWFS event occur. Initiating action immediately to restore all RCS cold leg temperatures to ≥ 500°F provides adequate assurance that the plant is promptly placed in a condition in which the boron concentration requirements of the LCO are no longer necessary.

Additionally, although not explicitly credited as a primary trip function, the Source Range Neutron Flux trip Function would provide protection for an RWFS event while RCS temperature is being increased.

Required Action A.3 is modified by a Note that states that it is not applicable in MODES 4 and 5. The Note provides assurance that this Required Action would only be taken in MODES 2 and 3 (i.e., during a plant startup) when the RCS temperature can readily be increased to ≥ 500°F. After the RCS cold leg temperatures are increased to ≥ 500°F, the requirements of LCO 3.1.9 are no longer applicable and protection for an RWFS event would be provided by the Power Range Neutron Flux - Low trip Function, which is required to be OPERABLE by LCO 3.3.1, "Reactor Trip System."

SURVEILLANCE REQUIREMENTS

SR 3.1.9.1

This SR ensures that the RCS boron concentration is within limit. The boron concentration is determined periodically by chemical analysis.

A Frequency of 24 hours is adequate based on the time required to significantly dilute the RCS, the various alarms available in the control room, and the heightened awareness in the control room when the rods are capable of being withdrawn. INSERT 2

REFERENCES

1. Westinghouse Nuclear Safety Advisory Letter NSAL-00-016, "Rod Withdrawal from Subcritical Protection in Lower Modes," December 4, 2000.
2. FSAR Section 15.4.1.
3. FSAR Table 16.3-1.

INSERT 2

This Frequency also reflects the low probability of an accident occurring without the required level of RCS boration and allows time for the operator to collect the required data from a boron concentration analysis of an RCS sample.

BASES

APPLICABLE SAFETY ANALYSES, LCO, AND APPLICABILITY

a. Power Range Neutron Flux - High (continued)

an uncontrolled RCCA bank
These excursions can be caused by ~~rod~~ withdrawal or reductions in RCS temperature.
, rod ejection,

The LCO requires all four of the Power Range Neutron Flux - High channels to be OPERABLE (two-out-of-four trip logic). The Trip Setpoint is ≤ 109% RTP.

3, 4, 5, or 6, accurately
In MODE 1 or 2, when a positive reactivity excursion could occur, the Power Range Neutron Flux - High trip must be OPERABLE. This Function will terminate the reactivity excursion and shut down the reactor prior to reaching a power level that could damage the fuel. In MODE 3, 4, 5, or 6, the NIS power range detectors cannot detect neutron levels. In ~~these~~ MODES, the Power Range Neutron Flux - High does not have to be OPERABLE because the reactor is shut down and reactivity excursions into the power range are extremely unlikely. Other RTS Functions and administrative controls provide protection against reactivity additions when in MODE 3, 4, 5, or 6.
(with any RCS cold leg temperature < 500°F),

b. Power Range Neutron Flux - Low

The LCO requirement for the Power Range Neutron Flux - Low trip Function ensures that protection is provided against a positive reactivity excursion from low power or subcritical conditions.
, such as an uncontrolled RCCA bank withdrawal or rod ejection,

The LCO requires all four of the Power Range Neutron Flux - Low channels to be OPERABLE (two-out-of-four trip logic). The Trip Setpoint is ≤ 25% RTP.

INSERT B 3.3.1-11A
In MODE 1, below the Power Range Neutron Flux (P-10 setpoint), and in MODE 2, the Power Range Neutron Flux - Low trip must be OPERABLE. This Function may be manually blocked by the operator when two out of four power range channels are greater than 10% RTP (P-10 setpoint). This Function is automatically unblocked when three out of four power range channels are below the P-10 setpoint. Above the P-10 setpoint, positive reactivity excursions ~~additions~~ are mitigated by the Power Range Neutron Flux- High trip Function.

INSERT B 3.3.1-11B
~~In MODE 3, 4, 5, or 6,~~ the Power Range Neutron Flux - Low trip Function does not have to be OPERABLE because the reactor is shut down and the NIS power range

(continued)

INSERT B 3.3.1-~~9A~~ *11A*

with $k_{eff} \geq 1.0$; and in MODE 2 with $k_{eff} < 1.0$, and all RCS cold leg temperatures $\geq$ 500°F, and the RCS boron concentration less than or equal to the all-rods-out (ARO) critical boron concentration, and the Rod Control System capable of rod withdrawal or one or more rods not fully inserted; and in MODE 3 with all RCS cold leg temperatures $\geq$ 500°F, and the RCS boron concentration less than or equal to the ARO critical boron concentration, and the Rod Control System capable of rod withdrawal or one or more rods not fully inserted,

INSERT B 3.3.1-~~9B~~ *11B*

The Power Range Neutron Flux - Low trip Function does not have to be OPERABLE in MODE 2 with the reactor subcritical ($k_{eff} < 1.0$) and any combination of one or more of the following specified conditions in the Applicability, nor does this trip Function have to be OPERABLE in MODE 3 with any combination of one or more of the following specified conditions in the Applicability:

- any RCS cold leg temperature < 500°F, or
- RCS boron concentration greater than the ARO critical boron concentration, or
- Rod Control System incapable of rod withdrawal and all rods fully inserted.

Accident analysis acceptance criteria with the reactor subcritical, and any RCS cold leg temperature < 500°F, and with the Rod Control System capable of rod withdrawal are satisfied by virtue of the RCS boration requirements of LCO 3.1.9, "RCS Boron Limitations < 500°F." Acceptance criteria are satisfied, and the protection provided by the Power Range Neutron Flux - Low trip Function is not required, if the RCS boron concentration is greater than the ARO critical boron concentration or the Rod Control System is rendered incapable of rod withdrawal per the requirements of LCO 3.1.9.

In addition, in MODE 3 (with any RCS cold leg temperature < 500°F, or the RCS sufficiently borated, or the RCCA bank withdrawal event precluded per the specified conditions of footnote (i) in Table 3.3.1-1), 4, 5, or 6,

BASES

APPLICABLE SAFETY ANALYSES, LCO, AND APPLICABILITY

b. Power Range Neutron Flux - Low (continued)

accurately

detectors cannot detect neutron levels in this range. Other RTS trip Functions and administrative controls provide protection against positive reactivity ~~additions or power~~ excursions in ~~MODE 3, 4, 5, or 6.~~ these MODES and specified conditions in the Applicability.

3. Power Range Neutron Flux Rate

The Power Range Neutron Flux Rate trip uses the same channels as discussed for Function 2 above.

Power Range Neutron Flux - High Positive Rate

The Power Range Neutron Flux - High Positive Rate trip Function ensures that protection is provided against rapid increases in neutron flux that are characteristic of an RCCA drive rod housing rupture and the accompanying ejection of the RCCA. This Function compliments the Power Range Neutron Flux - High and Low Setpoint trip Functions to ensure that the criteria are met for a rod ejection from the power range. This Function also provides protection for the ~~rod~~ uncontrolled RCCA bank withdrawal at power event.

The LCO requires all four of the Power Range Neutron Flux - High Positive Rate channels to be OPERABLE (two-out-of-four trip logic). The Trip Setpoint is ≤ 4.25% RTP with a time constant ≥ 2 seconds.

In MODE 1 or 2, when there is a potential to add a large amount of positive reactivity from a rod ejection accident (REA), the Power Range Neutron Flux - High Positive Rate trip must be OPERABLE. In MODE 3, 4, 5, or 6, the Power Range Neutron Flux - High Positive Rate trip Function does not have to be OPERABLE because other RTS trip Functions and administrative controls will provide protection against positive reactivity ~~additions.~~ excursions. Also, since only the shutdown banks may be withdrawn in MODE 3, 4, or 5, the remaining complement of control bank worth ensures a sufficient degree of SDM in the event of an REA. In MODE 6, no rods are withdrawn and the SDM is increased during refueling operations. The reactor vessel head is also removed or the closure bolts are detensioned preventing any pressure buildup. In addition, the NIS power range detectors cannot accurately detect neutron levels ~~present in this mode.~~ when RCS temperatures are less than 500°F.

(continued)

BASES

APPLICABLE SAFETY ANALYSES, LCO, AND APPLICABILITY (continued)

4. Intermediate Range Neutron Flux

The Intermediate Range Neutron Flux trip Function ensures that protection is provided against an uncontrolled RCCA bank rod withdrawal accident from a subcritical condition during startup (automatic rod withdrawal is no longer available). This trip Function provides redundant protection to the Power Range Neutron Flux - Low Setpoint trip Function. The NIS intermediate range detectors are located external to the reactor vessel and measure neutrons leaking from the core. The NIS intermediate range detectors do not provide any input to control systems. Note that this Function also provides a signal to prevent rod withdrawal prior to initiating a reactor trip. Limiting further rod withdrawal may terminate the transient and eliminate the need to trip the reactor.

The LCO requires two channels of Intermediate Range Neutron Flux to be OPERABLE. Two OPERABLE channels are sufficient to ensure no single random failure will disable this trip Function (one-out-of-two trip logic). The Trip Setpoint is ≤ 25% RTP.

Because this trip Function is important only during startup, there is generally no need to disable channels for testing while the Function is required to be OPERABLE. Therefore, a third channel is unnecessary.

an uncontrolled RCCA bank

In MODE 1 below the P-10 setpoint, and in MODE 2 above the P-6 setpoint, when there is a potential for an uncontrolled RCCA bank ~~rod~~ withdrawal accident during reactor startup, the Intermediate Range Neutron Flux trip must be OPERABLE. Above the P-10 setpoint, the Power Range Neutron Flux - High Setpoint trip and the Power Range Neutron Flux - High Positive Rate trip provide core protection for ~~a rod~~ withdrawal accident. In MODE 2 below the P-6 setpoint, the Source Range Neutron Flux trip Function provides the primary core protection for reactivity accidents. In MODE 3, 4, or 5, the Intermediate Range Neutron Flux trip does not have to be OPERABLE~~, because the control rods must be fully inserted and only the shutdown rods may be withdrawn. The reactor cannot be started up in this condition. The core also has the required SDM to mitigate the consequences of a positive reactivity addition accident.~~ In MODE 6, all rods are fully inserted and the core has a required increased SDM. Also, the NIS intermediate range detectors cannot detect neutron levels present ~~in this MODE.~~ during lower temperatures.

INSERT B 3.3.1-13

(continued)

INSERT B 3.3.1-~~11~~ 13

In MODE 3 with all RCS cold leg temperatures ≥ 500°F, and the RCS boron concentration less than or equal to the ARO critical boron concentration, and the Rod Control System capable of rod withdrawal or one or more rods not fully inserted, the Power Range Neutron Flux - Low trip Function provides protection for an uncontrolled RCCA bank withdrawal or control rod ejection event from low power or subcritical conditions.

With the Rod Control System capable of rod withdrawal in MODE 3 (with any RCS cold leg temperature < 500°F), MODE 4, or MODE 5, LCO 3.1.9, "RCS Boron Limitations < 500°F," requires that the RCS boron concentration be greater than the all-rods-out (ARO) critical boron concentration to ensure that sufficient SHUTDOWN MARGIN is available if an uncontrolled RCCA bank withdrawal event were to occur.

BASES

APPLICABLE SAFETY ANALYSES, LCO, AND APPLICABILITY (continued)

5. Source Range Neutron Flux

The LCO requirement for the Source Range Neutron Flux trip Function ensures that protection is provided against an uncontrolled RCCA bank ~~rod~~ withdrawal accident from a subcritical condition during startup (automatic rod withdrawal is no longer available). This trip Function provides redundant protection to the Power Range Neutron Flux - Low and Intermediate Range Neutron Flux trip Functions. In MODES 3, 4, and 5, administrative controls also prevent the uncontrolled manual withdrawal of rods. The NIS source range detectors are located external to the reactor vessel and measure neutrons leaking from the core. The NIS source range detectors do not provide any inputs to control systems. The source range trip is the only RTS automatic protection function required in MODES 3, 4, and 5 with the Rod Control System capable of rod withdrawal or one or more rods not fully inserted. ~~Therefore, the functional capability at the Trip Setpoint is assumed to be available.~~ (with any RCS cold leg temperature < 500°F),

INSERT B 3.3.1-14 →

The LCO requires two channels of Source Range Neutron Flux to be OPERABLE. Two OPERABLE channels are sufficient to ensure no single random failure will disable this trip Function. This Function uses one-out-of-two trip logic. The Trip Setpoint is ≤ 1.0 E5 cps. The outputs of the Function to RTS logic are not required OPERABLE in MODE 6 or when all rods are fully inserted and the Rod Control System is incapable of rod withdrawal.

The Source Range Neutron Flux trip Function provides protection for control rod withdrawal from subcritical, boron dilution, and control rod ejection events.

In MODE 2 when below the P-6 setpoint, the Source Range Neutron Flux trip must be OPERABLE. Above the P-6 setpoint, the Intermediate Range Neutron Flux trip and the Power Range Neutron Flux - Low trip will provide core protection for reactivity accidents. Above the P-6 setpoint, the NIS source range neutron flux reactor trip may be manually blocked. When the source range trip is blocked, the high voltage to the detectors is also removed.

In MODES 3, 4, and 5 with the Rod Control System capable of rod withdrawal or one or more rods not fully inserted, the Source Range Neutron Flux trip Function must also be OPERABLE. If the Rod Control System is capable of rod withdrawal, the Source Range Neutron Flux trip must be OPERABLE to provide core protection against a rod withdrawal accident. If the Rod Control

(continued)

INSERT B 3.3.1-~~12~~ *14*

In MODE 3 with all RCS cold leg temperatures ≥ 500°F, and the RCS boron concentration less than or equal to the ARO critical boron concentration, and the Rod Control System capable of rod withdrawal or one or more rods not fully inserted, the Power Range Neutron Flux - Low trip Function provides protection for an uncontrolled RCCA bank withdrawal or control rod ejection event from low power or subcritical conditions.

With the Rod Control System capable of rod withdrawal in MODE 3 (with any RCS cold leg temperature < 500°F), MODE 4, or MODE 5, LCO 3.1.9, "RCS Boron Limitations < 500°F," requires that the RCS boron concentration be greater than the all-rods-out (ARO) critical boron concentration to ensure that sufficient SHUTDOWN MARGIN (SDM) is available if an uncontrolled RCCA bank withdrawal event were to occur. The safety analyses do not take explicit credit for the Source Range Neutron Flux trip Function as a primary trip to mitigate an uncontrolled RCCA bank withdrawal event or control rod ejection occurring from low power or subcritical conditions since this trip Function is not tested for its response time under SR 3.3.1.16. LCO 3.1.9, "RCS Boron Limitations < 500°F," assures that sufficient SDM is available if an uncontrolled RCCA bank withdrawal were to occur while the plant is operating within that LCO's Applicability and specified conditions.

and all rods are fully inserted in MODES 3, 4, and 5,

BASES

APPLICABLE SAFETY ANALYSES, LCO, AND APPLICABILITY

5. Source Range Neutron Flux (continued)

System is not capable of rod withdrawal, the source range detectors are not required to trip the reactor. However, their monitoring Function must be OPERABLE to monitor core neutron levels and provide inputs to the BDMS as addressed in LCO 3.3.9, "Boron Dilution Mitigation System (BDMS)," to protect against inadvertent reactivity changes that may occur as a result of events like an uncontrolled boron dilution. The requirements for the NIS source range detectors in MODE 6 are addressed in LCO 3.9.3, "Nuclear Instrumentation."

6. Overtemperature ΔT

The Overtemperature ΔT trip Function is provided to ensure that the design limit DNBR is met. This trip Function also limits the range over which the Overpower ΔT trip Function must provide protection. The inputs to the Overtemperature ΔT trip include pressure, coolant temperature, axial power distribution, and reactor power as indicated by loop ΔT assuming full reactor coolant flow. Protection from violating the DNBR limit is assured for those transients that are slow with respect to delays from the core to the measurement system. The Overtemperature ΔT trip Function uses each loop's ΔT as a measure of reactor power and is compared with a setpoint that is automatically varied with the following parameters:

- reactor coolant average temperature - the Trip Setpoint is varied to correct for changes in coolant density and specific heat capacity with changes in coolant temperature;
- pressurizer pressure - the Trip Setpoint is varied to correct for changes in system pressure; and
- axial power distribution f(ΔI) - the Trip Setpoint is varied to account for imbalances in the axial power distribution as detected by the NIS upper and lower power range detectors. If axial peaks are greater than the design limits, as indicated by the difference between the upper and lower NIS power range detectors, the Trip Setpoint is reduced.

Dynamic compensation is included for system piping delays from the core to the temperature measurement system.

ΔT_0 and T′, as used in the Overtemperature ΔT trip, represent the 100% RTP values as measured by the plant for each loop. For

(continued)

BASES

ACTIONS

C.1, C.2.1, and C.2.2 (continued)

- Automatic Trip Logic.

This action addresses the train orientation of the RTS for these Functions. With one channel or train inoperable, the inoperable channel or train must be restored to OPERABLE status within 48 hours. If the affected Function(s) cannot be restored to OPERABLE status within the allowed 48 hour Completion Time, the unit must be placed in a MODE in which the requirement does not apply. To achieve this status, action must be initiated within the same 48 hours to fully insert all rods and the Rod Control System must be rendered incapable of rod withdrawal within the next hour (e.g., by de-energizing all CRDMs, by opening the RTBs, or de-energizing the motor generator (MG) sets). The additional hour for the latter provides sufficient time to accomplish the action in an orderly manner. With the rods fully inserted and the Rod Control System incapable of rod withdrawal, these Functions are no longer required.

The Completion Time is reasonable considering that in this Condition, the remaining OPERABLE train is adequate to perform the safety function, and given the low probability of an event occurring during this interval.

LCO 3.1.9, "RCS Boron Limitations < 500°F" is met

Risk assessments performed pursuant to LCO 3.0.4.b should consider the desirability of enabling the Rod Control System or allowing one or more rods to be other than fully inserted in MODES 3, 4, or 5 while one train of Function 19 (one RTB train), Function 20 (one trip mechanism for one RTB), or Function 21 (one SSPS logic train) is inoperable and the Reactor Trip System is degraded. The risk assessment should assure that prior to enabling the Rod Control System or allowing one or more rods to be other than fully inserted in MODES 3, 4, or 5. ~~procedural controls have been implemented to maintain the RCS boron concentration sufficient to preclude criticality with all control and shutdown rods fully withdrawn. These administrative controls apply prior to making this Applicability change (i.e., enabling the Rod Control System or allowing one or more rods to be other than fully inserted in MODES 3, 4, or 5); however, if the Applicability change took place, these controls also include immediate actions to borate or insert all rods and disable rod control whenever RCS temperature is below 500°F. This would mitigate any inadvertent rod withdrawal from subcritical transient.~~

(continued)

BASES

ACTIONS

U.1 and U.2 (continued)

RTB shall not be bypassed while one of the diverse features is inoperable except for the time required to perform maintenance to restore the inoperable trip mechanism to OPERABLE status.

The Completion Time of 48 hours for Required Action U.1 is reasonable considering that in this Condition there is one remaining diverse trip feature for the affected RTB, and one OPERABLE RTB capable of performing the safety function and given the low probability of an event occurring during this interval.

V.1

~~Not used.~~ INSERT B 3.3.1-48A

W.1 and W.2

Not used.

X.1 and X.2

Condition X applies to the Environmental Allowance Modifier (EAM) circuitry for the SG Water Level - Low Low trip Function in MODES 1 and 2. With one or more EAM channel(s) inoperable, they must be placed in the tripped condition within 72 hours. Placing an EAM channel in trip automatically enables the SG Water Level - Low Low (Adverse Containment Environment) bistable for that protection channel, with its higher SG level Trip Setpoint (a higher trip setpoint means a reactor trip would occur sooner). The Completion Time of 72 hours is based on Reference 17. If the inoperable channel cannot be placed in the tripped condition within the specified Completion Time, the unit must be placed in a MODE where this Function is not required to be OPERABLE. An additional six hours is allowed to place the unit in MODE 3.

INSERT B 3.3.1-48B →

SURVEILLANCE REQUIREMENTS

The SRs for each RTS Function are identified by the SRs column of Table 3.3.1-1 for that Function.

A Note has been added stating that Table 3.3.1-1 determines which SRs apply to which RTS Functions.

(continued)

INSERT B 3.3.1-~~43~~ *48A*

V.1, V.2.1, V.2.2.1, V.2.2.2, and V.2.3

Condition V applies to one inoperable Power Range Neutron Flux - Low channel in MODE 1 below the P-10 setpoint and in MODE 2 with $k_{eff} \geq 1.0$. The inoperable channel must be placed in the tripped condition within 72 hours. Placing the channel in the tripped condition results in a partial trip status requiring only a one-out-of-three logic for actuation of this reactor trip function. The 72 hours to place the inoperable channel in the tripped condition is justified in Reference 17.

The Required Action is modified by a Note. The Note allows placing an inoperable channel in the bypassed condition for up to 12 hours while performing routine surveillance testing of the other channels. The 12 hour time limit is justified in Reference 17.

If the inoperable channel can not be placed in the tripped condition within the specified 72-hour Completion Time, the plant must be placed in MODE 2 with $k_{eff} < 1.0$ within 78 hours. In addition, within 78 hours action must be initiated to either fully insert all rods and make the Rod Control System incapable of rod withdrawal *(e.g., by de-energizing all CRDMs, by opening the RTBs, or de-energizing the motor generator (MG) sets)* or to initiate boration of the RCS to greater than the all-rods-out (ARO) critical boron concentration. Required Actions V.2.2.1 and V.2.2.2 would preclude an uncontrolled RCCA bank withdrawal accident from occurring. Required Action V.2.3 would provide sufficient SHUTDOWN MARGIN if an uncontrolled RCCA bank withdrawal event were to occur.

INSERT B 3.3.1-44 *48B*

Y.1

Condition Y applies to one inoperable Power Range Neutron Flux - Low channel in MODE 2 with k_{eff} < 1.0, and all RCS cold leg temperatures ≥ 500°F, and the RCS boron concentration less than or equal to the all-rods-out (ARO) critical boron concentration, and the Rod Control System capable of rod withdrawal or one or more rods not fully inserted. Condition Y also applies to one inoperable Power Range Neutron Flux - Low channel in MODE 3 with all RCS cold leg temperatures ≥ 500°F, and the RCS boron concentration less than or equal to the ARO critical boron concentration, and the Rod Control System capable of rod withdrawal or one or more rods not fully inserted. The inoperable channel must be placed in the tripped condition within 72 hours. Placing the channel in the tripped condition results in a partial trip status requiring only a one-out-of-three logic for actuation of this reactor trip function. The 72 hours to place the inoperable channel in the tripped condition is justified in Reference 17.

The Required Action is modified by a Note. The Note allows placing an inoperable channel in the bypassed condition for up to 12 hours while performing routine surveillance testing of the other channels. The 12 hour time limit is justified in Reference 17.

Z.1.1, Z.1.2, and Z.2

Condition Z applies when the Required Action and associated Completion Time of Condition Y is not met or if two or more channels in the Power Neutron Flux - Low trip Function are inoperable when the plant is operating within the MODES and specified conditions in the Applicability discussed above under Condition Y.

If the inoperable channel can not be placed in the tripped condition within the specified 72-hour Completion Time, or if two or more channels are inoperable, action must be initiated to fully insert all rods and to make the Rod Control System incapable of rod withdrawal *(e.g., by de-energizing all CRDMs, by opening the RTBs, or de-energizing the motor generator (MG) sets).* These actions will preclude an uncontrolled RCCA bank withdrawal accident from occurring.

If the inoperable channel can not be placed in the tripped condition within the specified 72-hour Completion Time, or if two or more channels are inoperable, an alternate action is to initiate boration of the RCS to greater than the all-rods-out (ARO) critical boron concentration. Borating the RCS to greater than ARO critical boron concentration would provide sufficient SHUTDOWN MARGIN if an uncontrolled RCCA bank withdrawal event were to occur.