C. MINIMUM CONDITIONS FOR CRITICALITY

1. Except during low power physics test, the reactor shall not be made critical at any temperature above which the moderator temperature coefficient is positive.

2. This section intentionally deleted.

3. At all times during critical operation, the lowest loop T_{avg} shall be no lower than 540 °F.
   a. If T_{avg} is less than 540°F when the reactor is critical, restore T_{avg} to $\geq$ 540 °F within 15 minutes or be in hot shutdown within the following 15 minutes.

4. The reactor shall be maintained subcritical by at least 1% $\frac{\Delta k}{k}$ until normal water level is established in the pressurizer.

Basis

During the early part of the initial fuel cycle, the moderator temperature coefficient is calculated to be slightly positive at coolant temperatures below the power operating range. [1] [2] The moderator coefficient at low temperatures will be most positive at the beginning of life of the fuel cycle, when the boron concentration in the coolant is the greatest. Later in the life of the fuel cycle, the boron concentration in the coolant will be lower and the moderator coefficient will be either less positive or will be negative. At all times, the moderator coefficient is negative in the power operating range. [1] [2] Suitable physics measurements of moderator coefficient of reactivity will be made as part of the startup program to verify analytic predictions.

The requirement that the reactor is not to be made critical when the moderator coefficient is positive has been imposed to prevent any unexpected power excursion during normal operations as a result of an increase in moderator temperature. This requirement is waived during low power physics tests to permit measurement of reactor moderator coefficient and other physics design parameters of interest. During physics tests, special operating precautions will be taken.

The requirement that the reactor is not to be made critical except when T_{avg} is $\geq$ 540 °F provides assurance that an overpressure event will not occur whenever the reactor vessel is in the nil-ductility temperature range and that the reactor is operated within the bounds of the safety analyses. The safety analyses, which assume a critical temperature of 547 °F, are applicable for critical temperatures as low as 540 °F. Heatup to this temperature will be accomplished by operating the reactor coolant pumps. The Surveillance requirement to support this specification is provided in Table 4.1-1 item no. 4.

The requirement for bubble formation in the pressurizer when the reactor has passed the threshold of 1% subcriticality will assure that the reactor coolant not be solid when criticality is achieved.

References:

1. FSAR Table 3.2-1

2. FSAR Figure 3.2-9

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TABLE 4.1-1 (Sheet 1 of 6)

MINIMUM FREQUENCIES FOR CHECKS, CALIBRATIONS AND TESTS OF INSTRUMENT CHANNELS

Channel Description	Check	Calibrate	Test	Remarks
1. Nuclear Power Range	S	D (1) M (3)*	Q (2)** Q (4)	1) Heat balance calibration 2) Bistable action (permissive, rod stop, trips) 3) Upper and lower chambers for axial offset 4) Signal to Δ T
2. Nuclear Intermediate Range	S (1)	N.A.	P (2)	1) Once/shift when in service 2) Verification of channel response to simulated inputs
3. Nuclear Source Range	S (1)	N.A.	P (2)	1) Once/shift when in service 2) Verification of channel response to simulated inputs
4. Reactor Coolant Temperature	S (3)	18M (1) 24M (2)	 Q (2)	1) Engineered safety cicuits only 2) Reactor protection circuits only 3) Normal Instrument check interval is once/shift T_{avg} instrument check interval reduced to every 30 minutes when: - T_{avg} deviation and low T_{avg} alarms are not reset and, - Control banks are above 0 steps
5. Reactor Coolant Flow	S	24M	Q	
6. Pressurizer Water Level	S	18M	Q	
7. Pressurizer Pressure	S	18M	Q	High and Low
8. 6.9 KV Voltage 6.9 KV Frequency	N.A. N.A.	18M 24M	Q Q	Reactor protection circuits only Reactor protection circuits only
9. Analog Rod Position	S	24M	M	

ATTACHMENT II TO IPN-94-058

SAFETY EVALUATION

RELATED TO

MINIMUM TEMPERATURE FOR CRITICALITY

NEW YORK POWER AUTHORITY
INDIAN POINT 3 NUCLEAR POWER PLANT
DOCKET NO. 50-286
DPR-64

SAFETY EVALUATION OF TECHNICAL SPECIFICATION CHANGES ASSOCIATED WITH THE MINIMUM TEMPERATURE FOR CRITICALITY.

SECTION I- Description Of Changes

This application for amendment to the Indian Point 3 Technical Specifications proposes to revise Section 3.1.C. 3 and Table 4.1-1 of Appendix A of the Operating License. The proposed revision to Section 3.1.C. 3 will require the reactor coolant average temperature (T_{avg}) to be no lower than 540°F during critical operation. The proposed change will also require that T_{avg} be restored to ≥ 540°F within 15 minutes if T_{avg} is less than 540°F, or the plant be placed in hot shutdown within the following 15 minutes. The proposed change in Table 4.1-1 entitled, "Minimum Frequencies for Checks, Calibrations and Tests," will add the requirement for T_{avg} instrument check frequency to be reduced to 30 minutes when the T_{avg} deviation and low T_{avg} alarms are not reset and the control banks are above zero steps. This application also proposes revision to the Bases to reflect that the minimum temperature for criticality provides assurance that the reactor is operated within the bounds of the safety analyses. The proposed application also corrects the following typographical errors on page 3.1-25 of the Technical Specifications for Table and Figure numbers:

References:
1. FSAR Table 3.2.1-1 to read FSAR Table 3.2-1
2. FSAR Figure 3.2.1-9 to read FSAR Figure 3.2-9

SECTION II- Evaluation of Changes

The lowest moderator temperature that is supported by the licensing basis safety analyses when criticality is assumed to occur is defined as the minimum temperature for criticality. The Indian Point 3 current licensing basis safety analyses explicitly assume a minimum temperature for criticality corresponding to no-load temperature of 547°F. However, a minimum temperature for criticality which is up to 7°F below the no-load temperature can be supported by the licensing basis safety analyses. For Indian Point 3, this would correspond to 540°F. The current Indian Point 3 Technical Specifications prohibit critical operation with the reactor coolant temperature T_{avg} below 450°F. This specification is the only reference to the minimum temperature for criticality in the Technical Specifications. As such, it is open to possible misinterpretation. Therefore, changing the minimum temperature for criticality from 450°F to 540°F will continue to protect the vessel in the nil-ductility temperature range and will also make the temperature consistent with the safety analyses.

The minimum conditions for criticality currently provided in the Technical Specifications in Section 3.1.C on page 3.1-25 include the following:

a. Except during low power physics tests, the reactor shall not be made critical at any temperature above which the moderator temperature coefficient is positive. This specification ensures that the reactor is not made critical when the moderator coefficient is positive, thus preventing any unexpected power excursion during normal operations as a result of an increase in moderator temperature.

b. At all times during critical operation, T_{avg} shall be no lower than 450°F. This specification provides increased assurance that an overpressure event will not occur whenever the reactor vessel is in the nil-ductility temperature range. This specification is the only reference to the minimum temperature for criticality in the Technical Specifications. As such, it is open to possible misinterpretation. Therefore, changing the minimum temperature for criticality from 450°F to 540°F will continue to protect the vessel in the nil-ductility temperature range and will also make the temperature consistent with the safety analyses.

c. The reactor shall be maintained subcritical by at least 1% $\Delta k/k$ until normal water level is established in the pressurizer. During plant startup, pressurizer control via a steam bubble is normally available before leaving cold shutdown conditions, which is well below the minimum temperature value. Therefore, a minimum temperature for criticality within 7°F below the no-load temperature of 547°F does not adversely affect the design basis for the accident analyses events with respect to pressurizer control availability.

Other requirements on the minimum temperature for criticality not identified in the Technical Specifications but implied by the assumptions of the safety analyses include:

1. The core will not be critical in a temperature range which is outside of the normal operating range of the reactor trip system (RTS) and the engineered safety feature (ESF) instrumentation, and,

2. The core moderator temperature coefficient is within its analyzed temperature range.

Moderator temperature is continuously monitored and is always available to the reactor operator. Furthermore, it is under the operator's control and can be changed in response to a rapid change resulting from turbine load changes or Rod Cluster Control Assembly (RCCA) position changes, or in response to slow changes resulting from changes in boron chemical shim.

There are no reactor trips which are actuated with drift of T_{avg} below the program value. Thus, there is no trip associated with minimum temperature for criticality. However, alarms are actuated if the drift of indicated T_{avg} from program T_{avg} (i.e. $T_{ref.}$) is sufficiently large. For Indian Point 3, this deviation in temperature is ± 5°F. Another alarm (low T_{avg}) actuates before T_{avg} can fall below 540°F. Hence, the operator is alerted by instrumentation and alarms if T_{avg} is in danger of falling below the minimum temperature for criticality.

There are no acceptance criteria on the minimum temperature for criticality that relate to fundamental safety limits. Each design basis accident for which the moderator temperature is an initial condition has its own relevant safety limit acceptance criteria.

Before achieving criticality, the RTS and ESF must be available. Hence, the RTS and ESF instrumentation must be calibrated over a range of anticipated temperature conditions which include the minimum temperature for criticality. Furthermore, the automatic safety injection signal can be manually blocked when the reactor coolant pressure is below 1900 psig and will automatically unblock above this pressure. Hence, arming of the ESF is assumed to occur automatically during startup such that it is armed when the minimum temperature for criticality is reached.

The minimum moderator temperature requirements should be such that the core cannot be critical at a temperature that is far from the T_{avg} assumed in the safety analyses. This represents a constraint based on the initial conditions assumed in the safety analyses. As previously indicated, the current licensing basis safety analyses for Indian Point 3 assume a minimum temperature corresponding to the no-load temperature for criticality of 547°F. However, a minimum temperature for criticality of 540°F is supported on the basis that if the minimum temperature for criticality is set sufficiently close to the no-load T_{avg} (within 7°F) assumed in the analyses, operation at minimum temperature for criticality will not invalidate the conclusion of the safety analyses.

Specifically with respect to the RCCA Ejection and Uncontrolled RCCA Withdrawal From a Subcritical Condition events which assume no-load T_{avg} initial conditions, the difference in safety analyses results if analyzed at an initial T_{avg} condition 7°F lower is negligible. The no-load T_{avg} will generate slightly more conservative results when compared to the results obtained for a lower initial system average temperature. The transient conditions for a no-load T_{avg} initial condition when compared to the reduced T_{avg} initial condition result in a slightly less negative Doppler temperature coefficient which reduces Doppler power feedback. Thus, starting with a lower average temperature will result in a slight increase in the Doppler power feedback, which will serve to turn the transient around sooner with slightly less severe results.

Other licensing basis events which assume no-load T_{avg} initial conditions include Feedwater Malfunction event from zero power initial conditions, the Rupture of a Steam Pipe event, and the Chemical and Volume Control System (CVCS) Malfunction event during startup conditions. For the feedwater malfunction event from zero power initial conditions, a specific Departure from Nucleate Boiling (DNB) analysis is not performed. Instead, the reactivity insertion rate is calculated for the feedwater event and bounded by the reactivity insertion rate assumed in the Uncontrolled RCCA Withdrawal From a Subcritical Condition event. A feedwater malfunction event initiated from a lower initial T_{avg} condition will result in a less limiting cooldown. Thus, the differential temperature which drives the reactivity insertion rate will be lower and, therefore, the reactivity insertion rate will be lower. Hence, the reactivity insertion for the feedwater malfunction event initiated from no-load T_{avg} bounds that which would result from a lower initial T_{avg} condition and, therefore, the conclusions of the current safety analysis for this event remain valid.

Similar to the feedwater malfunction event from zero power initial conditions, a lower T_{avg} also results in a less severe cooldown for the rupture of a steam pipe event. Hence, the conclusions of the current licensing basis safety analysis for the rupture of a steam pipe event also remain valid for an initial T_{avg} condition 7°F lower than the no-load T_{avg} of 547°F.

For the CVCS Malfunction event during start-up conditions, a lower initial T_{avg} decreases the specific volume of the coolant assumed in the analysis. Using a lower specific volume increases the time from alarm to loss of shutdown margin. Hence, the use of no-load T_{avg} initial conditions is bounding for this event.

Any further reduction of the minimum temperature for criticality, beyond 7°F of the no-load T_{avg} would require a detailed evaluation of the safety and plant operational impact. This evaluation would have to include effects on core kinetics parameters, peaking factors, reactor protection and control systems response, fuel performance, and balance of plant integrity; none of these are affected by a small change (i.e., $\leq$ 7°F) in the no-load T_{avg} assumed in the safety analyses. In summary, minimum temperature for criticality, when defined to be within 7°F below the no-load T_{avg} value of 547°F, does not adversely affect pressurizer operability, reactor vessel nil-ductility temperature, the reactor protection system operability, nor the plant design basis analyses and is supported by the current licensing basis safety analyses. Furthermore, the increased surveillance of every 30 minutes (in Table 4.1-1) for the T_{avg} instrument check, when T_{avg} deviation and low T_{avg} alarms are not reset and the control banks are above zero steps, is adequate to prevent the inadvertent violation of the limiting conditions for operation (LCO).

Section III - No Significant Hazards Evaluation

Consistent with the criteria of 10 CFR 50.92, the enclosed application is judged to involve no significant hazards based on the following information:

(1) Does the proposed license amendment involve a significant increase in the probability or consequences of an accident previously evaluated?

Response:

The proposed license amendment does not involve a significant increase in the probability or consequences of an accident previously evaluated. The probability or the consequences of an accident previously evaluated will not be affected because the proposed changes will make the Minimum Temperature for Criticality Specification (540°F) more restrictive than the current specification which allows reactor criticality at a temperature as low as 450°F. The proposed changes will also make the minimum temperature for criticality consistent with the licensing basis safety analyses. In addition, critical operation at T_{avg} less than 540°F will require operator response to restore T_{avg} to ≥ 540°F within 15 minutes or be in hot shutdown within the following 15 minutes. As discussed in Section II, the minimum temperature for criticality when defined to be within 7°F below the no-load T_{avg} value of 547°F does not adversely affect pressurizer operability, reactor vessel nil-ductility temperature, the reactor protection system operability, nor the plant design basis analyses and is supported by the current licensing basis safety analyses. The presence of two separate alarms, each annunciating on a 1-out-of-4 T_{avg} signal, will provide assurance that constant T_{avg} monitoring is available during approaches to criticality. The proposed change also increases the surveillance frequency for T_{avg} instrument check when the T_{avg} deviation and low T_{avg} alarms are not reset and the control banks are above zero steps. Therefore, the proposed changes have no effect on the probability or consequences of an accident previously evaluated.

(2) Does the proposed license amendment create the possibility of a new or different kind of accident from any accident previously evaluated?

Response:

The proposed license amendment does not create the possibility of a new or different kind of accident from any accident previously evaluated. The proposed changes do not involve the addition of any new or different type of equipment, nor do they involve the operation of equipment required for safe operation of the facility in a manner different from those addressed in the Final Safety Analysis Report. The safety analyses, which assume a critical temperature of 547°F, are applicable for critical temperatures as low as 540°F. The proposed changes will ensure that the plant parameters are within their analyzed ranges and will increase the surveillance frequency for the T_{avg} instrument check when the T_{avg} deviation and low T_{avg} alarms are not reset and the control banks are above zero steps. Therefore, the proposed changes will not create the possibility of a new or different kind of accident from any accident previously evaluated.

(3) Does the proposed amendment involve a significant reduction in a margin of safety?

Response:

The proposed license amendment does not involve a significant reduction in a margin of safety. The proposed changes do not affect any safety related system or component operation or operability, instrument operation, or safety system setpoints and do not result in increased severity of any of the accidents considered in the safety analyses. Operator response to a drop in temperature after reaching criticality for a specified period of time will place the reactor in the hot shutdown condition where the LCO does not apply. The proposed changes are being made to make the Technical

Specifications consistent with the licensing basis safety analyses and increase the surveillance frequency. These changes have no effect on any margin of safety and, therefore, do not create a significant reduction in a margin of safety.

Section IV - Impact of Changes

These changes will not adversely affect the following:
ALARA Program
Security and Fire Protection Programs
Emergency Plan
FSAR or SER Conclusions
Overall Plant Operations and the Environment

Section V - Conclusions

The incorporation of these changes: a) will not increase the probability nor the consequences of an accident or malfunction of equipment important to safety as previously evaluated in the Safety Analysis Report; b) will not increase the possibility of an accident or malfunction of a different type than any evaluated previously in the Safety Analysis Report; c) will not reduce the margin of safety as defined in the bases for any technical specification; d) does not constitute an unreviewed safety question; and e) involves no significant hazards considerations as defined in 10 CFR 50.92.

Section VII - References

a) IP3 FSAR
b) IP3 SER

ATTACHMENT III TO IPN-94-058

COMMITMENT RELATED TO
TECHNICAL SPECIFICATION CHANGES
ASSOCIATED WITH THE
MINIMUM TEMPERATURE FOR CRITICALITY

NEW YORK POWER AUTHORITY
INDIAN POINT 3 NUCLEAR POWER PLANT
DOCKET NO. 50-286
DPR-64

ATTACHMENT III TO IPN-94-058

COMMITMENT RELATED TO PROPOSED
TECHNICAL SPECIFICATION CHANGES
ASSOCIATED WITH THE
MINIMUM TEMPERATURE FOR CRITICALITY

This commitment is in addition to those listed in LER 93-046-00.

COMMITMENT NUMBER	COMMITMENT DESCRIPTION	DUE DATE
IPN-94-058-01	Revise procedures to reduce T_{avg} instrument check frequency interval to every 30 minutes when: T_{avg} deviation and low T_{avg} alarms are not reset and control banks are above 0 steps.	Prior to plant startup.