Attachment I to IPN-88-005
Proposed Technical Specifications Related To
Minimum Number of RCPs Operating Between RCS
Tavg Greater Than 350°F and Hot Zero Power

New York Power Authority
Indian Point 3 Nuclear Power Plant
Docket No. 50-286
DPR-64

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3. LIMITING CONDITIONS FOR OPERATION

For the cases where no exception time is specified for inoperable components, this time is assumed to be zero.

3.1 REACTOR COOLANT SYSTEM

Applicability

Applies to the operating status of the Reactor Coolant System; operational components; heatup; cooldown; criticality; activity; chemistry and leakage.

Objective

To specify those limiting conditions for operation of the Reactor Coolant System which must be met to ensure safe reactor operation.

Specification

A. OPERATIONAL COMPONENTS

1. Coolant Pumps

   a. When a reduction is made in the boron concentration of the reactor coolant, at least one reactor coolant pump or one residual heat removal pump (connected to the Reactor Coolant System) shall be in operation.

   b. (1) When the reactor coolant system T_{avg} is greater than 350°F and electrical power is available to the reactor coolant pumps, and as permitted during special plant evolutions, at least one reactor coolant pump shall be in operation. All reactor coolant pumps may be de-energized for up to 1 hour provided no operations are permitted that would cause dilution of the reactor coolant system boron concentration, and core outlet temperature is maintained at least 10°F below saturation temperature.

      (2) When the reactor is subcritical and reactor coolant system T_{avg} is greater than 350°F, control bank withdrawal shall be prohibited unless four reactor coolant pumps are operating.

   c. When the reactor coolant system T_{avg} is greater than 200°F and less than 350°F, and as permitted during special plant evolutions, at least one reactor coolant pump or one residual heat removal pump (connected to the Reactor Coolant System) shall be in operation. All reactor coolant pumps may be de-energized with RHR not in service for up to 1 hour provided no operations are permitted that would cause dilution of the reactor coolant system boron concentration, and core outlet temperature is maintained at least 10°F below saturation temperature.

d. When the reactor coolant system T_{avg} is less than 200°F, but not in the refueling operation condition, and as permitted during special plant evolutions, at least one residual heat removal pump (connected to the Reactor Coolant System) shall be in operation.

e. When the reactor is critical and above 2% rated power, except for natural circulation tests, at least two reactor coolant pumps shall be in operation.

f. The reactor shall not be operated at power levels above 10% rated power with less than four (4) reactor coolant loops in operation.

g. If the requirements of 3.1.A.1.e and 3.1.A.1.f. above cannot be satisfied, the reactor shall be brought to the hot shutdown condition within 1 hour.

h. A reactor coolant pump (RCP) may not be started (or jogged) when the RCS cold leg temperature (T_{cold}) is at or below 326°F, with no other RCP's operating, unless RCS make up is not in excess of RCS losses, and one of the following requirements is met:

(1) The OPS is operable, steam generator pressure is not decreasing, and the temperature of each steam generator is less than or equal to the coldest T_{cold};

Or

(2) The OPS is operable, the temperature of the hottest steam generator exceeds the coldest T_{cold} by no more than 64°F, pressurizer level is at or below 75 percent, and T_{cold} is as per Figure 3.1.A-1;

Or

(3) The OPS is inoperable, steam generator pressure is not decreasing, the temperature of each steam generator is less than or equal to the coldest T_{cold}, pressurizer level is at or below 75 percent, and the RCS pressure does not exceed that given by Curve I on Fig. 3.1.A-2;

Or

(4) The OPS is inoperable, the temperature of the hottest steam generator exceeds the coldest T_{cold} by no more than $64^{o}F$, and pressurizer level and RCS pressure do not exceed the boundaries given on Fig. 3.1.A-4.

i. Additional pumps may not be started (or jogged) unless the OPS is operable and the pressurizer level is not increasing.

(1) Specification 3.1.A.1.i above may be modified to allow the OPS inoperable, providing the temperature of each steam generator has remained less than or equal to the coldest T_{cold} since the first RCP start, pressurizer level is at or below 75 percent, and the RCS pressure does not exceed that given by Curve I on Fig. 3.1.A-2.

(2) Specification 3.1.A.1.i above may be further modified to allow the OPS inoperable and the temperature of the hottest steam generator to be no greater than $64^{o}F$ higher than the coldest T_{cold}, provided that pressurizer level is at or below 75 percent and RCS pressure does not exceed that given by Curve II on Fig. 3.1.A-2.

j. Following the start of one or more RCP's and prior to reaching $326^{o}F$, the RCS pressure shall not exceed that given by Curves I and II on Fig. 3.1.A-3 as appropriate.

Basis

When the boron concentration of the Reactor Coolant System is to be reduced the process must be uniform to prevent sudden reactivity changes in the reactor. Mixing of the reactor coolant will be sufficient to maintain a uniform boron concentration if at least one reactor coolant pump or one residual heat removal pump is running while the change is taking place. The residual heat removal pump will circulate the primary system volume in approximately one half hour. The pressurizer is of no concern because of the low pressurizer volume and because the pressurizer boron concentration will be higher than that of the rest of the reactor coolant.

Heat transfer analyses show that reactor heat equivalent to 10% of rated power (P-7) can be removed with natural circulation only (1); hence, the requirement for one operating RCP above 350°F and two operating RCP's above 2% rated power (connected to the RCS) provides sufficient heat removal capability for removing decay heat.

The restriction on control bank withdrawal with less than four reactor coolant pumps operating when the reactor is subcritical and RCS T_{avg} is greater than 350°F is necessary to conform with the assumptions used in the transient analyses for the uncontrolled control rod withdrawal event from subcritical condition. The FSAR safety analysis for uncontrolled control rod assembly withdrawal from a subcritical condition assumes all four reactor coolant pumps to be operating within the temperature range of concern. Using this assumption the DNB design basis is satisfied for the combination of the two banks of the maximum combined worth withdrawn at maximum speed. Since there is no mechanism by which the control rods can be automatically withdrawn due to a control system error when T_{avg} is between 350°F and the no-load temperature, such an event can only be initiated as a result of human error during rod manipulation. Prohibiting control bank withdrawal with less than four RCPs operating provides assurance that the plant is operated within the accident analysis assumptions.

The reactor shall not be operated at power levels above 10% rated power with less than four (4) reactor coolant loops in operation until safety analyses for less than four loop operation have been submitted by the licensee and approval for less than four loop operation at power levels above 10% rated power has been granted by the Commission. (See license condition 2.C. (3))

Each of the pressurizer code safety valves is designed to relieve 420,000 lbs. per hr. of saturated steam at the valve set point.

If no residual heat were removed by the Residual Heat Removal System the amount of steam which could be generated at safety valve relief pressure would be less than half the capacity of a single valve. One valve therefore provides adequate protection for overpressurization.

The combined capacity of the three pressurizer safety valves is greater than the maximum surge rate resulting from complete loss of load (2) without a direct reactor trip or any other control.

The requirement that 150 kw of pressurizer heaters and their associated controls be capable of being supplied electrical power from an emergency bus provides assurance that these heaters can be energized during a loss of offsite power condition to maintain natural circulation at hot shutdown.

The power operated relief valves (PORVS) operate to relieve RCS pressure below the setting of the pressurizer code safety valves. These relief valves have remotely operated block valves to provide a positive shutoff capability should a relief valve become inoperable. The electrical power for both the relief valves and the block valves is capable of being supplied from an emergency power source to ensure the ability to seal off possible RCS leakage paths.

The limit on maximum indicated T_{avg} provides assurance that Reactor Coolant System Temperatures are maintained within the normal steady-state envelope of operation assumed in the FSAR transient and accident analyses and in WCAP-10704, "Safety Evaluation of Indian Point Unit 3 with Asymmetric Tube Plugging Among Steam Generators." WCAP-10704 assumed a maximum full-power T_{cold} of 546.9°F (including control deadband and measurement uncertainties). As shown in Tables II-1 and II-2 of WCAP-10704, a maximum indicated T_{avg} of 576°F (including 2°F measurement uncertainty) is calculated for a full power T_{cold} of 546.9°F at a flow of 323,600 gpm. Restricting maximum T_{avg} to 576°F (indicated) at all power levels will preserve the steady-state DNB margins assured in WCAP-10704.

Reactor vessel head vents are provided to exhaust noncondensible gases and/or steam from the primary system that could inhibit natural circulation core cooling. The OPERABILITY of at least one reactor vessel head vent path ensures the capability exists to perform this function.

The valve redundancy of the reactor coolant system vent paths serves to minimize the probability of inadvertent or irreversible actuation while ensuring that a single failure of a vent valve power supply or control system does not prevent isolation of the vent path.

The function, capabilities, and testing requirements of the reactor coolant system vent systems are consistent with the requirements of Item II.B.1 of NUREG-0737, "Clarification of TMI Action Plan Requirements", November, 1980.

The OPS is designed to relieve the RCS pressure for certain unlikely incidents to prevent the peak RCS pressure from exceeding the 10 CFR 50, Appendix G, limits. "Arming" means that the motor operated valve (MOV) is in the open position. This can be accomplished either automatically by the OPS when the RCS temperature is less than or equal to 326°F or manually by the control room operator.

The start of an RCP is allowed when the steam generators' temperature does not exceed the RCS and the OPS is operable (i.e., both PORVs available). During all modes of operation, the steam generator temperature may be measured using the Control Room instrumentation or, as a backup, from a contact reading off the steam generator's shells.

Most start-ups will satisfy these requirements as provided in Specification 3.1.A.1.d.(1)(a). In order to allow start of an RCP when the steam generators are hotter than the RCS, requirements for a pressurizer bubble (gas or steam) are developed. During this Heat Input initiation event the RCS fluid temperature rise in considerably more rapid than the reactor vessel metal temperature rise. Since OPS utilizes a setpoint curve (Fig. 3.1.A-2, curve II) and the temperature measured is the fluid temperature, and not the reactor vessel metal, it is necessary to shift to the right the OPS setpoint curve to ensure the pressure does not exceed the allowable (appendix G) values for the vessel. For the conditions when the OPS is inoperable, additional requirements are developed for the pressurizer bubble, RCS pressure and temperature.

Due to the rate of energy transferred to the RCS, when the RCP is started, the resultant rate of temperature rise and the pressure increase are strongly dependent on the temperature difference between the RCS and the steam generators. The presence of a pressurizer bubble provides for a more moderate pressure increase. The bubble size is sufficient to prevent the RCS from going water solid for 10 minutes during which time operator action will terminate the pressure transient. Pressurizer level refers to indicated level and includes instrument uncertainty. The preventive measures for a Mass Input initiating event (i.e., SI pump or charging pumps) as well as the Heat Input initiating event are described in References (3), (4) and (5). (Also refer to Specification 3.3.A.8. Safety Injection and Residual Heat Removal Systems). The OPS need not be operable when the RCS temperature is less than 326°F if the RCS is depressurized and vented with an equivalent opening of at least 2.00 square inches. This opening is adequate to relieve the worst case analyzed.

The OPS arming temperature of 326°F permits the performance of an RCS hydrostatic test (see Fig. 4.3-1) without activating the OPS.

Upon OPS inoperability, the RCS may be heated above 370°F. This temperature is that value for which the RCS heatup and cooldown curves (Figures 3.1-1 and 3.1-2) permit pressurization to the setting of the pressurizer safety valves. Accordingly, with an inoperable OPS and an RCS temperature 370°F, the pressurizer safety valves will preclude violation of the 10 CFR 50, Appendix G, curves. In addition, the OPS need not be operable upon satisfying the conditions of Specification 3.1.A.8.b. (3) which requires the presence of a pressurizer bubble to preclude RCS overpressurization during inadvertent mass inputs. Specification 3.1.A.8.b(3) also places restrictions on the number of SI pumps capable of feeding the RCS (see Specification 3.3.A.8). An SI pump can be rendered capable of feeding the RCS is, for example, its switch is in the trip pull-out position, or if at least one valve in the flow path from the SI pump to the RCS is closed and locked (if manual) or de-energized (if motor operated). This section has also been revised in accordance with the results of tests conducted on the capsule "T" specimens (Reference 6).

References

1) FSAR Section 14.1.6
2) FSAR Section 14.1.8
3) Letter dated 10/25/78 "Summary of Changes to IP-3 Plant Operating Procedures in Order to Preclude RCS Overpressurization"
4) Letter dated 2/28/76 "Conceptual Design of the Reactor Coolant Overpressure Protection System" and response to NRC questions.
5) IP-3 Low Temperature Overpressurization Protection System Analysis, NYPA Report dated 8/24/84.
6) WCAP-9491 "Analysis of Capsule T from IP-3 Reactor Vessel Radiation Surveillance Program", J.A. Davidson, S.L. Anderson, W. T. Kaiser, April 1979.

Attachment II to IPN- 88-005
Safety Evaluation of Proposed
Technical Specifications
Minimum Number of RCPs Operating
Between RCS Tavg Greater Than 350°F
and Hot Zero Power

New York Power Authority
Indian Point 3 Nuclear Power
Docket No. 50-286
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Safety Evaluation of
Proposed Technical Specification
Concerning Minimum Number of RCPs Operating
Between RCS Tavg Greater Than 350°F
and Hot Zero Power

I. Description of Change

This application seeks to amend Specification 3.1.A of Appendix A to the Operating License to revise the Technical Specifications to conform with the supporting FSAR transient analyses concerning the number of reactor coolant pumps assumed to be operating when the reactor coolant system average temperature is above 350°F but below the no-load reactor coolant average temperature (hot-zero power).

II. Evaluation of Change

Existing Technical Specification 3.1.A.b. requires at least one reactor coolant pump be in operation when reactor coolant system average temperature is greater than 350°F. FSAR Safety Analyses for steamline break, rod ejection and bank withdrawal from subcritical (the limiting zero power transients) assume all four reactor coolant pumps are operating as an initial condition. A review of the steamline break and rod ejection analyses under the reduced flow conditions of only one reactor coolant pump in operation has demonstrated that the conclusions presented in the FSAR will not be impacted. For the uncontrolled control rod withdrawal from subcritical event, however, the DNB design basis may not be met when only one pump is in operation.

There is no mechanism by which the control rods can be automatically withdrawn when RCS Tavg is between 350°F and hot zero power due to a control system error, thus an uncontrolled rod withdrawal event can only be initiated as a result of human error during rod manipulation. This proposed Technical Specification change would prohibit control bank withdrawal with less than four reactor coolant pumps in operation, thereby providing assurance that the plant is operated within the accident analysis assumptions and that the margin of safety as defined in the FSAR analysis is not reduced.

III. No Significant Hazards Evaluation

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

Response

The proposed amendment would resolve an inconsistency between the Technical Specifications and the FSAR analysis of the uncontrolled control rod withdrawal from a subcritical event and the number of reactor coolant pumps assumed to be in operation. By revising the Technical Specification to the more conservative assumption used in the FSAR analyses (four reactor coolant pumps operating) or prohibiting control bank withdrawal with less than four RCPs operating such that an uncontrolled rod withdrawal event is precluded assures that consequences of this event are not increased and are maintained consistent with previous analysis. The revised requirement for operating reactor coolant pumps will not change the probability of a rod withdrawal event.

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

Response

In so far as the proposed change revises the Technical Specifications to conform with the more conservative assumptions employed in the FSAR Safety Analysis for the uncontrolled control rod withdrawal from subcritical, the proposed change constitutes an additional restriction not presently included in Technical Specifications. Prohibiting control bank withdrawal when less than four reactor coolant pumps are in operation between Tavg = 350°F and hot zero power 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

As noted previously, the proposed amendment constitutes an additional restriction not presently included in Technical Specifications. As such, the amendment does not involve a significant reduction in a margin of safety but rather an enhancement to assure the margin of safety assumed in the uncontrolled control rod withdrawal analysis is maintained.

IV. Impact of Change

This change will not impact the following:

- ALARA Program
- Security and Fire Protection Program
- Emergency Plan
- FSAR or SER Conclusions
- Overall Plant Operations and the Environment

V. Conclusion

This change: 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 for an accident or malfunction of a different type than evaluated previously in the Safety Analysis Report; c) will not reduce the margin of safety as defined in the basis for any Technical Specification; d) does not constitute an unreviewed safety question as defined in 10 CFR 50.59; e) involves no significant hazards considerations as defined in 10 CFR 50.92.

VI. References

a) IP-3 FSAR
B) IP-3 SER