SAFETY EVALUATION BY THE RESEARCH & POWER REACTOR SAFETY BRANCH

DIVISION OF REACTOR LICENSING

IN THE MATTER OF

NORTHERN STATES POWER COMPANY

PATHFINDER ATOMIC POWER PLANT

DOCKET NO. 50-130

PROPOSED CHANGE NO. 9

Superseded Retain for info only. P.

Introduction

By application dated April 4, 1966, the Northern States Power Company (NSP) requested a change in the Technical Specifications of License No. DPR-11. The request would allow a number of changes to the Pathfinder reactor facility which are discussed separately as Items (1) - (8) in the following evaluation. We have designated these requests Proposed Change No. 9.

Evaluation

(1) The Technical Specifications presently require that the total rate of reactor coolant flow increase limited by the butterfly valves on the discharge side of the recirculation pumps shall not exceed 455 gpm/second, and that this rate shall correspond to a reactivity addition rate of less than 5 cents/second. Recent calculations and measurements indicate that, at the specified rate of flow increase, the corresponding reactivity addition rates could exceed 5 cents/second for some conditions of flow rate and power. For this reason NSP is requesting that the reactivity rate limit in Section 4.2.1.2 be deleted. The governing rate of reactivity addition would then be 12 cents/second specified in the second paragraph of Section 5.13 authorized by a subsequent section of this change and discussed under Item (5) of this evaluation.

Section 4.2.1.2 also specifies that reactivity addition by recirculation flow control shall not be continued for more than 10 seconds in any one 20 second interval. In modifying the valves to meet the flow increase limit discussed later, the valve opening time was necessarily increased. Since the valves automatically open to the 45% position upon pump startup (their travel cannot be stopped unless the pump is turned off), NSP proposes to delete the time restriction of this section. This deletion would essentially make it possible to continuously add reactivity at the maximum rate which NSP calculates to be 9.2 cents/second. In support of this change NSP has run a series of transients on its analog simulator. An analysis starting at the worst case of power and flow, and assuming that flow rate is continuously increased at twice the maximum possible rate up to 100% flow, resulted in no scram (trip points were not reached), and temperature rises of 38°F for bulk exit steam, and 100°F for the superheater fuel. In our opinion, these calculations are conservative and the results indicate that the request is acceptable from a safety standpoint.

(2) The maximum steam temperature is specified to be 750°F in the Technical Specifications. However, the trip point is presently authorized at 775°F to allow for sufficient operating margin above the expected operating temperature of 725°F. NSP is requesting that the maximum limit of 750°F specified in Section 5.6.1(b) be changed to 775°F to conform with the trip point allowed in the second table of Section 6.1.4. Since NSP assumes a set point of 775°F in performing accident analyses, we believe that the maximum steam temperature may be specified to be the same as the trip set-point temperature as requested without compromising operational safety of the reactor.

(3) During the core shutdown margin demonstrations, Section 5.8.2 now requires that the core remain subcritical after the most worthy rod is fully withdrawn, and a rod or rod group of <u>known</u> worth greater than 0.003 k_{eff} is withdrawn. NSP states that the worth of the rod group cannot always be known before it is withdrawn and is therefore proposing a different procedure which allows a demonstration that the partially withdrawn rod group is worth more than 0.003 k_{eff} after criticality is achieved. We do not believe that this new procedure is significantly different from that now allowed with the possible exception that the worth of the rod group could be less than 0.003 k_{eff}. However, under the old procedure a precise measurement of the worth of the partially withdrawn rod group before withdrawing the most worthy rod is difficult due to the reacitvity interaction effects between rods adjacent to the most worthy rods while it is still in the core. The new procedure requires a more conservative approach to critical since some rods will be cocked before the worthy rod is removed. In our opinion, the proposed procedure allows for a more precise measurement of shutdown margin and is acceptable from a safety viewpoint.

(4) To add further automatic protection during the shutdown margin verification, discussed in Item (3) above, the applicant proposes to procedurally limit the range switch positions on the intermediate level channels 5 and 6 such that a scram will occur if the power level exceeds 600 Kw. This would serve as a backup to the source range period protection and has the additional advantage of preventing excessive power peaking in either side of the core (near the fully withdrawn rod) since scram will not require coincident signals from each channel. The adequacy of a set point of 600 Kw in an accident case is discussed in Item (5) below. We believe this change will further enhance safety and is therefore acceptable.

(5) The licensee states that the maximum reactivity insertion rate specified in Section 5.13 to be less than 5 cents/second when the core k_{eff} is greater than 0.997 cannot be met under certain conditions. These conditions are: (1) differential rod worth measurements indicate that reactivity insertion may exceed 5 cents/second

for some rods during a portion of their travel, (2) rate of recirculation flow increase could cause more rapid insertion rates as discussed in Item (1) above, and (3) the shutdown margin verification procedures allowed by this change and discussed in Item (3) above result in reactivity additions in excess of 5 cents/second due to depletion effects and altered procedures. Thus, NSP proposes that the reactivity insertion rate be limited to 12 cents/second for all conditions where the core k_{eff} is above 0.997 except during the zero-power shutdown margin verification where the limit is requested to be approximately 34 cents/second. The staff believes that the time requirement in Section 5.13 which specifies that the reactivity insertion shall not last longer than 10 seconds in and 20 second interval can appropriately be deleted since it is more important for an operator to observe the response of the nuclear instrumentation rather than time. Also the worst core accident evaluations assume continuous reactivity addition to the maximum obtainable amount and the safety evaluation is made on this basis, not on the operators termination of reactivity addition after 10 seconds.

In support of these proposed increases in rate of reactivity insertion, the licensee has performed a number of calculations using its analog simulator. We have been informed that the most recent data measured at the facility have been used in these simulation studies. The evaluations assume scram takes place when any one of the set points for a scram condition is exceeded since redundancy of instrumentation is provided for each of these conditions. The temperature of the core superheater section is the most critical during a power excursion due to assumed inadequate cooling of the superheater which is conservatively assumed to be steam-filled during all but the 34 cents/second reactivity insertion accidents when the reactor will be at zero-power and the superheater dry. The applicant reports that the most serious accidents would occur for initial conditions between 20% and 100% of full power and accordingly analyzed several different reactivity addition rates up to 25 cents/second starting from power levels in this range. Additional cases assuming the reactor was in the zero-power condition and cold were run assuming ramp reactivity insertion rates up to 68 cents/second, which is twice the requested limit of 34 cents/second necessary during shutdown margin verification. Only level scram at 600 Kw (required by this change and discussed in Item (4)) was assumed, even though period scram protection is in effect in the three startup channels. In all cases it was found that maximum superheater temperatures were below the level at which damage could occur. NSP also reports that the burnout limits of Section 5.6.1(b) are not affected by this change.

On the basis of the evaluations reported and our review of the simulation technique, we believe the requested changes are acceptable and that safe operation of the facility will not be compromised.

(6) The licensee proposes to modify the pushbutton which initiates operation of the emergency condenser to make it incapable of starting operation of the condenser on the basis that inadvertent operation could result in addition of cold water to the reactor. NSP has proposed to delete the reference to this pushbutton in Section 6.1.1 since operation of the condenser can also be manually initiated through the use of the manual reactor isolation scram pushbutton. Inadvertent use of the isolation button would not result in a reactivi y ex ursion since the reactor would

scram prior to introduction of cold water from the condenser. Operation of the emergency condenser can still be terminated by the modified pushbutton. We believe this change is acceptable and will in no way limit proper function of the emergency condenser.

(7) Section 6.1.7 of the Technical Specifications now requires a rod runback upon loss of all three recirculation pumps. This makes it impossible to latch or unlatch rods or perform shutdown margin verifications unless the breaker circuit is bypassed with a jumper. NSP proposes to install a key switch bypass to provide more stringent administrative control during manipulation of rods when pump operation is not required or desired during certain test programs and core manipulations at zero-power. In our opinion the bypass key switch can be installed and safely used as proposed.

(8) NSP requests that Table 2 of Section 6.1.9.6, "Nuclear System Annunciator Points," be updated to reflect small modifications made to the annunciator system. We have reviewed the proposed new Table 2 and have concluded that the annunciators listed therein are adequate to direct operators attention to abnormal conditions important to safe operation of the plant.

Technical Specifications

In view of the foregoing, we believe that the Technical Specifications (Appendix A) of License No. DPR-11 should be changed as follows:

(1) Delete the last sentences from the first and third paragraphs of Section 4.2.1.2 which read:

"(This shall correspond to a maximum reactivity addition rate of less than 5 cents/sec)," and
"Reactivity addition by recirculation flow control shall not be continued for more than 10 seconds in any one 20 second interval."

(2) Change the maximum steam temperature in the table of Section 5.6.1(b) from "750°F" to "775°F."

(3) Delete the first sentence of the second paragraph of Section 5.8.2 and substitute the following:

"The core shutdown margin shall be verified by a demonstration that the reactor is subcritical with the superheater in its most reactive condition, the most valuable reactivity-worth rod fully withdrawn, and other rods partially withdrawn. Immediately, subsequent to the withdrawal of the most valuable reactivity-worth rod, it shall be demonstrated that the rods partially withdrawn contribute 0.003 k_{eff} or more to the effective multiplication."

(4) Add the following to the last sentence of the second paragraph of Section 5.8.2:

". . . and with the range switch of channels 5 and 6 set at positions such that scram level shall not exceed 600 Kw for the duration of the demonstration."

(5) Change the second paragraph of Section 5.13 to read:

"The maximum reactivity insertion rate when the k_{eff} of the core is greater than 0.997 shall be 12 cents/sec except during the core shutdown margin verification of Section 5.8.2, when it shall be approximately 34 cents/sec."

(6) Delete the words "and operation of the emergency condenser." from the second paragraph of Section 6.1.1.

(7) Change the wording in the first table of Section 6.1.7 to read:

"Condition	Setpoint
(1) Loss of all three recirculation pumps	Breaker Operation (may be bypassed through use of a key switch during rod latching and unlatching and during verification of core shut-down margin)"

(8) Replace Table 2, "Nuclear System Annunciator Points" in Section 6.1.9.6 with an updated Table 2 (attached) dated 3/1/66.

Conclusion

Based on our review, we have concluded that the changes previously discussed do not present significant hazards considerations not described or implicit in the Final Hazards Summary Report, and that there is reasonable assurance that the health and safety of the public will not be endangered.

...l signed by:
...r S. Boyd

Roger S. Boyd, Chief
Research & Power Reactor Safety Branch
Division of Reactor Licensing

Date: MAY 1 1 1966

TABLE 2

NUCLEAR SYSTEM ANNUNCIATOR POINTS

Superheater outlet t‑ erature - High
Reactor feedwater temperature - Low
Superheater outlet pressure - High
Reactor pressure - High
Turbine 102% overspeed - Tripped
Turbine trip-stop valves - Tripped
Reactor Control - Runback
Reactor Control - Scram
Nuclear instrumentation reactor period - Short
Main steam isolation valve by-pass flow - Low
Main steam isolation valve - Tripped - Closed
Main s' am isolation valve - Loss of Power
Super' ater outlet temperature - Low
Superheater outlet pressure - Low
Main steam safety valves - Open
Reactor recirculating pump motors bearing temperature - High
Reactor recirculating pump motors - Overload
Reactor recirculating pump motor temperatures - High
Reactor recirculating discharge valves - Loss of Power
Reactor water level - High
Reactor water level - Low
Reactor feedwater temperature - High
Reactor recirculating water temperature - Low
Reactor feedwater temperature control set point - Low
Reactor building shield pool seals - Leaking
Reactor building air lock doors - Open
Reactor building pressure - High
Reactor vent temperature - High Radiation - High, Isolation - Trip
Reactor control rod drive motors - Overload
Reactor control rod drive motors - Loss of Power
Reactor control rod drive motors - Reverse Phase
Reactor control rod drive seals leakage flow - High
Main steam isolation valve interlock switch - Out-of-Position
Nuclear instrumentation power range flux channels 7 & 8 - High Differential
Nuclear instrumentation - Trouble
Reactor pressure control pressure error - High - Low
Nuclear instrumentation short period - Runback Trip
Nuclear instrumentation channels, 5, 6, 7, & 8 - 2 of 4 Runback trip
Reactor control loss of feedwater - Runback Trip
Reactor control ejector exhaust high activity - Isolate - Scram
Reactor control main steam dump valve - Low oil pressure
Nuclear instrumentation channels 5, 6, 7, & 8 - Scram logic trip