Table 2.3-1

REACTOR PROTECTION SYSTEM TRIP SETTING LIMITS (5)

	Four Reactor Coolant Pumps Operating (Nominal Operating Power - 100%)	Three Reactor Coolant Pumps Operating (Nominal Operating Power - 75%)	One Reactor Coolant Pump Operating in Each Loop (Nominal Operating Power - 49%)	Shutdown Bypass
1. Nuclear power, max. % of rated power(6)	105.1	105.1	105.1	5.0(2)
2. Nuclear power based on flow (1) and imbalance max. of rated power	1.08 times flow minus reduction due to imbalance	1.08 times flow minus reduction due to imbalance	1.08 times flow minus reduction due to imbalance	Bypassed
3. Nuclear power based (4) on pump monitors max. % of rated power	NA	NA	55%	Bypassed
4. High reactor coolant system pressure, psig max.	2355	2355	2355	1720(3)
5. Low reactor coolant system pressure, psig min.	1900	1900	1900	Bypassed
6. Reactor coolant temp. F., max.	618.8	618.8	618.8	618.8
7. High Reactor Building pressure, psig max.	4	4	4	4

(1) Reactor coolant system flow, %.
(2) Administratively controlled reduction set during reactor shutdown.
(3) Automatically set when other segments of the RPS (as specified) are bypassed.
(4) The pump monitors also produce a trip on: (a) loss of two reactor coolant pumps in one reactor coolant loop, and (b) loss of one or two reactor coolant pumps during two-pump operation.
(5) Trip settings limits are limits on the setpoint side of the protection system bistable connectors.
(6) During plant startup from 0% to 47% power, this setpoint shall be lowered to 63% Full Power. During plant shutdown, the high flux trip setpoint change to 63% power shall be initiated within 6 hours of reaching a power level at or below 47% full power.

4.7 REACTOR CONTROL ROD SYSTEM TESTS

4.7.1 CONTROL ROD DRIVE SYSTEM FUNCTIONAL TESTS

Applicability

Applies to the surveillance of the control rod system.

Objective

To assure operability of the control rod system.

Specification

4.7.1.1 The control rod trip insertion time shall be measured for each control rod at either full flow or no flow conditions following each refueling outage prior to return to power. The maximum control rod trip insertion time for an operable control rod drive mechanism, except for the axial power shaping rods (APSRs), from the fully withdrawn position to 3/4 insertion (104 inches travel) shall not exceed 1.66* seconds at hot reactor coolant full flow conditions or 1.40 seconds for the hot no flow conditions (Reference 1). For the APSRs it shall be demonstrated that loss of power will not cause rod movement. If the trip insertion time above is not met, the rod shall be declared inoperable.

4.7.1.2 If a control rod is misaligned with its group average by more than an indicated nine inches, the rod shall be declared inoperable and the limits of Specification 3.5.2.2 shall apply. The rod with the greatest misalignment shall be evaluated first. The position of a rod declared inoperable due to misalignment shall not be included in computing the average position of the group for determining the operability of rods with lesser misalignments.

4.7.1.3 If a control rod cannot be exercised, or if it cannot be located with absolute or relative position indications or in or out limit lights, the rod shall be declared to be inoperable.

*For the remainder of Cycle 10, the following control rods will be considered operable if the maximum trip insertion time from the fully withdrawn position to 3/4 insertion does not exceed 2.11 seconds at hot coolant full flow conditions: Control Rods 1-1, 1-2, 1-3, 3-3, 3-4, 3-5, 3-6, 4-5, 5-4, 5-7, 5-9, and 6-5. The optional hot no flow test and its 1.40 second acceptance value is unchanged.

Bases

The control rod trip insertion time is the total elapsed time from power interruption at the control rod drive breakers until the control rod has actuated the 25% withdrawn reference switch during insertion from the fully withdrawn position. The specified trip time is based upon the safety analysis in UFSAR, Chapter 14 and the Accident Parameters as specified therein. The specified trip time of 2.11 seconds for Cycle 10 is based upon reanalysis of the limiting safety analyses using a bounding trip time of 3.0 seconds for all control rods at hot reactor coolant full flow conditions.

Each control rod drive mechanism shall be exercised by a movement of at least two inches of travel every two weeks. This requirement shall apply to either a partial or fully withdrawn control rod at reactor operating conditions. Exercising the drive mechanisms in this manner provides assurance of reliability of the mechanisms.

A rod is considered inoperable if it cannot be exercised, if the trip insertion time is greater than the specified allowable time, or if the rod deviates from its group average position by more than nine inches. Conditions for operation with an inoperable rod are specified in Technical Specification 3.5.2.

REFERENCE

(1) UFSAR, Section 3.1.2.4.3 - "Control Rod Drive Mechanism"

TABLE 1
TMI-1 FSAR TRANSIENT/ACCIDENT REVIEW

EVENT	COMMENT
1. Uncompensated Operating Reactivity Changes	Not Affected
2. Startup Accident	Reanalyzed
3. Rod Withdrawal Accident at Rated Power Operation	Reanalyzed
4. Moderator Dilution Accident	Not Limiting
5. Cold Water Accident	Not Affected
6. Loss-of-Coolant Flow	Reanalyzed
7. Stuck-out, Stuck-in, or Dropped Control Rod Accident	Not Affected
8. Loss of Electric Load	Not Limiting
9. Steam Line Break	Not Limiting
10. Steam Generator Tube Rupture	Not Affected
11. Fuel Handling Accident, Waste Gas Tank Rupture, Fuel Cask Drop Accident	Not Affected
12. Rod Ejection Accident	Reanalyzed
13. Large Break Loss of Coolant Accident/ Maximum Hypothetical Accident	Not Affected
14. Small Break LOCA	Evaluated (Bounded by #13)
15. Loss of Feedwater Accident	Reanalyzed

Table 2

Summary of Startup Accident Reanalysis

Acceptance Criteria	2765 psia
FSAR Method	KAPPB
FSAR Assumptions	2.15E-4ΔK/K/sec reactivity insertion rate MTC of +0.9E-4ΔK/K/F
FSAR Results	2653.4 psia
TSCR Analysis Method	KAPPB
TSCR Assumptions	Original FSAR assumptions. 1.34 second scram delay.
TSCR Analysis Results	2544 psia (includes 1% valve accumulation) High flux trip setpoint reduced to 63% when power is ≤ 47%.
Why Is It Conservative	Establishing the high flux trip setpoint at 63% for power levels below 47%FP limits the pressure increase to well below acceptance criteria. Fixed trip delay instead of slowed reactivity insertion. The rod withdrawal rate is conservative and cannot be achieved without failure of interlocks and operator action. The MTC for the balance of Cycle 10 is increasingly negative.
Expected FSAR Method Result	Lower pressure than TSCR method because: 1. Rods start moving immediately at time of trip. 2. The MTC for the balance of Cycle 10 is increasingly negative.

Table 3

Summary of Rod Withdrawal at Rated Power Accident Reanalysis

Acceptance Criteria	2765 psia	112% Thermal Power
FSAR Method	KAPPB	
FSAR Assumptions	2568 MWt 5.0E-5ΔK/K/sec reactivity insertion rate MTC of 0.0ΔK/K/F	
FSAR Results	2479 psia	110.0% Thermal Power
TSCR Analysis Method	Assumed the pressurizer safety valves (PSVs) would lift. Original KAPPB data was obtained and the maximum pressurizer surge line flowrate was used to calculate the maximum volumetric insurge rate. Compared the insurge rate to the PSV capacity at lift setpoint pressure. Insurge rate was found to be within the capacity of the PSVs. Peak pressurizer pressure would be limited to the PSV lift setpoint. The rate of change in thermal power was obtained from the KAPPB data at the time just prior to reactor trip and multiplied by the additional 1.34 second delay to determine the increase in thermal power from the original analysis result.	
TSCR Assumptions	Original FSAR assumptions. PSVs assumed to lift.	
TSCR Analysis Results	2540 psia	110.5% Thermal Power
Why Is It Conservative	Assumes PSVs lift. In actuality, peak pressure may remain below the PSV lift setpoint. Increased lift setpoint due to valve accumulation (1%) was used and results in higher peak pressure prediction. Fixed trip delay instead of slowed reactivity insertion. The rod withdrawal rate is conservative and cannot be achieved without failure of interlocks and operator action. The MTC for the balance of Cycle 10 is increasingly negative.	
Expected FSAR Method Result	Pressurizer pressure may remain less than 2500 psia. The maximum pressure expected is 2540 psia.	

Table 4

Summary of One RCP Coastdown Reanalysis

Acceptance Criteria	1.18 MDNBR using BWC correlation
FSAR Method	LYNXT
FSAR Assumptions	2568 MWt 108% rated power 106.5% rated flow 2135 psia 555.9°F T_o Flow coastdown to 75% rated flow
FSAR Results	1.6 MDNBR
TSCR Analysis Method	LYNXT with delayed initiation of the transient heat flux profile.
TSCR Assumptions	Original FSAR Assumptions. 1.4 seconds trip delay.
TSCR Analysis Results	1.58 MDNBR
Why Is It Conservative	1.4 instead of 1.34 second rod trip delay. Fixed trip delay instead of slowed reactivity insertion. Actual 3 RCP flow is greater than 75%.
Expected FSAR Method Result	Same.

Table 5

Summary of Four Pump Coastdown Reanalysis

Acceptance Criteria	1.18 MDNBR using BWC correlation 1.32 MDNBR using BAW-2 correlation
FSAR Method	LYNXT 2 second transient
FSAR Assumptions	2568 MWt 102% rated power 106.5% rated flow 2135 psia 557.3°F T_o Trip of RCP Status
FSAR Results	1.75 MDNBR using BAW-2 correlation
TSCR Analysis Method	LYNXT with delayed initiation of the transient heat flux profile. Linear extension of flow coastdown curve to 3.64 seconds based on coastdown rate from 1.9 - 2.0 seconds.
TSCR Assumptions	Original FSAR Assumptions. Linear extrapolation of flow coastdown curve.
TSCR Analysis Results	1.55 MDNBR using BWC correlation
Why Is It Conservative	Actual flow coastdown has a decreasing slope. Fixed trip delay instead of slowed reactivity insertion.
Expected FSAR Method Result	Same.

Table 6

Summary of Locked Rotor Event Reanalysis

Acceptance Criteria	1.18 MDNBR using BWC correlation
FSAR Method	Statepoint calculation using BWC correlation and LYNXT. No power reduction is credited.
FSAR Assumptions	2568 MWt 102% rated power 106.5% rated flow 2135 psia 557.3°F T_o MTC of 0.0%ΔK/K/F State points: 75% rated flow, initial power.
FSAR Results	1.43 MDNBR
TSCR Analysis Method	LYNXT
TSCR Assumptions	Same as FSAR.
TSCR Analysis Results	1.43 MDNBR (the result of the analysis of record)
Why is It Conservative	Actual 3 RCP flow is greater than 75%. Pressure increase is conservatively neglected. The MTC for the balance of Cycle 10 is increasingly negative.
Expected FSAR Method Result	Same - not affected by trip delay time.

Table 7

Summary of Rod Ejection Accident Reanalysis

Acceptance Criteria	200 cal/gm	10CFR100 Dose Limits
FSAR Method	KAPPB	
FSAR Assumptions	BOL 100% FP 0.65%ΔK/K ejected rod worth -0.9E-5ΔK/K/F Doppler 0.0%ΔK/K/F MTC Adiabatic heatup determine fuel enthalpy.	
FSAR Results	180 cal/gm	17.5% pins in DNB 4.43 rem-2hr Thyroid dose
TSCR Analysis Method	Original KAPPB power vs time results for 0.40ΔK/K ejected rod worth. Extrapolated pre-trip power ramp for 1.34 sec. Normalized power response to the KAPPB power response at time of scram. Integrated power using trapezoidal rule for delayed scram. Average fuel temperature from TACO3 results at maximum LOCA LHR with 12% uncertainty factor. Initial fuel enthalpy from Bureau of Mines enthalpy as a function of fuel temperature equation. Determined total peaking factor based on the maximum LOCA LHR and 102% FP. Calculated peak fuel enthalpy from initial enthalpy and integrated power from delayed scram increased by the total peaking factor.	
TSCR Assumptions	Original SAR KAPPB run results used. TACO3 results of fuel temperature based on maximum LOCALHR. Adiabatic heatup determines fuel enthalpy. Maximum Cycle 10 ejected rod worth at HFP is 0.24%ΔK/K. Least negative Doppler for Cycle 10 is -1.47 E-5ΔK/K/F. 0.40Δk/k ejected rod worth conservatively bounds Cycle 10 values.	
TSCR Analysis Results	193 cal/gm	19.3% pins in DNB 4.43 rem + 10% -2hr Thyroid dose
Why Is It Conservative	MTC for the balance of Cycle 10 is increasingly negative. Non-trip enthalpy deposition for 1.34 sec beyond FSAR trip.	
Expected FSAR Method Result	KAPPB: <193 cal/gm BWKIN: <193 cal/gm	KAPPB: <19.3% pins in DNB BWKIN: <10% pins in DNB Lower dose consequences

Table 8

Summary of Loss of Feedwater Accident Reanalysis

Acceptance Criteria	Pressurizer does not go water solid. 2765 psia
FSAR Method	RELAP5-MOD2 Analysis
FSAR Assumptions	1.02 x 2568MWt 220" pressurizer level on 400" range
FSAR Results	2644.6 psia
TSCR Analysis Method	RELAP5/MOD2 analysis. Extrapolation of pressurization results for 1.34 sec rod delay.
TSCR Assumptions	1.02 x 2568 Mw(t) FW coastdown of 7 sec RPS trip at 2410 psia (14.3 sec) PSV 70% open at 1% accumulation, 100% open at full accumulation (3%) 300,000lbm/hr per PSV
TSCR Analysis Results	2720.1 psia
Why Is It Conservative	Rated capacity of TMI-1 safety valves is 623,400 lbm/hr - total for 2 valves. Fixed trip delay instead of slowed reactivity insertion. The large PSV accumulation produces the highest RCS pressure response.
Expected FSAR Method Result	Same