3.3 LIMITING SAFETY SYSTEM SETTINGS

Applicability

Applies to the trip settings for instruments and devices which provide for monitoring of reactor power, hot reheat temperature, reactor internal pressure, and moisture content of the helium coolant.

Objective

To provide for automatic protective action such that the principal process variables do not exceed a safety limit as a result of transients.

Specification LSSS 3.3 - Limiting Safety System Settings

The Limiting Safety System Settings for trip shall be as specified in Table 3.3.1. The following definitions are used in the table:

Trip Setpoint - The trip setpoint is the least conservative "as left" value for a channel to be considered Operable.

Allowable Value - The allowable value is the least conservative "as found" value for a channel to be considered Operable.

Specification LSSS 3.3

Table 3.3-1

LIMITING SAFETY SYSTEM SETTINGS

PARAMETER	FUNCTION	TRIP SETPOINT	ALLOWABLE VALUE
1. Reactor Core Limiting Safety System Settings			
a) Linear Channel-High (Neutron Flux)	Scram	Varies as a Function of Indicated Thermal Power per Figure 3.3-1	Varies as a Function of Indicated Thermal Power per Figure 3.3-1
b) Reheat Steam Temperature-High	Scram	≤ 1055 degree F	≤ 1061 degree F
c) Primary Coolant Pressure-Programmed Low	Scram	≤ 64.6 psi below normal, programmed with Circulator Inlet Temperature. Upper TRIP SETPOINT of ≥ 635.4 psia.	≤ 67 psi below normal, programmed with Circulator Inlet Temperature per Figure 3.3-2. Upper limit to produce trip at ≥ 633 psia.

Specification LSSS 3.3

Table 3.3-1 (Continued)

LIMITING SAFETY SYSTEM SETTINGS

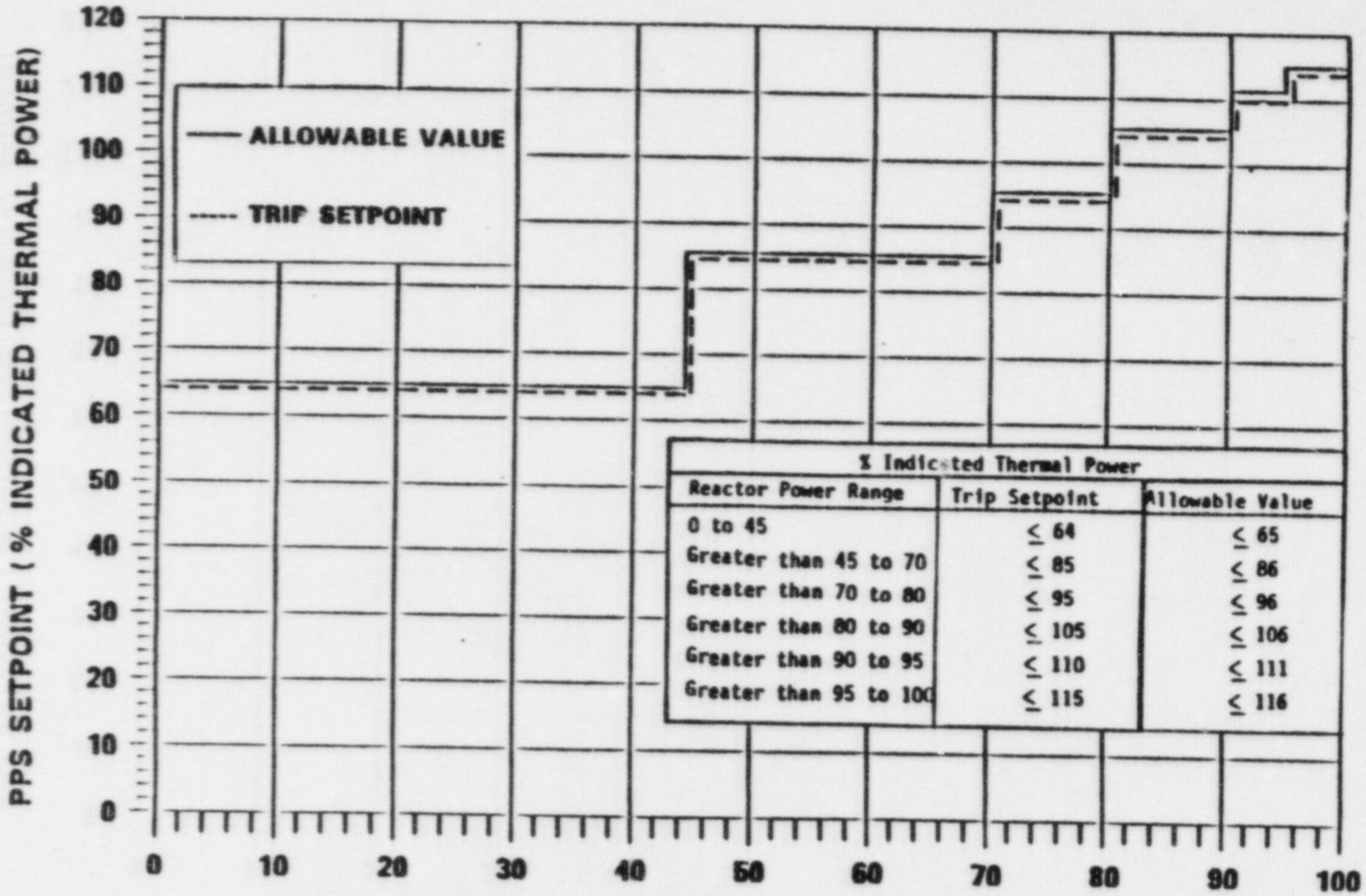
PARAMETER	FUNCTION	TRIP SETPOINT	ALLOWABLE VALUE
2. Reactor Vessel Pressure Limiting Safety System Settings			
a) Primary Coolant Pressure-Programmed High	Scram and Preselected Loop Shutdown and Steam/Water Dump	≤ 44 psi above normal, programmed with Circulator Inlet Temperature. Upper TRIP SETPOINT of ≤ 744 psia. Lower TRIP SETPOINT of ≤ 536 psia.	≤ 47 psi above normal, programmed with Circulator Inlet Temperature per Figure 3.3-2. Upper limit to produce trip at ≤ 747 psia. Lower limit to produce trip at ≤ 539 psia.
b) Primary Coolant Moisture-High	Scram, Loop Shutdown, and Steam/Water Dump	≤ 60.5 degree F dewpoint temperature	≤ 60.5 degree F dewpoint temperature
c) PCRV Pressure:	Pressure Relief		
Rupture Disc (Low Set Safety Valve)		812 psig plus or minus 8 psi	820 psig

Specification LSSS 3.3

Table 3.3-1 (Continued)

LIMITING SAFETY SYSTEM SETTINGS

PARAMETER	FUNCTION	TRIP SETPOINT	ALLOWABLE VALUE
Low Set Safety Valve		796 psig plus or minus 8 psi	804 psig
Rupture Disc (High Set Safety Valve)		832 psig plus or minus 8 psi	840 psig
High Set Safety Valve		812 psig plus or minus 8 psi	820 psig
d) Helium Circulator Penetration Interspace Pressure:	Pressure Relief		
Rupture Disc (2 Per Penetration)		825 psig plus or minus 17 psi	842 psig
Safety Valve (2 Per Penetration)		805 psig plus or minus 24 psi	829 psig
e) Steam Generator Penetration Interspace Pressure:	Pressure Relief		
Rupture Disc (2 For Each Steam Generator)		825 psig plus or minus 17 psi	842 psig
Safety Valve (2 For Each Steam Generator)		475 psig plus or minus 14 psi	489 psig



% Indicated Thermal Power		
Reactor Power Range	Trip Setpoint	Allowable Value
0 to 45	≤ 64	≤ 65
Greater than 45 to 70	≤ 85	≤ 86
Greater than 70 to 80	≤ 95	≤ 96
Greater than 80 to 90	≤ 105	≤ 106
Greater than 90 to 95	≤ 110	≤ 111
Greater than 95 to 100	≤ 115	≤ 116

FIGURE 3.3-1
HIGH NEUTRON FLUX SCRAM
DETECTOR DECALIBRATION
CURVES FOR CYCLE 4

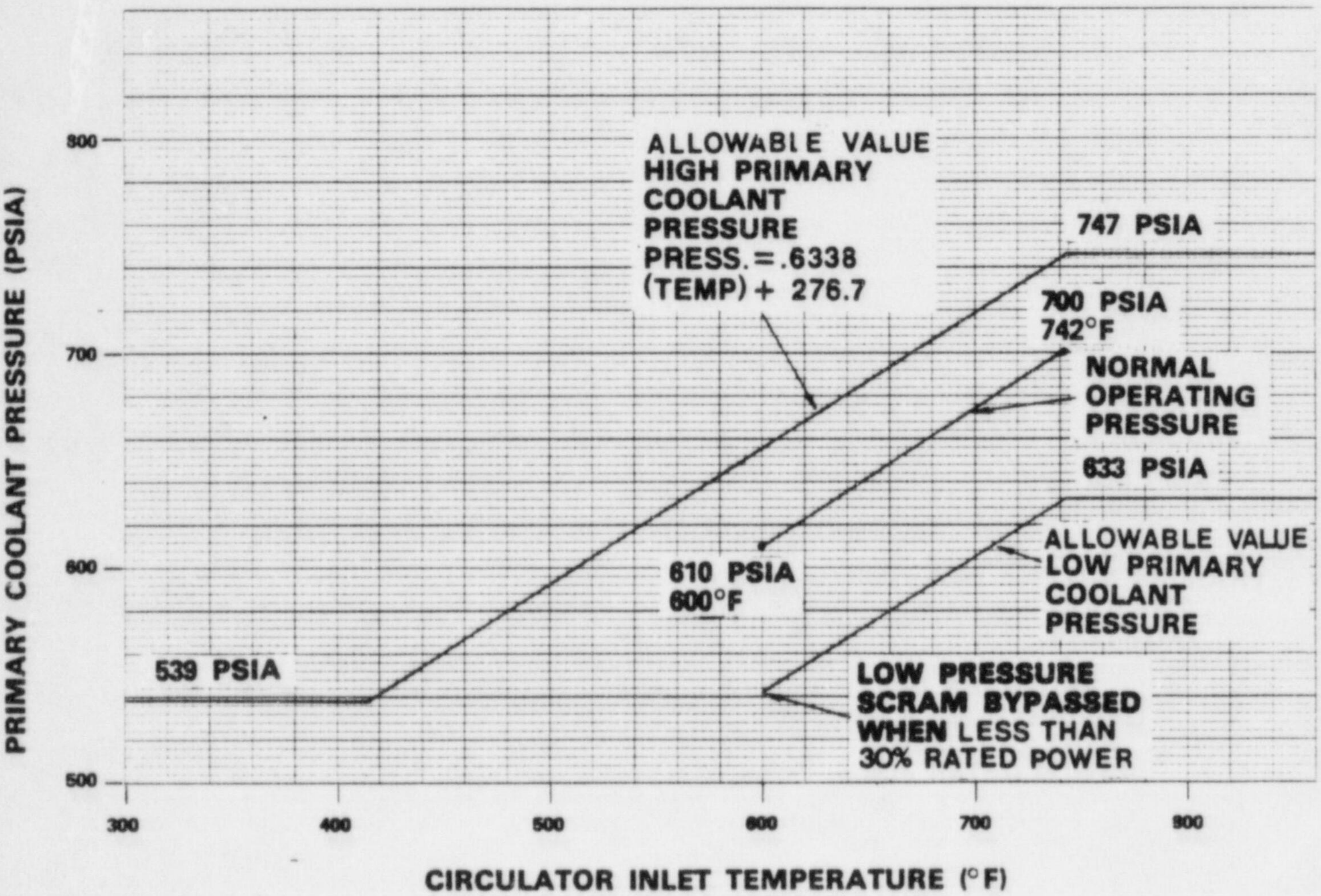


FIGURE 3.3-2

PRIMARY COOLANT PRESSURE vs. CIRCULATOR INLET TEMPERATURE

ALLOWABLE OPERATION

Basis for Specification LSSS 3.3

Safety Limits have been established in Specification SL 3.1 and SL 3.2 to safeguard the fuel particle integrity and the reactor primary coolant system barriers. Protective devices have been provided in the plant design to ensure that automatic corrective action is taken when required to prevent the Safety Limits from being exceeded during normal or abnormal operation. This specification establishes the Trip Setpoints and Allowable Values for these automatic protective devices.

Operation with setpoints less conservative than the Trip Setpoint but within the Allowable Value is acceptable since an allowance has been made in the safety analysis to accommodate this error, as described below.

General Methodology

The Analysis Value is the value of a parameter for which a Trip and initiation of automatic protective action is assumed to occur in FSV accident analyses (FSAR Chapter 14). Provided that the trip occurs at a value equal to or more conservative than the Analysis Value, analyses demonstrate that consequences of the accident or transient are acceptable.

ISA Standard, S67.04-1982 has been applied to these Analysis Values to arrive at Allowable Values and Trip Setpoints for each PPS parameter.

The factors which are identified by the ISA Standard and considered in the determination of Analysis Values are:

a. The effects of potential transient overshoot,

b. The effects of transient time response characteristics, and

c. Process measurement inaccuracy.

Basis for Specification LSSS 3.3 (Continued)

The ISA Standard states that "For each LSSS a Trip Setpoint and its associated Allowable Value shall be established." An Allowable Value is defined in the ISA Standard by the allowances for instrument error between the Allowable Value and the Safety Limit. These allowances are divided into six factors in Section 4.3.1 of ISA S67.04-1982. Three of these factors are accounted for in the determination of the Analysis Value (as described above). The remaining three factors contributing to instrument error and used to determine the Allowable Values are:

a. Accuracy (including drift) of components not tested when the setpoint is measured,

b. Accuracy of test equipment, and

c. Environmental effects on equipment accuracy.

A "total inaccuracy" value was calculated which was used to determine the margin between the Analysis Value and the Allowable Value.

The Trip Setpoint, according to the ISA Standard, is to be established by determining the margin for drift between the Allowable Value and Trip Setpoint. This margin is defined by the ISA Standard as "Drift of that portion of the instrument channel which is tested when the setpoint is determined." The test selected to be utilized for this drift consideration is the monthly functional test, as opposed to the annual calibration test. (The drift of the latter is taken into consideration in the allowances between the Analysis Value and the Allowable Value.) For certain parameters, the portion of the instrument channel which is tested monthly is checked only for logic operability, hence no monthly drift is determined. Therefore, the Allowable Value and the Trip Setpoint are the same for those parameters.

Basis for Specification LSSS 3.3 (Continued)

Linear Channel - High (Neutron Flux)

The neutron flux Trip Setpoints are established to protect the fuel particle integrity during rapid overpower transients. The power range nuclear channels respond to changes in neutron flux. During normal power operation, the channels are calibrated using a plant heat balance so that the neutron flux that is sensed is indicated as percent of Rated Thermal Power. For slow maneuvers, those where core thermal power, surface heat flux, and the heat transferred to the helium follow the neutron flux, the power range nuclear channels will indicate reactor Thermal Power. For fast transients, the neutron flux change will lead the change in heat transferred from the core to the helium due to the effect of the fuel, moderator and reflector thermal time constants. Therefore, when the neutron flux increases to the scram Trip Setpoint rapidly, the percent increase in heat flux and heat transferred to the helium will be less than the percent increase in neutron flux. Trip Setpoints that ensure a reactor scram at no greater than 140% Rated Thermal Power are sufficient for the plant because the negative temperature coefficient of reactivity and large heat capacity of the reactor limit the transient increases in fuel and helium temperatures to acceptable values. Control rod shim bank movement can result in decalibration of the external-core neutron flux detectors. To account for this potential decalibration and other instrumentation errors, the actual Trip Setpoint is administratively set less than 140% Rated Thermal Power based upon indicated power. These administratively set flux Trip Setpoints ensure the scram will occur at or less than 140% Rated Thermal Power for those postulated reactivity accidents evaluated in FSAR Section 14.2. Additional discussion on detector decalibration is given in FSAR Section 7.3.1.2.1. Further discussion and details on the methodology for determining the Trip Setpoints to allow for decalibration are given in Updated FSAR Section 3.5.4.*

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* Beginning with Updated FSAR, Revision 4.

Basis for Specification LSSS 3.3 (Continued)

Reheat Steam Temperature - High

High reheat steam temperature indicates either an increase in Thermal Power generation without an appropriate increase in helium cooling flow rate or a decrease in steam flow rate. (Reheat steam temperature in lieu of reactor core outlet helium temperature is used because of the difficulty in measuring gross helium temperature for protective system purposes.) The design of the steam generator is such that changes in hot helium temperature due to a power increase first affect the reheat steam temperature, thus allowing the latter to serve as an index of the helium temperature. A reheat steam temperature scram is provided to prevent excessive Power-to-Flow-Ratio due to a power increase or steam flow imbalance. (FSAR Section 14.2)

Primary Coolant Pressure - Programmed Low

The low primary coolant pressure Trip Setpoint has been established to maintain the fuel particle coating integrity due to loss of primary coolant as a result of a coolant leak.

Primary Coolant Pressure - Programmed High

The major potential source of primary coolant pressure increase above the normal operating range is due to water and/or steam inleakage by means of a defective evaporator-economizer-superheater subheader or tube. For a double-ended offset tube rupture, the rate of water and steam inleakage will not exceed 35 lbs/sec initially, resulting in a maximum rate of primary coolant pressure increase of approximately 1 psi per second. The normal PPS action upon detection of moisture is reactor scram, loop shutdown, and steam/water dump (FSAR Section 7.1.2.5), occurring after approximately 12 seconds, assuming rated power and flow conditions. In this situation, the peak PCRV pressure at 100% reactor power does not exceed 705 psia. The Trip Setpoint of less than or equal to 44 psi above the normal operating pressure between 25% and 100% rated power is selected: (1) to prevent false scrams due to normal plant transients, and (2) to allow adequate time for the normal protective action (high moisture) to terminate the accident while limiting the resulting peak PCRV pressure in the unlikely event that the normal protective action was inoperative. In this case, Reactor Pressure would continue to rise to the high pressure Trip Setpoint. The resulting peak PCRV pressure would be less than the PCRV Reference Pressure. The high pressure Trip Setpoint is programmed as a function of load, using helium circulator inlet temperature as the measured variable indicative of load, as shown in Figure 3.3-2. The PCRV safety valves provide the ultimate protection against primary coolant system pressure exceeding the PCRV Reference Pressure of 845 psig.

Basis for Specification LSSS 3.3 (Continued)

Primary Coolant Moisture - High

The high moisture Trip Setpoint corresponding to 60.5 degrees F dewpoint was established, considering the moisture monitor characteristics and the necessity to minimize water inleakage to the primary coolant system. A Trip would be reached after several hours of full power operation with a minimum water/steam inleakage rate in excess of about 20 lbs/hr. Below that inleakage rate, the Trip Setpoint would never be reached, but the indicating instruments would show an abnormal condition. For maximum design leakage rates, the system behavior is as discussed in the preceding section on Primary Coolant Pressure-Programmed High. Backup protective action is provided by the high primary coolant pressure scram, loop shutdown, and dump of a pre-selected loop and remaining loop steam depressurization. (FSAR Sections 7.1.2.3 and 7.1.2.4.)

PCRV Pressure

If the pressure in the PCRV were to rise significantly above the Normal Working Pressure, the low-set rupture disc would rupture within the range of 804 psig (-1%), to 820 psig (+1%). The low set safety valve, set at 796 psig plus or minus 1%, would be wide open and relieving at full capacity at or above 820 psig (3% accumulation). If the pressure still continued to rise, the high-set rupture disc would rupture between 824 psig and 840 psig. The high-set safety valve, set at 812 psig plus or minus 1%, would be relieving at full capacity above 836 psig (3% accumulation). As the pressure decreased, the high-set safety valve would close at a pressure of approximately 690 psig and the low-set safety valve at approximately 677 psig; the corresponding primary system pressure would be approximately 737 psig when the low-set safety valve closed. (FSAR Section 6.8.3.) See Specification 3.6.1.1.

Basis for Specification LSSS 3.3 (Continued)

Helium Circulator Penetration Interspace Pressure

The penetration interspaces are protected against pressures exceeding PCRV Reference Pressure. The safety valves are set at 805 psig and rupture discs are set at 825 psig (nominal). A redundant safety valve and rupture disc are provided. The rupture discs would burst in the pressure range of 809 psig (-2%) to 842 psig (+2%). The safety valves would open in the range of 781 psig (-3%) to 829 psig (+3%) and would relieve at full capacity at 886 psig (10% accumulation). The safety valves would reseat at about 725 psig. The safety valve and rupture disc relieving pressures were specified so as to comply with the ASME Boiler and Pressure Vessel Code, Section III, Class B, Nuclear Vessels, for overpressure protection. See Specification 3.6.1.2.

Steam Generator Penetration Interspace Pressure

The six steam generator penetration interspaces in each loop are provided with common upstream rupture discs and safety valves to protect against pressures exceeding PCRV Reference Pressure (845 psig). A redundant safety valve and rupture disc are provided. The rupture discs would burst in the pressure range of 809 psig (-2%) to 842 psig (+2%), with a nominal setting of 825 psig. The safety valves are each set at 475 psig which allows for a pressure drop in the inlet lines of 370 psi when relieving at valve capacity. See Specification 3.6.1.2.

4.4 INSTRUMENTATION AND CONTROL SYSTEMS - LIMITING CONDITIONS FOR OPERATION

Applicability

Applies to the plant protective system and other critical instrumentation and controls.

Objective

To assure the operability of the plant protective system and other critical instrumentation by defining the minimum operable instrument channels and trip settings.

Specification LCO 4.4.1 - Plant Protective System Instrumentation, Limiting Conditions for Operation

The limiting conditions for the plant protective system instrumentation are shown on Tables 4.4-1 through 4.4-4. These tables utilize the following definitions:

Degree of Redundancy - Difference between the number of operable channels and the minimum number of operable channels which when tripped will cause an automatic system trip.

Operable Channel - A channel is operable if it is capable of fulfilling its design functions.

Inoperable Channel - Opposite of operable channel.

Trip Setpoint - The trip setpoint is the least conservative "as left" value for a channel to be considered Operable.

Allowable Value - The allowable value is the least conservative "as found" value for a channel to be considered Operable.

Tables 4.4-1 through 4.4-4 are to be read in the following manner: If the minimum operable channels or the minimum degree of redundancy for each functional unit of a table cannot be met or cannot be bypassed under the stated permissible bypass conditions, the following action shall be taken:

For Table 4.4-1, the reactor shall be shut down within 12 hours, except that to facilitate maintenance on the Plant Protective System (PPS) moisture monitors, the moisture monitor input trip functions to the Plant Protective System which cause scram, loop shutdown, circulator trip, and steam water dump may be disabled for up to 72 hours. During the time that the Plant Protective System moisture monitor trips are disabled, an observer in direct communication with the reactor operator shall be positioned in the control room in the location of pertinent instrumentation. The observer shall continuously monitor the primary coolant moisture levels indicated by at least two moisture monitors and the primary coolant pressure indications, and shall alert the reactor operator to any indicated moisture or pressure change. During the time in which the trip functions are disabled the requirements of LCO's 4.2.10 and 4.2.11 shall be met and primary coolant shall not exceed a moisture concentration of 100 ppmv.

For Table 4.4-2, the affected loop shall be shut down within 12 hours.

For Table 4.4-3, perform one of the following within 12 hours:

a) The reactor shall be shutdown, or

b) the affected helium circulator shall be shutdown, or

c) if the nonaffected circulator in the loop is Operable (Operable instrumentation channels per this Specification and Operable circulator per LCO 4.2.2), the two loop trouble input on the affected circulator shall be placed in the tripped condition).

For Table 4.4-4, the reactor shall be shut down within 24 hours.

If, within the indicated time limit, the minimum number of operable channels and the minimum degree of redundancy can be reestablished, the system is considered normal and no further action needs to be taken.

Specification LCO 4.4.1

Table 4.4-1 (Part 1)

INSTRUMENT OPERATING REQUIREMENTS FOR PLANT PROTECTIVE SYSTEM, SCRAM

NO.	FUNCTIONAL UNIT	TRIP SETPOINT	ALLOWABLE VALUE
1a.	Manual Scram (Control Room)	Not Applicable	Not Applicable
1b.	Manual Scram (Outside Control Room)	Not Applicable	Not Applicable
2.	STARTUP Channel High	$\leq$8.3E+04 cps	$\leq$9.3E+04 cps
3a.	Linear Channel-High Channels 3,4,5 (Neutron Flux)	-----------See Table 3.3-1-------	
3b.	Linear Channel-High Channels 6,7,8 (Neutron Flux)	-----------See Table 3.3-1-------	
4.	Primary Coolant Moisture High Level Monitor	$\leq$60.5 degree F dewpoint	$\leq$60.5 degree F dewpoint
	Loop Monitor	$\leq$20.4 degree F dewpoint	$\leq$20.4 degree F dewpoint
5.	Reheat Steam Temperature -High	$\leq$1055 degree F	$\leq$1061 degree F

Notes for Tables 4.4-1 through 4.4-4 are on Pages 4.4-8 and 4.4-9

Specification LCO 4.4.1

Table 4.4-1 (Part 1)

INSTRUMENT OPERATING REQUIREMENTS FOR PLANT PROTECTIVE SYSTEM, SCRAM

NO.	FUNCTIONAL UNIT	TRIP SETPOINT	ALLOWABLE VALUE
6.	Primary Coolant Pressure -Low	---------See Table 3.3-1---------	
7.	Primary Coolant Pressure -High	---------See Table 3.3-1---------	
8.	Hot Reheat Header Pressure -Low	≥44 psig	≥44 psig
9.	Main Steam Pressure-Low	≥1529 psig	≥1529 psig
10.	Plant Electrical System-Loss	>278V ≤31.5 Seconds	>278V ≤35 Seconds
11.	Two Loop Trouble	Not Applicable	Not Applicable
12.	High Reactor Building Temperature (Pipe Cavity)	≤161 degree F	≤165 degree F

Notes for Tables 4.4-1 through 4.4-4 are on Pages 4.4-8 and 4.4-9

SPECIFICATION LCO 4.4-1

TABLE 4.4-1 (Part 2)

INSTRUMENT OPERATING REQUIREMENTS FOR PLANT PROTECTIVE SYSTEM, SCRAM

NO.	FUNCTIONAL UNIT	MINIMUM OPERABLE CHANNELS	MINIMUM DEGREE OF REDUNDANCY	PERMISSIBLE BYPASS CONDITIONS
1a.	Manual (Control Room)	1	0	None
1b.	Manual (Emergency Board)	2 (f)	1	None
2.	Startup Channel-High	2	1	Reactor Mode Switch in "RUN"
3a.	Linear Channel-High, Channels 3, 4, 5	2 (f)	1	None
3b.	Linear Channel-High, Channels 6, 7, 8	2 (f)	1	None
4.	Primary Coolant Moisture High Level Monitor	1 (f,t)	1(c)	(h2)
	Loop Monitor	2/Loop (f,t)	1/Loop	(h1)
5.	Reheat Steam Temperature - High b)	2 (b,f)	1	None
6.	Primary Coolant Pressure - Low	2 (f,k)	1	Less Than 30% Rated Power
7.	Primary Coolant Pressure - High	2 (f,k)	1	None
8.	Hot Reheat Header Pressure - Low	2 (f)	1	Less Than 30% Rated Power
9.	Main Steam Pressure - Low	2 (f)	1	Less Than 30% Rated Power
10.	Plant Electrical System - Loss	2 (e,f)	1	None
11.	Two Loop Trouble	2	1	Reactor Mode Switch in "Fuel Loading"
12.	High Reactor Building Temperature (Pipe Cavity)	2 (f)	1	None

Notes for Tables 4.4-1 through 4.4-4 are on Pages 4.4-8 and 4.4-9

Specification LCO 4.4.1

Table 4.4-2 (Part 1)

INSTRUMENT OPERATING REQUIREMENTS
FOR THE PLANT PROTECTIVE SYSTEM, LOOP SHUTDOWN

NO.	FUNCTIONAL UNIT	TRIP SETPOINT	ALLOWABLE VALUE
1a.	Steam Pipe Rupture Under PCRV, Loop 1	$\leq$ 8.68 VDC	$\leq$ 8.86 VDC
1b.	Steam Pipe Rupture Under PCRV, Loop 2	$\leq$ 8.68 VDC	$\leq$ 8.86 VDC
1c.	Steam Pipe Rupture, North Pipe Cavity Loop 1	$\leq$ 8.68 VDC	$\leq$ 8.86 VDC
1d.	Steam Pipe Rupture, South Pipe Cavity Loop 1	$\leq$ 8.68 VDC	$\leq$ 8.86 VDC
1e.	Steam Pipe Rupture, North Pipe Cavity Loop 2	$\leq$ 8.68 VDC	$\leq$ 8.86 VDC
1f.	Steam Pipe Rupture, South Pipe Cavity Loop 2	$\leq$ 8.68 VDC	$\leq$ 8.86 VDC
2a.	High Pressure, Pipe Cavity	$\leq$ 1.3" H2O	$\leq$ 1.3" H2O
2b.	High Temperature, Pipe Cavity	$\leq$ 125 degrees F	$\leq$ 125 degrees F
2c.	High Pressure, Under PCRV	$\leq$ 1.3" H2O	$\leq$ 1.3" H2O
2d.	High Temperature, Under PCRV	$\leq$ 125 degrees F	$\leq$ 125 degrees F
3a.	Loop 1 Shutdown Logic	Not Applicable	Not Applicable
3b.	Loop 2 Shutdown Logic	Not Applicable	Not Applicable
4a.	Circulator 1A and 1B Shutdown - Loop Shutdown Logic	Not Applicable	Not Applicable

Notes for Tables 4.4-1 through 4.4-4 are on Pages 4.4-8 and 4.4-9

Specification LCO 4.4.1

Table 4.4-2 (Part 1)

INSTRUMENT OPERATING REQUIREMENTS
FOR THE PLANT PROTECTIVE SYSTEM, LOOP SHUTDOWN

NO.	FUNCTIONAL UNIT	TRIP SETPOINT	ALLOWABLE VALUE
4b.	Circulator 1C and 1D Shutdown - Loop Shutdown Logic	Not Applicable	Not Applicable
5a.	Steam Generator Penetration Overpressure Loop 1	≤ 796 psig	≤ 796 psig
5b.	Steam Generator Penetration Overpressure Loop 2	≤ 796 psig	≤ 796 psig
6a.	High Reheat Header Activity, Loop 1	< 3.2 mrem/hr Above Background	< 3.2 mrem/hr Above Background
6b.	High Reheat Header Activity, Loop 2	< 3.2 mrem/hr Above Background	< 3.2 mrem/hr Above Background
7a.	Low Superheat Header Temperature, Loop 1	≥ 798 degree F	≥ 798 degree F
7b.	Low Superheat Header Temperature, Loop 2	≥ 798 degree F	≥ 798 degree F
7c.	High Differential Temperature Between Loop 1 and Loop 2	≤ 44.8 degree F	≤ 44.8 degree F

Notes for Tables 4.4-1 through 4.4-4 are on Pages 4.4-8 and 4.4-9

SPECIFICATION LCO 4.4-1

TABLE 4.4-2 (Part 2)

INSTRUMENT OPERATING REQUIREMENTS FOR PLANT PROTECTIVE SYSTEM, LOOP SHUTDOWN

NO.	FUNCTIONAL UNIT	MINIMUM OPERABLE CHANNELS	MINIMUM DEGREE OF REDUNDANCY	PERMISSIBLE BYPASS CONDITIONS
1a.	Steam Pipe Rupture Under PCRV, Loop 1 (j)	2 (f,s)	1	None
1b.	Steam Pipe Rupture Under PCRV, Loop 2 (j)	2 (f,s)	1	None
1c.	Steam Pipe Rupture, North Pipe Cavity Loop 1 (j)	2 (f)	1	None
1d.	Steam Pipe Rupture, South Pipe Cavity Loop 1 (j)	2 (f)	1	None
1e.	Steam Pipe Rupture, North Pipe Cavity Loop 2 (j)	2 (f)	1	None
1f.	Steam Pipe Rupture, South Pipe Cavity Loop 2 (j)	2 (f)	1	None
2a.	High Pressure, Pipe Cavity (j)	2 (f)	1	None
2b.	High Temperature, Pipe Cavity (j)	2 (f)	1	None
2c.	High Pressure, Under PCRV (j)	2 (f)	1	None
2d.	High Temperature, Under PCRV (j)	2 (f)	1	None
3a.	Loop 1 Shutdown Logic	2	1	None
3b.	Loop 2 Shutdown Logic	2	1	None

Notes for Tables 4.4-1 through 4.4-4 are on Pages 4.4-8 and 4.4-9

SPECIFICATION LCO 4.4-1

TABLE 4.4-2 (Part 2)

INSTRUMENT OPERATING REQUIREMENTS FOR PLANT PROTECTIVE SYSTEM, LOOP SHUTDOWN

NO.	FUNCTIONAL UNIT	MINIMUM OPERABLE CHANNELS	MINIMUM DEGREE OF REDUNDANCY	PERMISSIBLE BYPASS CONDITIONS
4a.	Circulator 1A and 1B Shutdown - Loop Shutdown Logic	2	1	None
4b.	Circulator 1C and 1D Shutdown - Loop Shutdown Logic	2	1	None
5a.	Steam Generator Penetration Overpressure Loop 1	2 (f)	1	None
5b.	Steam Generator Penetration Overpressure Loop 2	2 (f)	1	None
6a.	High Reheat Header Activity, Loop 1	2 (f)	1	None
6b.	High Reheat Header Activity, Loop 2	2 (f)	1	None
7a.	Low Superheat Header Temperature, Loop 1 (p)	2 (f)	1	Less Than 30% Rated Power
7b.	Low Superheat Header Temperature, Loop 2 (p)	2 (f)	1	Less Than 30% Rated Power
7c.	High Differential Temperature Between Loop 1 and Loop 2 (p)	2 (f)	1	Less Than 30% Rated Power

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Notes for Tables 4.4-1 through 4.4-4 are on Pages 4.4-8 and 4.4-9

Specification LCO 4.4.1

Table 4.4-3 (Part 1)

INSTRUMENT OPERATING REQUIREMENTS FOR THE PLANT PROTECTIVE SYSTEM, CIRCULATOR TRIP

NO.	FUNCTIONAL UNIT	TRIP SETPOINT	ALLOWABLE VALUE
1.	Circulator Speed - Low	≤1850 rpm Below Normal As Programmed by Feedwater Flow	≤1974 rpm Below Normal As Programmed by Feedwater Flow
2a.	Loop 1, Fixed Feedwater Flow - Low (Both Circulators)	≥230,500 lb/hr (20% of normal Full Load)	≥230,500 lb/hr (20% of normal Full Load)
2b.	Loop 2, Fixed Feedwater Flow - Low (Both Circulators)	≥230,500 lb/hr (20% of normal Full Load)	≥230,500 lb/hr (20% of normal Full Load)
3.	Loss of Circulator Bearing Water	≥459 psid	≥459 psid
4.	Circulator Penetration Trouble	≤796 psig	≤796 psig
5.	Circulator Drain Malfunction	≥8 psid	≥8 psid
6.	Circulator Speed - High Steam	≤11,495 rpm	≤11,570 rpm
7.	Manual	Not Applicable	Not Applicable

Notes for Tables 4.4-1 through 4.4-4 are on Pages 4.4-8 and 4.4-9

Specification LCO 4.4.1

Table 4.4-3 (Part 1)

INSTRUMENT OPERATING REQUIREMENTS FOR THE PLANT PROTECTIVE SYSTEM, CIRCULATOR TRIP

NO.	FUNCTIONAL UNIT	TRIP SETPOINT	ALLOWABLE VALUE
8.	Circulator Seal Malfunction	$\geq$-5.2" H_2O, $\leq$+74.8" H_2O	$\geq$-6" H_2O, $\leq$+75.6" H_2O
9.	Circulator Speed - High Water	$\leq$8,589 rpm	$\leq$8,670 rpm

Notes for Tables 4.4-1 through 4.4-4 are on Pages 4.4-8 and 4.4-9

SPECIFICATION LCO 4.4-1

TABLE 4.4-3 (Part 2)

INSTRUMENT OPERATING REQUIREMENTS FOR PLANT PROTECTIVE SYSTEM, CIRCULATOR TRIP

NO.	FUNCTIONAL UNIT	MINIMUM OPERABLE CHANNELS	MINIMUM DEGREE OF REDUNDANCY	PERMISSIBLE BYPASS CONDITIONS
1.	Circulator Speed - Low (r)	2 (f)	1	Less Than 30% Rated Power
2a.	Loop 1, Fixed Feed-water Flow - Low (Both Circulators)	2 (f)	1	Less Than 30% Rated Power
2b.	Loop 2, Fixed Feed-water Flow - Low (Both Circulators)	2 (f)	1	Less Than 30% Rated Power
3.	Loss of Circulator Bearing Water (r)	2 (f)	1	None
4.	Circulator Penetration Trouble (r)	2 (f)	1	None
5.	Circulator Drain Malfunction (r)	2 (f)	1	None
6.	Circulator Speed - High Steam (r)	2 (f)	1	None
7.	Manual	1	0	None
8.	Circulator Seal Malfunction (r)	2 (f)	1	Opposite loop shutdown <u>or</u> circulator seal malfunction trip of other circulator in same loop
9.	Circulator Speed - High Water	2 (f)	1	None

Notes for Tables 4.4-1 through 4.4-4 are on Pages 4.4-8 and 4.4-9

Specification LCO 4.4.1

Table 4.4-4 (Part 1)

INSTRUMENT OPERATING REQUIREMENTS FOR THE PLANT PROTECTIVE SYSTEM, ROD WITHDRAWAL PROHIBIT (RWP)

NO.	FUNCTIONAL UNIT	TRIP SETPOINT	ALLOWABLE VALUE
1.	STARTUP Channel-Low Count Rate	≥ 4.2 cps	≥ 3.2 cps
2a.	Linear Channel-Low Power RWP (Channels 3, 4 and 5)	≤ 5%	≤ 5%
2b.	Linear Channel-Low Power RWP (Channels 6, 7 and 8)	≤ 5%	≤ 5%
3a.	Linear Channel-High Power RWP (Channels 3, 4 and 5)	≤ 30%	≤ 30%
3b.	Linear Channel-High Power RWP (Channels 6, 7 and 8)	≤ 30%	≤ 30%

Notes for Tables 4.4-1 through 4.4-4 are on Pages 4.4-8 and 4.4-9

SPECIFICATION LCO 4.4-1

TABLE 4.4-4 (Part 2)

INSTRUMENT OPERATING REQUIREMENTS
FOR REACTOR PROTECTIVE SYSTEM, ROD WITHDRAWAL PROHIBIT (RWP)

NO.	FUNCTIONAL UNIT	MINIMUM OPERABLE CHANNELS	MINIMUM DEGREE OF REDUNDANCY	PERMISSIBLE BYPASS CONDITIONS
1.	Startup Channel - Low Count Rate	2	1	Above 10-3% Rated Power
2a.	Linear Channel - Low Power RWP (Channels 3, 4, and 5)	2	1	(g)
2b.	Linear Channel - Low Power RWP (Channels 6, 7, and 8)	2	1	(g)
3a.	Linear Channel - High Power RWP (Channels 3, 4, and 5)	2 (f)	1	Above 30% Rated Power
3b.	Linear Channel - High Power RWP (Channels 6, 7, and 8)	2 (f)	1	Above 30% Rated Power

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Notes for Tables 4.4-1 through 4.4-4 are on Pages 4.4-8 and 4.4-9

Contents moved to Page 4.4-6. Page left blank.

SPECIFICATION LCO 4.4.1
NOTES FOR TABLES 4.4-1 THROUGH 4.4-4

a) Deleted.

b) Two thermocouples from each loop, total of four, constitute one channel. For each channel, two thermocouples must be operable in at least one operating loop for that channel to be considered operable.

c) With one primary coolant high level moisture monitor tripped, trips of either loop primary coolant moisture monitors will cause full scram. Hence, number of operable channels (1) minus minimum number required to cause scram (0) equals one, the minimum degree of redundancy.

d) Deleted.

e) One channel consists of one undervoltage relay from each of the two 480 volt buses (two undervoltage relays per channel). These relays fail open which is the direction required to initiate a scram.

f) The inoperable channel must be in the tripped condition, unless the trip of the channel will cause the protective action to occur. Failure to trip the inoperable channel requires taking the appropriate corrective action as listed on Pages 4.4-1 and 4.4-2 within the specified time limit.

g) RWP bypass permitted if the bypass also causes associated single channel scram.

h1) For loop monitors only, permissible bypass conditions include

I. Any circulator buffer seal malfunction.
II. Loop hot reheat header high activity.

h2) For high level monitors only, permissible bypass conditions include:

I. As stated in LCO 4.9.2.

j) Items 1a., 1c. or 1d. accompanied by 2a., 2b., 2c., or 2d. on Table 4.4-2 are required for loop 1 shutdown. Items 1b., 1e. or 1f., accompanied by 2a., 2b., 2c., or 2d. on Table 4.4-2 are required for loop 2 shutdown.

k) One operable helium circulator inlet thermocouple in an operable loop is required for the channel to be considered operable.

m) Low Power RWP bistable resets at 4% after reactor power initially exceeds 5%.

n) Power range RWP bistables automatically reset at 10% after reactor power is decreased from greater than 30%. The RWP may be manually reset between 10% and 30% power.

p) Item 7a. must be accompanied by item 7c. for Loop 1 shutdown. Item 7b. must be accompanied by item 7c. for Loop 2 shutdown.

Basis for Specification LCO 4.4-1

The plant protection system automatically initiates protective functions to prevent established limits from being exceeded. In addition, other protective instrumentation is provided to initiate action which mitigates the consequences of accidents. This specification provides the limiting conditions for operation necessary to preserve the effectiveness of these instrument systems.

If the minimum operable channels or the minimum degrees of redundancy for each functional unit of a table cannot be met or cannot be bypassed under the stated permissible bypass conditions, the following action shall be taken:

For Table 4.4-1, the reactor shall be shut down within 12 hours.

For Table 4.4-2, the affected loop shall be shut down within 12 hours.

For Table 4.4-3, perform one of the following within 12 hours:

1) the reactor shall be shutdown, or

2) the affected helium circulator shall be shutdown, or

3) if the nonaffected circulator in the loop is Operable (Operable instrumentation channels per this Specification and Operable circulators per LCO 4.2.2), the two loop trouble input on the affected circulator shall be placed in the tripped condition).

For Table 4.4-4, the reactor shall be shut down within 12 hours.

If, within the indicated time limit, the minimum number of operable channels and the minimum degree of redundancy can be reestablished, the system is considered normal and no further action needs to be taken.

The trip level settings are included in this section of the specification. The bases for these settings are briefly discussed below. Additional discussions pertaining to the scram, loop shutdown and circulator trip inputs may be found in Sections 7.1.2.3, 7.1.2.4 and 7.1.2.6, respectively, of the FSAR. High moisture instrumentation is discussed in Section 7.3.2 of the FSAR.

Basis for Specification LCO 4.4-1 (Continued)

To accommodate the instrument drift assumed to occur between operational tests and the accuracy to which Trip Setpoints can be measured and calibrated, Allowable Values and Trip Setpoints have been specified in Part 1 of Tables 4.4-1 through 4.4-4.

a. Scram Inputs

The simultaneous insertion of the control rods will be initiated by the following conditions:

Manual Scram

A manual scram is provided to give the operator means for emergency shutdown of the reactor independent of the automatic reactor protective system. The Reactor Mode Switch (RMS) in the "off" position also causes a manual scram.

Start-up Channel - High Count Rate

High start-up count rate is provided as a scram for use during fuel loading, preoperational testing, or other low-power operations.

Linear Channel - High (Neutron Flux)

See Technical Specification LSSS 3.3.

Wide Range Channel - Rate of Change - High

High rate of change of neutron flux is used as a scram input during plant start-up and results in additional protection to the Linear Channel - High scram in case of accidental control rod withdrawal. The Trip Setpoint is selected to be above the operating rate of flux change. This scram Trip Setpoint is active only when the Interlock Sequence Switch is in Start-up position.

Basis for Specification LCO 4.4-1 (Continued)

Primary Coolant Moisture - High

See Technical Specification LSSS 3.3.

Reheat Steam Temperature - High

See Technical Specification LSSS 3.3.

Primary Coolant Pressure - Programmed Low

See Technical Specification LSSS 3.3.

Primary Coolant Pressure - Programmed High

See Technical Specification LSSS 3.3.

Hot Reheat Header Pressure - Low

Low reheat steam pressure is an indication of either a cold reheat steam line or a hot reheat steam line rupture in a section of line common to both loops. Loss of the cold reheat steam line results in loss of the steam supply to the circulators which necessitates plant shutdown. The direct scram in this case precedes a scram resulting from the two-loop trouble. The loss of either steam line results in loss of plant generation output, and a reactor scram is appropriate in this situation. The Trip Setpoint is selected to be below normal operating and transient levels, which vary over a wide range.

Main Steam Pressure - Low

Low main steam pressure is an indication of main steam line rupture or loss of feedwater flow. Immediate shutdown of the reactor is appropriate in this case. In addition, the superheater outlet stop check valves are automatically closed to reroute main steam to the flash tank (through the individual loop bypass valves and desuperheaters). This is required for the continued operation of the helium circulators on steam. The Trip Setpoint is selected to be below normal operating levels and system transients.

Plant Electrical System Power - Loss

Loss of plant electrical system power requires a scram to prevent any Power-to-Flow mismatches from occurring. A preset time delay is provided following a power loss before the scram is initiated to allow an emergency diesel generator to start. If it does start, the scram is avoided.

Basis for Specification LCO 4.4-1 (Continued)

Two-Loop Trouble Scram Logic

Operation on one loop at a maximum of about 50% power may continue following the shutdown of the other loop (unless preceded by scram as in the case of high moisture). Onset of trouble in the remaining loop (two-loop trouble) results in a scram. Trouble is defined as a signal which normally initiates a loop shutdown. Similarly, simultaneous shutdown signals to both loops result in shutdown of one of the two loops only, and a reactor scram.

High Reactor Building Temperature, Pipe Cavity

High temperature in the pipe cavity would indicate the presence of an undetected steam leak or the failure of the steam pipe rupture detection system to determine the loop in which the leak had occurred and to shut the faulty loop down.

The Trip Setpoint has been set above the temperature that would be expected to occur in the pipe cavity if the steam leak were detected and the faulty loop shutdown for all steam leaks except those of major proportion such as that due to an offset rupture of one of the steam lines.

An undetected steam leak or pipe rupture under the PCRV within the support ring would also be detectable in the pipe cavity, therefore only one set of sensors and logic is required to monitor both areas.

Basis for Specification LCO 4.4-1 (Continued)

b. Loop Shutdown Inputs.

The following loop shutdown inputs are provided primarily for equipment protection and are not relied upon to protect Safety Limits. Malfunction of these items could prevent a scram due to loss of the two loop trouble scram input.

Steam Pipe Rupture In The Reactor Building

The purpose of the ultrasonic detectors is to identify the specific secondary coolant loop within the reactor building containing a pipe rupture. Ultrasonic noise caused by escaping steam in conjunction with a pressure or temperature rise will cause the appropriate loop to shut down.

The Trip Setpoint of the ultrasonic detection system is set at a level which corresponds to 8.68 VDC output from the ultrasonic amplifier. The pressure and temperature trips are set above normal operating building pressure and temperature levels.

High Pressure - Pipe Cavity

The Trip Setpoint is above normal reactor building pressure of 0.25" w.g. but below the pressure of about 3" w.g. at which the reactor building louvers open to relieve any overpressure condition.

High Temperature - Pipe Cavity

The Trip Setpoint is established to be above the normal ambient temperature in the pipe cavity, and low enough to assure a fast response to steam pipe ruptures in the pipe cavity.

High Pressure, Under PCRV

The Trip Setpoint is above normal reactor building pressure of 0.25" w.g. but below the pressure of 3" w.g. at which the reactor building louvers open to relieve any overpressure condition.

Basis for Specification LCO 4.4-1 (Continued)

High Temperature, Under PCRV

The Trip Setpoint is established to be above the normal temperature inside the PCRV support ring to preclude spurious Trips. The ambient temperature under the PCRV is normally higher than that in the pipe cavity. Conversely, the Trip Setpoint is low enough not to preclude a fast response in the event of a steam pipe rupture.

Shutdown of Both Circulators (Loop Shutdown Logic)

Shutdown of both circulators is a loop shutdown input which is necessary to ensure proper action of the reactor protective (scram) system through the two-loop trouble scram in the event of the loss of all circulators and low feedwater flow.

Steam Generator Penetration - Overpressure (Loop 1/Loop 2)

Steam generator penetration overpressure is indicative of a pipe rupture within the penetration. A loop shutdown is appropriate for such an accident, and the helium pressurizing line to the penetration is closed to prevent moisture backflow to the purified helium system. The penetration overpressure is handled by relief valves; however, to minimize the amount of steam/water released, the steam generator contents are also dumped.

The steam generator interspace rupture discs are set at 825 psig (nominal). The burst pressure range (plus or minus 2%) is 809 psig to 842 (Technical Specification LSSS 3.3, Table 3.3-1). The relief valve is sized to allow a 370 psi pressure drop in a safety valve inlet line when the valve is relieving at nameplate capacity of 126,000 lb/hr superheated steam at 1000 degree F. This prevents the penetration pressure from exceeding the reference pressure of 845 psig.

<u>**Basis for Specification LCO 4.4-1 (Continued)**</u>

<u>**Reheat Header Activity - High (Loop 1/Loop 2)**</u>

High reheat header activity is an indication of a reheater tube rupture resulting in leakage of reactor helium into the steam system. The Trip Setpoint ensures detection of major reheat tube ruptures and an on-scale reading, with up to design value circulating activity for post accident monitoring. Detection of smaller size leaks or leaks with low circulating coolant activity can be detected and alarmed by the backup reheat condensate monitors and/or the air ejector monitor.

<u>**Low Superheat Header Temperature (Loop 1/Loop 2 and Differential)**</u>

Low superheat header temperature in a loop is indicative either of a feedwater valve or controller failure yielding an excessive loop feedwater flow rate or a deficiency of helium flow rate, and a loop shutdown is appropriate. The required coincident high differential temperature between loops functions to prevent the loop Trip from occurring during normal operation at low main steam temperatures such as in a normal plant shutdown.

Basis for Specification LCO 4.4-1 (Continued)

c. Circulator Shutdown Inputs

All circulator shutdown inputs (except circulator speed high on water turbines) are equipment protection items which are connected to two loop trouble through the loop shutdown system. These items are included in Table 4.4-3 because a malfunction could prevent a scram due to loss of the two loop trouble scram input. Circulator speed high on water turbines is included to assure continued core cooling capability on loss of steam drive.

Circulator Speed - Low

Too low a circulator speed causes a mismatch between thermal power input and heat removal (feedwater flow) in a steam generator, which may result in flooding the superheater section. The circulator Trip causes an automatic adjustment, as required, in the turbine governor setting, feedwater flow rate, and remaining circulater speed to maintain stable steam pressure and temperature conditions.

Loop 1/Loop 2 Fixed Feedwater Flow - Low

The Fixed Feedwater Flow - Low is an equipment protection feature designed to protect the steam generator from overheating for complete loss of feedwater flow.

Loop 1/Loop 2 Programmed Feedwater Flow - Low

A Programmed Feedwater Flow - Low prevents prolonged operation in the region of speed versus flow which may cause excessive superheat steam temperatures.

Loss of Circulator Bearing Water

In order to prevent circulator damage upon loss of normal and backup bearing water supplies, a gas pressurized water accumulator is fired when water pressure falls below the Trip Setpoint value. The Trip Setpoint value is selected so that adequate water pressure is available during circulator coastdown, which lasts for about 30 seconds, to maintain clearances within the circulator bearings of at least 0.001 in. Tests and analyses have shown that a Trip at 450 psid provides substantial clearance margin above 0.001 in. when the circulators are operating at normal speeds.

Basis for Specification LCO 4.4-1 (Continued)

Circulator Penetration Trouble

Circulator penetration overpressure is indicative of a pipe rupture within the penetration. A circulator Trip is appropriate for such an accident and the helium pressurizing line to the penetration is closed to prevent moisture backflow to the purified helium system. The overpressure is handled by the penetration relief valves. The penetration interspace rupture discs are set at 825 psig (nominal). The burst pressure range (plus or minus 2%) is 809 psig to 842 psig (Technical Specification LSSS 3.3, Table 3.3-1). The relief valve is sized to allow a 40 psi pressure drop in the safety valve inlet line when the valve is relieving at nameplate capacity (170 gpm).

Circulator Drain - Malfunction

This Trip is provided to prevent steam from entering the bearing of an operating circulator. A differential pressure controller is utilized to maintain the bearing water main drain pressure above the steam turbine exhaust pressure. When the pressure differential drops, the steam water drain control valves are opened to prevent steam from entering the bearings. If the above controls do not work, three PPS differential pressure switches for each circulator, set at greater than or equal to 8 psid, will initiate an automatic shutdown of the circulator.

Circulator Speed - High (Steam)

The speed sensing system response and Trip setting are chosen so that under the maximum overspeed situation possible (loss of restraining torque) the circulator will remain within design criteria.

Circulator Trip - Manual (Steam/Water)

A manual Trip of each circulator for both steam and water turbine drives is available so that in an emergency an operator can trip a circulator when required.

Basis for Specification LCO 4.4-1 (Continued)

Circulator Seal - Malfunction (Low/High)

A high reverse differential of -6" H2O would be reasonable evidence that bearing water is leaking into the primary coolant system. An increasing differential pressure of +75.6" H2O would be reasonable evidence that primary coolant is leaking into the bearing water and thus into the closed circulator service system. In both cases a circulator trip with brake and seals set is appropriate.

Circulator Speed - High (Water)

The Trip Setpoint has been established above normal operating speed. Equipment testing ensures that this Trip Setpoint will prevent failure due to fatigue cracking.

Basis for Specification LCO 4.4-1 (Continued)

d. Rod Withdrawal Prohibit Inputs

The termination of control rod withdrawal to prevent further reactivity addition will occur with the following conditions:

Start-up Channel - Low Count Rate

Start-up Channel - Low Count Rate is provided to prevent control rod pair withdrawal and reactor startup without adequate neutron flux indication. The trip level is selected to be above the background noise level.

Linear Channel - 5% RWP

Linear Channel (5% Power) directs the reactor operator's attention to either a downscale failure of a power range channel or improper positioning of the Interlock Sequence Switch.

Linear Channel - 30% RWP

Linear Channel (30% Power) is provided to prevent control rod pair withdrawal if reactor power exceeds the Interlock Sequence Switch limit for the "Low Power" position.

Start-up Channel/Wide Range Channel - Rate of Change - High

High Rate of change of neutron flux on the wide range channels (less than or equal to 2 dpm) initiates an RWP.

Linear Channel - High Power RWP

High neutron flux level from the power range channels initiates an RWP.

ATTACHMENT 3

TO

P-86279

PSC'S EDITORIAL MARKUPS ON THE NRC'S
DRAFT SAFETY EVALUATION REPORT

Enclosure 1

Draft

Safety Evaluation ~~Report~~

Fort St Vrain Nuclear Generating Station

Background: By letter dated June 21, 1985, the Public Service Company of Colorado (the licensee) proposed changes to THE Technical Specifications for the Fort St Vrain Nuclear Generating Station. The primary purpose of the proposed changes was to modify the trip setpoints for the Plant Protection System~~s~~ (PPS) such that the values specified included a sufficient allowance for uncertainties associated with the instrument systems. Currently, the setpoints for the PPS are specified at the values for which the safety analysis assumed mitigative actions would be initiated. The proposed changes result in revised trip setpoints that include an additional margin of conservatism to account for instrumentation uncertainties. The revised trip setpoints were determined using Instrument Society of America Standard S67.04-1982, "Setpoints for Nuclear Safety-Related Instrumentation Used in Nuclear Power Plants", as guidance.

As a result of the licensee's evaluation program to determine appropriate values for instrumentation trip setpoints, the ~~resulting~~ values for some trip functions were found to offer the potential for increased inadvertent scrams, loop shutdowns, or circulator trips. In these cases, the results of a reanalysis were provided to justify the use of trip setpoints that provide a greater margin between the trip setpoint value and normal operating conditions.

This safety evaluation report provides the staff's conclusions on the acceptability of the proposed trip setpoints and the reanalysis provided to reduce the potential for inadvertent safety actions.

Evaluation: By letter dated March 9, 1984, the licensee provided a copy of a ~~work~~ specification outlining the reevaluation of THE Plant Protection System setpoints. This document incorporates the requirements of ISA Standard S67.04-1982, which the staff has previously found acceptable as defining a methodology for establishing trip setpoint values. Therefore, the staff finds that the licensee has established a methodology which is acceptable for determining trip setpoints based on safety analyses for the Fort St Vrain Nuclear Generating Station as documented in the FSAR.

Attachment 3 to the licensee's letter of June 21, 1985, provided a Significant Hazards Consideration Analysis that addresses the results of new analyses for selected safety functions. The conclusions of this analysis and the staff findings are provided as follows:

A. Primary Coolant Pressure-Low

The setpoint for the low primary coolant pressure scram is programmed with load (circulator inlet temperature) such that a scram is initiated when reactor coolant pressure is 50 psi below normal. The low primary coolant pressure scram provides protection for inadequate core cooling that could result in temperature limits being exceeded. For rapid depressurization accidents, a scram would occur instantaneously such that changes in the low pressure setpoint would not have an impact on the consequences of the accident.

Two cases were reanalyzed based on the assumption that a scram occurs at a pressure of 90 psi below normal. The first is the offset rupture of a two inch line in the helium purification regeneration piping as currently analyzed in FSAR Sections 4.3.3 and 14.8. For this accident, which is assumed to occur at 100 percent power, a scram occurs at 50 psi below normal pressure in about 120 seconds. At this time, primary coolant flow is 97% of rated and the peak core average OUTLET temperature is 13°F above normal. Under the assumption that a scram does not occur until primary coolant pressure is 90 psi below normal, in 220 seconds primary coolant flow will have been reduced to 92.5 percent ~~below~~ of rated and the core average outlet-temperature peaks at 44°F above normal. After the reactor scram, core average outlet temperature ~~reduces~~ decreases with continued core cooling.

% vs PERCENT

The second case analyzed is the effect of continued plant operation at 100 and at 25 percent power with reduced primary coolant pressure just above the assumed scram value of 90 psi below normal. For these two conditions, circulator speed increases in response to the decreased helium inventory; however the core power –

to-flow ratio only changes by 0.01 at both 25 and 100 percent power. The impact on helium temperature at the inlet to the steam generators is an ~~a small~~ increase of 9°F at 100 percent power and 40°F at 25 percent power.

Therefore, it was concluded that since neither a safety limit or equipment design limit is exceeded, the assumption of a lower primary coolant pressure for initiation of a reactor scram is acceptable. ~~not safety-significant~~. Based on the review of these results, the staff concludes that this analysis provides an acceptable basis to justify a lower trip setpoint for this safety function. With the allowance for instrument uncertainty the new trip setpoint is 64.6 psi below normal primary coolant pressure.

B. Primary Coolant Pressure - High

The setpoint for the high primary coolant pressure scram is programmed with load (circulator inlet temperature) such that a scram is initiated when the reactor coolant pressure is 7.5 percent (approximately 53 psi) above normal. The high primary coolant pressure scram and preselected steam generator dump is a backup for the primary coolant moisture monitor scram and dump of a leaking steam generator. The FSAR safety analyses addresses six accident cases related to steam ingress with various postulated failures of the protection systems. Of the six accident cases analyzed only four involve safety actions initiated on high primary coolant pressure. Each case was reanalyzed as follows based on the assumption of a high pressure scram at 70 psi above normal.

(1) Wrong Loop Dump. For this case it is assumed that the moisture monitors initiate a scram, however the wrong loop is dumped. The only safety action initiated on high pressure is the initiation of the steam generator depressurization program which reduces steam ingress by lowering steam generator pressure. For this case the current analysis results in the safety action being initiated after about 80 seconds with a total steam ingress of 14,580 lbs of which 180 lbs react with core graphite. With the assumption of a higher pressure trip, 70 psi above normal, the depressurization program is initiated at 120 seconds with a total steam ingress of 15,000 lbs and no change in the amount that reacts with core graphite.

(2) Moisture Monitor Failure and Correct Loop Dump. For this case it is assumed that no safety actions are initiated by the moisture monitors. On high primary coolant pressure, a reactor scram is initiated and the preselected loop dump isolates the leaking steam generator. For this case the current analysis results in a scram and steam generator dump in 95 seconds with a total steam ingress of 2,160 lbs of which 855 lbs react with core graphite. With the assumption of a higher pressure trip, 70 psi above normal, safety action is initiated in 157 seconds with a total steam ingress of 3,200 lbs of which 1,112 lbs react with core graphite.

(3) Moisture Monitor Failure and Incorrect Loop Dump. This case is the same as (2) above, however, it is assumed that the intact loop is dumped. For this case the current analysis results in a total steam ingress of 15,740 lbs of which 894 lbs react with core graphite. With the assumption of a higher pressure trip, the total steam ingress is 15,600 lbs of which 1,162 lbs react with core graphite.

Although the reanalysis shows a lower total steam ingress, it was noted that the original analysis was conservative since it assumed that the leakage was terminated 30 minutes after the time a scram was initiated rather than 30 minutes after the time of the accident.

(4) Moisture Monitor Failure with Correct Loop Isolation and Failure to Dump. This case is the same as (2) above; however, it is assumed that the faulty steam generator is only isolated and not dumped. Thus the only difference in this case and case (2) above is that the entire 6,000 lbs inventory of the steam generator is assumed to enter the primary coolant system. For the current analysis the total steam ingress is 8,080 lbs of which 919 lbs react with core graphite. With the assumption of a higher value for the high pressure trip, the total steam ingress is 9,200 lbs of which 1,200 lbs reacts with core graphite.

The overall impact of the change from 50 to 70 psi above normal for the high primary coolant pressure trip is an increase of 30 percent in amount of moisture that reacts with core graphite for those cases for which multiple failures of the protection systems are assumed. While the impact of increased steam/graphite

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reaction was not specifically analyzed, the present analysis of steam graphite reactions as noted in FSAR Section 14.5.2.2 demonstrates that these effects are not safety-significant with regard to the structural integrity of graphite core support posts, bottom reflector blocks or core support blocks. Further, there would not be a safety-significant change in the effect on fuel particles or potential fission product release to the primary coolant system. More importantly the consequences of increased steam ingress ~~does~~ do not result in any significant change in the peak primary coolant pressure which could challenge the primary coolant system safety valves. Therefore, based on the review of these results, the staff concludes that this analysis provides an acceptable basis to justify a higher value to establish the setpoint for the high~~er~~ primary coolant pressure scram. With the allowance for instrument uncertainty, the new trip setpoint is 44 psi above normal primary coolant pressure.

C. Superheat Header Temperature - Low

Low superheat header temperature initiates a loop shutdown at a setpoint of 800°F coincident with high differential temperature between loop 1 and loop 2 at a setpoint of 50°F. This provides protection to preclude a flood out of the steam generators due to an increase in feedwater flow or a reduction in helium flow to a loop. For this analysis, it is assumed that the trip on ~~core~~ Loop superheat temperature is initiated at a superheat temperature of 780°F with a differential between loops of 65°F or greater. The impacts of these assumptions were considered for two cases; 30% and 100% power.

EQUIPMENT PROTECTION

There are two basic considerations that are applicable to this safety function. The first is that the trip should be initiated prior to reaching flood out temperatures. Since the saturation temperature at normal operating pressure of 2400 psig is 660°F, the assumption of 780°F for mitigative action provides an adequate margin of safety. The second consideration is that loop shutdown should occur before a turbine trip is initiated on low main steam temperature. This turbine protection is initiated when the main steam temperature, i.e. the temperature of the combined loop steam flow, falls to 800°F.

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Since the superheat header temperature for each loop is maintained by controlling primary coolant flow in that loop, a malfunction in one loop which would result in low superheat temperature for that loop would not result in a change in superheat temperature for the other loop. At 30% power, steam temperature is controlled at ABOUT 880°F. Therefore, if a loop isolation occurs at a superheat header temperature of 780°F, the temperature difference will be 100°F and the ~~main~~ TURBINE MIXED INLET steam temperature will be 830°F. This is sufficient to assure that the loop temperature difference is sufficient to satisfy that portion of the trip logic and that loop isolation will occur prior to the occurrence of a turbine trip on low main steam temperature. At 100% power, steam temperature is controlled at 1000°F. For this case the temperature difference between loops is ~~230~~ 220°F and the main steam temperature is 890°F when the trip occurs. Thus the available margins are greater than at 30% power.

Therefore, based on this review, the staff concludes that this analysis provides an acceptable basis to justify a change in the bases for determining the setpoint for these protection system channels. With the allowance for instrument uncertainty, the new trip setpoints are 798°F for low superheat header temperature at a 44.8°F differential temperature between loops.

D. Circulator Speed-Low.

The setpoint for the low circulator speed circulator trip is 1910 rpm below normal, as programmed by load (feedwater flow). The circulator trip results in a reduction in plant load when operating at full load conditions. Also the low feedwater flow setpoint which is programmed by circulator speed is lowered to preclude a trip of the operating circulator. Under conditions for single circulator operation the ratio of circulator speed to feedwater flow is about a factor of two greater than normal operation.

For a malfunction which would result in a loss of circulator speed, the coast-down of the circulator is only a matter of a few seconds. For the reanalyzed case it was assumed that a trip does not occur until a reduction of circulator speed to 2390 rpm below normal OCCURS. At part load conditions, the time to reach this value is about four seconds. In addition, the trip includes a fixed 5 second

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delay to avoid spurious trips due to changes in circulator speed during normal operation. In contrast, the response of the steam generator superheat header temperature to changes in helium flow is about 30 seconds. Therefore, it was concluded that the assumption of a circulator trip at 2390 rpm below normal is ~~not safety significant~~ acceptable.

Based on this review, the staff concludes that this analysis provides an acceptable basis to justify a change in the bases for determining the trip setpoint for these protection system channels. With the allowance for instrumentation uncertainties the trip setpoint is 1850 rpm below normal as programmed by feedwater flow.

E. Fixed Feedwater Flow - Low

The setpoint for the fixed low feedwater flow circulator trip is 20% of rated feedwater flow. Since both circulators in a loop are tripped on low flow, this results in a loop shutdown. This provides protection against steam generator operation at tube temperatures above design values.

Two basic operating conditions were addressed in the revised analysis to support an assumption that the fixed low feedwater flow trip occurs at 5% of rated feedwater flow. The first condition addressed a sudden total loss of feedwater flow to a steam generator and to both loops. Under this condition feedwater flow is reduced to zero flow instantaneously. Due to a built-in five second delay, loop isolation occurs five seconds following the occurrence of these events. Under this condition the consequences of these events are the same as the original FSAR analysis and tube temperatures remain below design limits.

The second condition addressed was continued operation at reduced feedwater flow. However, under this condition, the minimum feedwater flow rate considered was 14 percent of rated flow. Further, with regard to static boiling stability conditions, it is noted that even if unstable boiling conditions are encountered at flow rates below 18.6 percent, the maximum helium temperature available at the Superheater II inlet would be less than 957°F and thus could not result in significantly exceeding the maximum allowable temperature of 952°F at the limiting

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tube location. While it is noted that this analysis is conservative, since it postulates that a hot gas streak could penetrate the entire EES bundle from top to bottom with no mixing, the staff cannot conclude that this analysis justifies an assumption of loop isolation at feedwater flows as low as 5 percent of rated flow.

Therefore, based on this analysis, the staff concludes that an acceptable basis has not been set forth to support the proposed change in the low feedwater flow trip setpoint.

F. <u>Loss of Circulator Bearing Water</u>.

The circulator trip on the loss of bearing water is initiated when the bearing water DIFFERENTIAL pressure with respect to primary coolant pressure is reduced to a low differential pressure of 475 psid. This provides protection for the circulator bearings on a loss of the normal and backup bearing water supply systems. In addition to a trip of the helium circulator, the protective action includes the ~~firing~~ actuation of the bearing water accumulators to provide a source of bearing water during circulator coast down and operation of the circulator brake and seal system, as well as isolation of the circulator auxiliary system service lines. The latter insures the integrity of the primary coolant system when the dynamic seal provided by the bearing water system is not available.

The reanalysis of the operation of the loss of bearing water protection was undertaken based on the assumption that the safety action is initiated at a differential pressure of 450 psid. From prior testing of the bearing water system, the minimum differential pressure during a transient response of the system was 375 psid. From this data it is concluded that a 25 psid reduction in the trip setpoint would result in transient minimum differential pressures of 350 psid. Based on this value, analyses demonstrate that the bearing acceptance criterion of a minimum clearance of 0.001 inches will be maintained.

Therefore, based on this review, the staff concludes that an acceptable basis has been provided to justify a lower setpoint for this safety action. With an allowance for instrument uncertainty, the new trip setpoint is 459 psid.

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G. Circulator Speed - High

The setpoint for the trip of the heli_m circulator steam turbine drive is 11,000 rpm. This provides protection to assure that the circulator does not exceed the design speed limit of 13,500 rpm. For steam line ruptures down stream of the circulator steam turbine, the maximum speed is 13,264 rpm with no control action or overspeed trip. Therefore, this event does not establish a limit for an acceptable high speed setpoint.

With the presently assumed overspeed trip value, the maximum transient overspeed for a loss of restraining torque event (blade shedding) is 13,050 rpm. Reanalysis with an assumed overspeed trip value of 11,500 rpm results in a maximum transient overspeed of 13,267 rpm. Based on these analyses, it is extrapolated that an assumed overspeed trip at 11,750 rpm would result in a maximum transient overspeed of 13,370 rpm or less.

Therefore, based on this analysis the staff concludes that an assumed overspeed trip value of 11,750 rpm provides an acceptable basis for determining the trip setpoint for this protection function. With the allowance for instrument uncertainty, the overspeed trip setpoint is 11,495 rpm.

H. Neutron Flux-High

The setpoint for the high neutron flux scram is 140 percent of rated thermal power. As a consequence of uncertainties in the reactor power measurement, the setpoint for the high neutron flux scram has been administratively controlled and adjusted at conservative values based on indicated reactor power. The licensee provided curves that are currently being used to control the setpoint for the high neutron flux scram as well as the high neutron flux rod withdrawal prohibit. Further, the licensee proposed to delete the values for the trip setpoints for the protective actions and to note that these settings are to be established for each fuel cycle and implemented based upon the approval of the Nuclear Facility Safety Committee. The staff finds that this proposal is unacceptable; therefore the curves which define these setpoints must be retained ~~have been included~~ in the Technical Specification requirements.

since these changes could potentially be an unreviewed safety question.

Summary

~~Conclusion.~~

In addition to the proposed changes for the trip setpoints for the plant protection system, a number of additional changes were proposed in the format of the Technical Specifications. These changes are primarily a part of an overall upgrade program to provide an improved statement of requirements consistent with the format of Technical Specifications for light water reactors. At this time the staff has a number comments on the specifics of these proposed changes that require resolution before action can be taken on these proposed changes. However, those changes related to trip setpoints are safety-significant in that the current specification requirements do not include adequate margins for instrumentation uncertainty. Therefore, these changes are being incorporated in Appendix A of Facility Operating License, No. DPR-34 at this time. Based on this review, the staff concludes that the proposed changes related to the trip setpoints for the plant protection systems are acceptable, with the exception of Fixed Feedwater Flow - Low. This change will be addressed in a seperate review.