~~l. Degree of Redundancy~~

~~Degree of redundancy is defined as the difference between the number of operable channels and the minimum number of channels which when tripped will cause an automatic shutdown.~~

ml. Reactor Critical

The reactor is said to be critical when the neutron chain reaction is self-sustaining and $k_{eff} = 1.0$.

nm. Low Power Operation

The reactor is in the low-power operating condition when the reactor is critical and the average neutron flux of the power range instrumentation indicates less than or equal to 2% of rated power.

on. Fire Suppression Water System

A FIRE SUPPRESSION WATER SYSTEM shall consist of: a water source; pump(s); and distribution piping with associated sectionalizing control or isolation valves. Such valves shall include yard post indicating valves and the first valve ahead of the water flow alarm device on each sprinkler, hose standpipe or spray system riser.

oo. Dose Equivalent I-131

Dose Equivalent I-131 shall be that concentration of I-131 (microcurie/gram) which alone would produce the same thyroid dose as the quantity and isotopic mixture of I-131, I-132, I-133, I-134, and I-135 actually present. The thyroid dose conversion factors used for this calculation shall be those listed in Table III of TID-14844, "Calculation of Distance Factors for Power and Test Reactor Sites."

pp. $\bar{E}$ - Average Disintegration Energy

$\bar{E}$ shall be the average (weighted in proportion to the concentration of each radionuclide in the reactor coolant at the time of sampling) of the sum of the average beta and gamma energies per disintegration (in MeV) for isotopes, other than iodines, with half lives greater than 15 minutes, making up at least 95% of the total non-iodine activity in the coolant.

15.3.5 INSTRUMENTATION SYSTEM

Operational Safety Instrumentation

Applicability: Applies to plant instrumentation systems.

Objectives: To provide for automatic initiation of the Engineered Safety Features in the event that principal process variable limits are exceeded, and to delineate the conditions of the plant instrumentation and safety circuits necessary to ensure reactor safety.

Specification:

A. The Engineered Safety Features initiation instrumentation setting limits shall be as stated in Table 15.3.5-1.

B. For on-line testing or in the event of a sub-system instrumentation channel failure, plant operation at rated power shall be permitted to continue in accordance with Tables 15.3.5-2 through 15.3.5-4.

C. In the event the number of channels of a particular sub-system in service falls below the limits given in the column entitled Minimum Operable Channels, ~~or Minimum Degree of Redundancy cannot be achieved,~~ operation shall be limited according to the requirement shown in Tables 15.3.5-2 through 15.3.5-4, Operator Action when minimum operable channels unavailable.

D. The post-accident monitoring instrumentation channels in Table 15.3.5-5 shall be operable. In the event the number of channels in a particular sub-system falls below the minimum number of operable channels given in Column 2, operation and subsequent operator action shall be in accordance with Column 3. This specification is not applicable in the cold or refueling shutdown conditions.

Basis: Instrumentation has been provided to sense accident conditions and to initiate operation of the Engineered Safety Features(1).

TABLE 15.3.5-2
INSTRUMENT CONDITIONS FOR REACTOR TRIP

NO.	FUNCTIONAL UNIT	1 TOTAL NO. OF CHANNELS	2 NO. OF CHANNELS TO TRIP	3 MINIMUM OPERABLE CHANNELS	4 PERMISSIBLE BYPASS CONDITIONS	OPERATOR ACTION IF CONDITIONS OF COLUMN 3 CANNOT BE MET
1.	Manual	2	1	1		Be in hot shutdown in 8 hours
2.	Nuclear Power Range					
a.	low setting	4	2	3#,**	2 of 4 channels greater than 10% full power (low setting only)	Be in hot shutdown in 8 hours
b.	high setting	4	2	3#,**		Be in hot shutdown in 8 hours
3.	Nuclear Flux Intermediate Range	2	1	1	2 of 4 channels greater than 10% full power	Be in hot shutdown in 8 hours*
4.	Nuclear Flux Source Range	2	1	1	1 of 2 intermediate range channels greater than 10^{-10} amps.	Be in hot shutdown in 8 hours*
5.	Overtemperature Delta T	4	2	3**		Be in hot shutdown in 8 hours
6.	Overpower Delta T	4	2	3**		Be in hot shutdown in 8 hours
7.	Low Pressurizer Pressure	4	2	3**		Be in hot shutdown in 8 hours
8.	Hi Pressurizer Pressure	3	2	2**		Be in hot shutdown in 8 hours
9.	Hi Pressurizer Water Level	3	2	2**		Be in hot shutdown in 8 hours

TABLE 15.3.5-2(continued)

NO.	FUNCTIONAL UNIT	1 TOTAL NO. OF CHANNELS	2 NO. OF CHANNELS TO TRIP	3 MINIMUM OPERABLE CHANNELS	4 PERMISSIBLE BYPASS CONDITIONS	OPERATOR ACTION IF CONDITIONS OF COLUMN 3 CANNOT BE MET
10.	Low Reactor Coolant System Flow					
a.	Low Flow in One Loop (>50% full power)	3/loop	2/loop (any loop)	2/loop**		Be in hot shutdown in 8 hours
b.	Low Flow in Both Loops (10-50% full power)	3/loop	2/loop (both loops)	2/loop**		Be in hot shutdown in 8 hours
11.	Turbine Trips					
a.	Turbine Autostop Oil Pressure	3	2	2**		Be <50% of rated power within 4 hours
b.	Turbine Stop Valve Position	2	2	2**		Be <50% of rated power within 4 hours
12.	Steam Flow-Feedwater Flow Mismatch	2/loop	1/loop	1/loop		Be in hot shutdown in 8 hours
13.	Lo Lo Steam Generator Level (input to reactor trip)	3/loop	2/loop	2/loop**		Be in hot shutdown in 8 hours
14.	4KV Bus (A01 and A02)					
a.	Undervoltage (input to reactor trip)	2/each bus	1/each bus	1/each bus		Be in hot shutdown in 8 hours
b.	Underfrequency	2/each bus	1/each bus	1/each bus		Be in hot shutdown in 8 hours
15.	Safety Injection	See Table 15.3.5-3	1	See Table 15.3.5-3		Be in hot shutdown in 8 hours***

TABLE 15.3.5-2(continued)

NO.	FUNCTIONAL UNIT	1 TOTAL NO. OF CHANNELS	2 NO. OF CHANNELS TO TRIP	3 MINIMUM OPERABLE CHANNELS	4 PERMISSIBLE BYPASS CONDITIONS	OPERATOR ACTION IF CONDITIONS OF COLUMN 3 CANNOT BE MET
16.	RCP Breaker Open Position					
a.	(>50% full power)	2	1	2		Be in hot shutdown in 8 hours
b.	(10 - 50% full power)	2	2	2		Be in hot shutdown in 8 hours
17.	Reactor Trip Breakers	2	1	2	****	Be in hot shutdown in 8 hours

\# One additional channel may be taken out of service for low power physics testing.

* When block condition exists, maintain normal operation.

** If a channel is determined to be inoperable, resulting in one less than the total number of channels being operable, power operation may continue if the following conditions are met:

1. The minimum number of operable channels is still satisfied.
2. The affected channel is placed in trip within 1 hour.

*** If minimum conditions are not met within 24 hours after reaching hot shutdown, the unit shall be in cold shutdown within 48 hours of the event causing the unit shutdown.

**** When at power, one channel may be bypassed for up to 8 hours provided that the other channel is operable. When the plant is shutdown and rod withdrawal is possible, restore the inoperable channel to operable status within 48 hours or open the Reactor Trip Breakers within 1 hour.

TABLE 15.3 5-3

~~EMERGENCY COOLING~~ ENGINEERED SAFETY FEATURES

NO.	FUNCTIONAL UNIT	1 NO. OF CHANNELS	2 NO. OF CHANNELS TO TRIP	3 MINIMUM OPERABLE CHANNELS	4 PERMISSIBLE BYPASS CONDITIONS	OPERATOR ACTION IF CONDITIONS OF COLUMN 3 CANNOT BE MET
1.	SAFETY INJECTION					
a.	Manual	2	1	1		Be in hot shutdown in 8 hours*
b.	Hi Containment Pressure	3	2	2**		Be in hot shutdown in 8 hours*
c.	Steam Generator Low Steam Pressure/Loop	3	2	2**	Primary pressure <1800 psig	Be in hot shutdown in 8 hours*
d.	Low Pressurizer Pressure	3	2	2**	Primary pressure <1800 psig	Be in hot shutdown in 8 hours*
2.	CONTAINMENT SPRAY					
a.	Manual****	2	2	2		Be in hot shutdown in 8 hours*
b.	Hi Hi Containment Pressure (Containment Spray)	2 sets of 3	2 of 3 in each set	2 per set**		Be in hot shutdown in 8 hours*
3.	AUXILIARY FEEDWATER					
a.	Start Motor-Driven Pumps					
i.	Low Low Steam Gen. Water Level	3/SG	2/either SG	2/SG**		Be in hot shutdown in 8 hours*
ii.	SI signal	SI Initiating Conditions as in Item 1				Be in hot shutdown in 8 hours*

TABLE 15.3.5-3(continued)
~~EMERGENCY COOLING~~ ENGINEERED SAFETY FEATURES

NO.	FUNCTIONAL UNIT	1 NO. OF CHANNELS	2 NO. OF CHANNELS TO TRIP	3 MINIMUM OPERABLE CHANNELS	4 PERMISSIBLE BYPASS CONDITIONS	OPERATOR ACTION IF CONDITIONS OF COLUMN 3 CANNOT BE MET
~~b.~~	~~Trip of Both Main Feedpumps Starts Motor Driven Pumps~~	~~2/pump~~	~~1/pump~~	~~1/pump~~	~~Reactor Power is Less Than 40%~~	~~Hot Shutdown***~~
	b. Start Turbine-Driven Pump					
	i. Undervoltage on 4KV Buses (A01 & A02)	2/each bus	1/each bus	1/each bus**		Be in hot shutdown in 8 hours*
	ii. Low Low Steam Gen. Water Level	3/SG	2/each SG	2/SG**		Be in hot shutdown in 8 hours*
4.	SAFETY-RELATED ELECTRICAL ~~BUSES~~ LOADS					
	a. 4.16KV Buses					
	i. Degraded Voltage	3/bus	2/bus	2/bus**		***
	ii. Loss of Voltage	2/bus	1/bus	1/bus		***
	b. 480V Buses					
	i. Loss of Voltage	3/bus	2/bus	2/bus**		Be in hot shutdown in 8 hours*

* If minimum conditions are not met within 24 hours after reaching hot shutdown, the unit shall be in cold shutdown within 48 hours of the event causing the unit shutdown.

** If a channel is determined to be inoperable, resulting in one less than the total number of channels being operable, power operation may continue if the following conditions are met:
1. The minimum number of operable channels is still satisfied.
2. The affected channel is placed in trip within 1 hour.

*** Normal operation is allowed provided both diesel generators are available and the associated diesel generator is operating and providing power to the affected safeguards bus. If these minimum conditions are not met within 7 days, the affected unit shall be placed in hot shutdown.

**** Both switches must be activated simultaneously.

TABLE 15.3.5-4

INSTRUMENT OPERATING CONDITIONS FOR ISOLATION FUNCTIONS

NO.	FUNCTIONAL UNIT	1 TOTAL NO. OF CHANNELS	2 NO. OF CHANNELS TO TRIP	3 MINIMUM OPERABLE CHANNELS	4 PERMISSIBLE BYPASS CONDITIONS	OPERATOR ACTIONS IF CONDITIONS OF COLUMN 3 CANNOT BE MET
1.	CONTAINMENT ISOLATION					
a.	Safety Injection	See Items 1b, c, and d of Table 15.3.5-3				Be in hot shutdown in 8 hours*
b.	Manual	2	1	1		Be in hot shutdown in 8 hours
2.	STEAM LINE ISOLATION					
a.	Hi Hi Steam Flow with	2/loop	1/either loop	1/loop		Be in hot shutdown in 8 hours*
	Safety Injection	See Items 1b, c, and d of Table 15.3.5-3				Be in hot shutdown in 8 hours*
b.	Hi Steam Flow and	2/loop	1/either loop	1/loop		Be in hot shutdown in 8 hours*
	Low Tavg with	4	2	3**		Be in hot shutdown in 8 hours*
	Safety Injection	See Items 1b, c, and d of Table 15.3.5-3				Be in hot shutdown in 8 hours*
c.	Hi Containment Pressure	3	2	2**		Be in hot shutdown in 8 hours*
d.	Manual	1/loop	1/loop	1/loop		Be in hot shutdown in 8 hours
3.	FEEDWATER ISOLATION					
a.	Hi Steam Generator Water Level	3/SG	2/SG	2/SG**		Be in hot shutdown in 8 hours*
b.	Safety Injection	See Item 1 of Table 15.3.5-3				Be in hot shutdown in 8 hours*

* If minimum conditions are not met within 24 hours, steps shall be taken on the affected unit to place the unit in cold shutdown conditions.

** If a channel is determined to be inoperable, resulting in one less than the total number of channels being operable, power operation may continue if the following conditions are met:

1. The minimum number of operable channels is still satisfied.
2. The affected channel is placed in trip within 1 hour.

TABLE 15.3.5-5

INSTRUMENT OPERATING CONDITIONS FOR ~~INDICATIONS~~ POST-ACCIDENT MONITORING INSTRUMENTATION

NO.	FUNCTIONAL UNIT	1 TOTAL NO. OF CHANNELS	2 MINIMUM OPERABLE CHANNELS	3 OPERATOR ACTION IF CONDITIONS OF COLUMN 2 CANNOT BE MET
1.	PORV Position Indicator	1/Valve	1/Valve	If the operability of the PORV position indicator cannot be restored within 48 hours, shut the associated PORV Block Valve.
2.	PORV Block Valve Position Indicator	1/Valve	1/Valve	If the operability of the PORV Block Valve Position Indicator cannot be restored within 48 hours, shut and verify the Block Valve shut by direct observation or declare the Block Valve inoperable.
3.	Safety Valve Position Indicator	2/Valve	1/Valve	If the operability of at least one of the Safety Valve Position Indicators cannot be restored within seven days, be in at least hot shutdown within the next 12 hours.
4.	Reactor Coolant System Subcooling	2	1	If operability of at least one subcooling monitor cannot be restored within 48 hours, be in hot shutdown within the next twelve hours.

NOTE: The channel requirements in this table refer only to that portion of the instrument channel required for post-accident monitoring. The applicable channels are listed in FSAR Table 7.7-2.

TABLE 15.3.5-5 (continued)

NO.	FUNCTIONAL UNIT	1 TOTAL NO. OF CHANNELS	2 MINIMUM OPERABLE CHANNELS	3 OPERATOR ACTION IF CONDITIONS OF COLUMN 2 CANNOT BE MET
5.	AFW Pump Discharge Flowrate	3	#	If the minimum number of AFW Pump Discharge Flowrate channels required to provide indication of AFW flow to both steam generators cannot be restored to an operable status within 48 hours, be in hot shutdown within the next twelve hours.
6.	AFW to Steam Generator Flowrate	2	1	If operability cannot be restored within 48 hours, be in hot shutdown within the next twelve hours.
7.	Containment High Range Radiation	3	2	If the operability cannot be restored within seven days after failure, prepare a special report to be submitted within thirty days in accordance with 15.6.9.2.D.
8.	Containment ~~Water~~ Sump Level ~~Keyway~~ (Sump A)	2	1	Operation may continue up to thirty days. If operability cannot be restored, be in hot shutdown within the next twelve hours.
9.	Containment ~~Water~~ Sump Level (Sump B) ~~Continuous Indic.~~	2	1	If operability cannot be restored within 48 hours, be in hot shutdown within the next twelve hours.

The minimum number of operable channels for AFW Pump Discharge Flowrate is the number of AFW Pump Discharge Flowrate channels, in conjunction with the number of operable AFW to Steam Generator Flowrate channels, required to provide indication of AFW flow to both steam generators.

NOTE: The channel requirements in this table refer only to that portion of the instrument channel required for post-accident monitoring. The applicable channels are listed in FSAR Table 7.7-2.

TABLE 15.3.5-5 (continued)

NO.	FUNCTIONAL UNIT	1 TOTAL NO. OF CHANNELS	2 MINIMUM OPERABLE CHANNELS	3 OPERATOR ACTION IF CONDITIONS OF COLUMN 2 CANNOT BE MET
10.	Containment Hydrogen ~~Monitors~~ Concentration	2*	1	If operability cannot be restored within 72 hours, be in hot shutdown within the next six hours.
11.	Reactor Vessel Wide Range Level	2	1	If operability cannot be restored within 48 hours, be in hot shutdown within the next twelve hours.
12.	Reactor Vessel Narrow Range Level	2	1	If operability cannot be restored within 48 hours, be in hot shutdown within the next twelve hours.
13.	In-Core Thermocouples	39 installed per core	2/core quadrant	If operability cannot be restored within 48 hours, be in hot shutdown within the next twelve hours.
14.	Main Steam Line Radiation ~~Monitors (SA 11)~~	1/steam line	1/steam line	If operability cannot be restored within seven days, prepare a special report to be submitted within thirty days in accordance with 15.6.9.2.E.
15.	Refueling Water Storage Tank Level	2	1	If operability cannot be restored within 48 hours, be in hot shutdown within the next twelve hours.
16.	RCS Wide Range Pressure	3	1	If operability cannot be restored within 48 hours, be in hot shutdown within the next twelve hours.

* With only one hydrogen monitor operable, restore an inoperable monitor with an independent power supply to an OPERABLE status within 30 days or be in hot shutdown within 6 hours.

NOTE: The channel requirements in this table refer only to that portion of the instrument channel required for post-accident monitoring. The applicable channels are listed in FSAR Table 7.7-2.

TABLE 15.3.5-5 (Continued)

NO.	FUNCTIONAL UNIT	1 TOTAL NO. OF CHANNELS	2 MINIMUM OPERABLE CHANNELS	3 OPERATOR ACTION IF CONDITIONS OF COLUMN 2 CANNOT BE MET
17.	RCS Narrow Range Pressure	4	1	If operability cannot be restored within 48 hours, be in hot shutdown within the next twelve hours.
18.	RCS Wide Range Hot Leg Temperature	2/loop	1/loop	If operability cannot be restored within 48 hours, be in hot shutdown within the next twelve hours.
19.	RCS Wide Range Cold Leg Temperature	2/loop	1/loop	If operability cannot be restored within 48 hours, be in hot shutdown within the next twelve hours.
20.	Pressurizer Level	4	1	If operability cannot be restored within 48 hours, be in hot shutdown within the next twelve hours.
21.	Containment ~~High~~ Wide Range Pressure ~~Monitor~~	2	1	If operability cannot be restored within 48 hours, be in hot shutdown within the next twelve hours.
22.	Containment Intermediate Range Pressure	3	1	If operability cannot be restored within 48 hours, be in hot shutdown within the next twelve hours.
23.	Containment Low Range Pressure	3	1	If operability cannot be restored within 48 hours, be in hot shutdown within the next twelve hours.
24.	Condensate Storage Tank Level	2/tank	1/tank	If operability cannot be restored within 48 hours, be in hot shutdown within the next twelve hours.
25.	Steam Generator Wide Range Level	2/SG	1/SG	If operability cannot be restored within 48 hours, be in hot shutdown within the next twelve hours.

NOTE: The channel requirements in this table refer only to that portion of the instrument channel required for post-accident monitoring. The applicable channels are listed in FSAR Table 7.7-2.

TABLE 15.3.5-5 (Continued)

NO.	FUNCTIONAL UNIT	1 TOTAL NO. OF CHANNELS	2 MINIMUM OPERABLE CHANNELS	3 OPERATOR ACTION IF CONDITIONS OF COLUMN 2 CANNOT BE MET
26.	Steam Generator Narrow Range Level	2/SG	1/SG	If operability cannot be restored within 48 hours, be in hot shutdown within the next twelve hours.
27.	Steam Generator Pressure	3/SG	1/SG	If operability cannot be restored within 48 hours, be in hot shutdown within the next twelve hours.
28.	Containment Isolation Valve Position Indication	1	1	If the operability of the shut position indication of a containment isolation valve cannot be restored within seven days, close the valve or be in hot shutdown within the next twelve hours.

NOTE: The channel requirements in this table refer only to that portion of the instrument channel required for post-accident monitoring. The applicable channels are listed in FSAR Table 7.7-2.

15.4.1 OPERATIONAL SAFETY REVIEW

Applicability:

Applies to items directly related to safety limits and limiting conditions for operation.

Objective:

A. Instrumentation shall be checked, tested and calibrated at sufficiently frequent intervals to assure safe operation.

B. Equipment and sampling tests shall be conducted at sufficiently frequent intervals to assure safe operation.

Specification:

A. Calibration, testing, and checking of analog channel and testing of logic channel shall be performed as detailed in Table 15.4.1-1.

B. Equipment and sampling tests shall be conducted as detailed in Table 15.4.1-2.

Basis:

A. Check

Failures such as blown instrument fuses, defective indicators, faulted amplifiers which result in "upscale" or "downscale" indication can be easily recognized by simple observation of the functioning of an instrument or system. Furthermore, such failures are, in many cases, revealed by alarm or annunciator action, and a check supplements this type of built-in surveillance.

Based on experience in operation of both conventional and nuclear plant systems, when the plant is in operation, the minimum checking frequency of once per shift is deemed adequate for reactor and steam system instrumentation.

Calibration

Calibration shall be performed to ensure the presentation and acquisition of accurate information.

The nuclear flux (linear level) channels shall be calibrated at least daily against a heat balance standard to verify drift and effects of changing rod patterns.

Other channels are subject only to "drift" errors induced within the instrumentation itself and, consequently, can tolerate longer intervals between calibration. Process system instrumentation errors induced by drift can be expected to remain within acceptable tolerances if recalibration is performed at intervals of each refueling shutdown.

Substantial calibration shifts within a channel (essentially a channel failure) will be revealed during routine checking and testing procedures.

Thus, minimum calibration frequencies of once-per-day for the nuclear flux (linear level) channels, and once each refueling shutdown for the process system channels is considered acceptable.

Testing

Experience with this type of instrumentation has shown that the testing frequency as specified in Table 15.4.1-1 will assure the required level of performance.

B. The equipment testing and system sampling frequencies specified in Table 15.4.1-2 are considered adequate to maintain the status of the equipment and systems so as to assure safe operation.

TABLE 15.4.1-1

MINIMUM FREQUENCIES FOR CHECKS, CALIBRATIONS, AND TESTS OF INSTRUMENT CHANNELS

NO.	CHANNEL DESCRIPTION	CHECK	CALIBRATE	TEST	PLANT CONDITIONS WHEN REQUIRED
1.	Nuclear Power Range	-	R	-	ALL
	-Heat Balance	S(1)	D(1,19)	-	ALL
	-Signal to delta T; bistable actions(permissive, rod stops, trips)	-	-	M(1,2)	ALL
	-Compare results of the incore detector measurements to NIS axial flux difference	M(4,5,20)	-	-	PWR
2.	Nuclear Intermediate Range	-	R	-	ALL
	-when not blocked	S(1)	-	-	ALL
	-logarithmic level;bistable action (permissive, rod stop, trips)	-	-	P	ALL
3.	Nuclear Source Range	-	R	-	ALL
	-when not blocked	S	-	-	ALL
	-Bistable action (alarm and trips)	-	-	P	ALL
4.	Reactor Coolant Temperature	S	R	-	PWR,HOT S/D,COLD S/D
	-Overtemperature delta T	-	-	M(1,2)	ALL
	-Overpower delta T	-	-	M(1,2)	ALL
5.	Reactor Coolant Flow	S(1)	R	-	ALL
	-Analog and single loop loss-of-flow logic testing	-	-	M(1,2)	ALL
	-Logic channel testing for reactor trip on loss of reactor coolant flow in both loops	-	-	R	ALL
6.	Pressurizer Pressure	S(1)	R	M(1,2)	ALL
7.	Pressurizer Water Level	S(1)	R	M(1,2)	ALL

TABLE 15.4.1-1 (continued)

NO.	CHANNEL DESCRIPTION	CHECK	CALIBRATE	TEST	PLANT CONDITIONS WHEN REQUIRED
8.	Steam Generator Level	S(1)	R	M(1,17)	ALL
9.	Steam Generator Flow Mismatch	S(1)	R	M(1)	ALL
10.	Steam Generator Pressure	S(16)	R	M(1)	ALL
11.	4KV Bus Undervoltage (A01 & A02)				
	-AFW pump actuation	-	R	M(1)	ALL
	-Reactor Protection actuation	-	R	M(1,2)	ALL
12.	4KV Bus Underfrequency (A01 & A02)				
	-to Reactor Coolant Pump trip	-	R	-	ALL
13.	Safeguards Bus Voltage				
	-Loss of 4KV	S	R	M(1)	ALL
	-Degraded 4KV	S	R	M(1)	ALL
	-Loss of 480V	S	R	M(1)	ALL
14.	120 Vac Instrument Buses	W(6)	-	-	ALL
15.	Reactor Trip Signal From Turbine				
	-Turbine Autostop	-	-	M(1)	ALL
	-Turbine Stop Valve	-	-	M(1)	ALL
16.	Reactor Trip Signal From SI	-	-	M(1)	ALL
17.	Feedwater Isolation on SI				
	-MFP Trip on Safety Injection	-	-	R	ALL
	-MFRV Shutting on Safety Injection	-	-	R	ALL
18.	Accumulator Level and Pressure	S	R	-	ALL
19.	Analog Rod Position	S(8)	R	M(1)	ALL
	-with step counters	S(1)	-	-	ALL
	-Monitoring by On-Line Computer	(18)	-	-	PWR,HOT S/D

TABLE 15.4.1-1 (continued)

NO.	CHANNEL DESCRIPTION	CHECK	CALIBRATE	TEST	PLANT CONDITIONS WHEN REQUIRED
20.	Auxiliary Feedwater Flowrate	(13)	R	-	ALL
21.	Boric Acid Control System	-	R	-	ALL
22.	Boric Acid Tank Level	D	R	-	ALL
23.	Charging Flow	-	R	-	ALL
24.	Condensate Storage Tank Level	S(1)	R	-	ALL
25.	Containment High Range Radiation	S(1)	R(14)	M(1)	ALL
26.	Containment Hydrogen Monitor	D	-	-	ALL
	-Gas Calibration	-	Q(15)	-	ALL
	-Electronic Calibration	-	R	-	ALL
27.	Containment Pressure	S	R	M(1,3,9)	ALL
28.	Containment Water Level	M	R	-	ALL
29.	Emergency Plan Radiation Survey Instruments	Q	R	Q	ALL
30.	Environmental Monitors	M	-	-	ALL
31.	In-Core Thermocouples	M	R(14)	-	ALL
32.	Overpressure Mitigating System	S(12)	R	(10)	ALL
33.	PORV Block Valve Position Indicator	Q	R	-	ALL
34.	PORV Operability	-	R	M(11)	ALL
35.	PORV Position Indicator	S	R	R	ALL

TABLE 15.4.1-1 (continued)

NO.	CHANNEL DESCRIPTION	CHECK	CALIBRATE	TEST	PLANT CONDITIONS WHEN REQUIRED
36.	Radiation Monitoring System	D(7)	R(7)	M(7)	ALL
37.	Reactor Vessel Fluid Level System	M	R	-	ALL
38.	Refueling Water Storage Tank Level	-	R	-	ALL
39.	Residual Heat Removal Pump Flow	-	R	-	ALL
40.	Safety Valve Position Indicator	M	R	-	ALL
41.	Subcooling Margin Monitor	M	R	-	ALL
42.	Turbine First Stage Pressure	S(1)	R	M(1)	ALL
43.	Turbine Overspeed Trips				
	-Independent Overspeed Protection System	-	R	M(1)	ALL
	-Overspeed Block trip	-	R	M(1)	ALL
44.	Volume Control Tank Level	-	R	-	ALL

NOTATION USED IN TABLE 15.4.1-1

S- Each shift
D- Daily
W- Weekly
Q- Quarterly
M- Monthly
P- Prior to reactor criticality if not performed during the previous week.
R- Each refueling interval (but not to exceed 18 months)
PWR- Power and Low Power Operation, as defined in Specifications 15.1.C.h. and 15.1.C.n.
HOT S/D- Hot Shutdown, as defined in Specification 15.1.C.g.1.
COLD S/D- Cold Shutdown, as defined in Specification 15.1.C.g.2.
REF S/D- Refueling Shutdown, as defined in Specification 15.1.C.g.3.
ALL- All conditions of operation, as defined in Specifications 15.1.C.g, h and n.

NOTES USED IN TABLE 15.4.1-1

(1) Not required during periods of refueling shutdown, but must be performed prior to reactor criticality if it has not been performed during the previous surveillance period.

(2) Tests of permissive and low power trip bistable setpoints which cannot be done during power operations shall be conducted prior to reactor criticality if not done in the previous two weeks.

(3) Perform test of the isolation valve signal.

(4) Perform by means of the moveable incore detector system.

(5) Recalibrate if the absolute difference is ≥3 percent.

(6) Verification of proper breaker alignment and that the 120 Vac instrument buses are energized.

(7) Radioactive Effluent Monitoring Instrumentation Surveillance Requirements are specified in Section 15.7.4.

(8) Verify that the associated rod insertion limit is not being violated at least once per 4 hours whenever the rod insertion limit alarm for a control bank is inoperable.

(9) Test of Narrow Range Pressure, 3.0 psig, -3.0 psig excluded.

(10) When used for the Overpressure Mitigating System, each PORV shall be demonstrated operable by:
a. Performance of a channel functional test on the PORV actuation channel, but excluding valve operation, within 31 days prior to entering a condition in which the PORV is required operable and at least once per 31 days thereafter when the PORV is required operable.
b. Testing valve operation in accordance with the inservice test requirements of the ASME Boiler and Pressure Vessel Code, Section XI.

(11) Performance of a channel functional test is required, excluding valve operation.

(12) Shiftly check is required when the reactor coolant system is not open to the atmosphere and the reactor coolant system temperature is less than the minimum temperature for the in-service pressure test as specified in TS Figure 15.3.1-1.

NOTES USED IN TABLE 15.4.1-1 (continued)

(13) An AFW flow path to each steam generator shall be demonstrated operable, following each cold shutdown of greater than 30 days, prior to entering power operation by verifying AFW flow to each steam generator.

(14) Calibration is to be a verification of response to a source.

(15) Sample gas for calibration at 2% and 6%.

(16) A check of one pressure channel per steam generator is required whenever the steam generator could be pressurized.

(17) Includes test of logic for reactor trip on low-low level, automatic actuation logic for auxiliary feedwater pumps, and test of logic for feedwater isolation on high steam generator level.

(18) Rod positions must be logged at least once per hour, after a load change >10% or after >30 inches of control rod motion if the on-line computer is inoperable.

(19) The daily heat balance is a gain adjustment performed to match Nuclear Instrumentation System indicated power level with reactor thermal output.

(20) To confirm that hot channel factor limits are being satisfied, the requirements of TS 15.3.10.B must be met.

TABLE 15.4.1-2

MINIMUM FREQUENCIES FOR EQUIPMENT AND SAMPLING TESTS

		Test	Frequency
1.	Reactor Coolant Samples	Gross Beta-gamma activity (excluding tritium)	5/week[7]
		Tritium activity	Monthly
		Radiochemical $\bar{E}$ Determination	Semiannually [2][10]
		Isotopic Analysis for Dose Equivalent I-131 Concentration	Every two weeks[1]
		Isotopic Analysis for Iodine including I-131, I-133, and I-135	a.) Once per 4 hours whenever the specific activity exceeds 1.0μCi/gram Dose Equivalent I-131 or 100/$\bar{E}$ μCi/gram.[6] b.) One sample between 2 and 6 hours following a thermal power change exceeding 15% of rated power in a one hour period.
		Chloride Concentration	5/week[8]
		Diss. Oxygen Conc.	5/week[6]
		Fluoride Conc.	Weekly
2.	Reactor Coolant Boron	Boron Concentration	Twice/week
3.	Refueling Water Storage Tank Water Sample	Boron Concentration	Weekly[6]
4.	Boric Acid Tanks	Boron Concentration	Twice/week
5.	Spray Additive Tank	NaOH Concentration	Monthly
6.	Accumulator	Boron Concentration	Monthly
7.	Spent Fuel Pit	a) Boron Concentration b) Water Level Verification	Monthly Weekly

TABLE 15.4.1-2 (Continued)

		Test	Frequency
8.	Secondary Coolant	Gross Beta-gamma Activity or gamma isotopic analysis	Weekly[6]
		Iodine concentration	Weekly when gross Beta-gamma activity equals or exceeds 1.2 μCi/cc [6]
9.	Control Rods	a) Rod drop times of all full length rods [3]	Each refueling or after maintenance that could affect proper functioning [4]
		b) Rodworth measurement	Following each refueling shutdown prior to commencing power operation
10.	Control Rod	Partial movement of all rods	Every 2 weeks [13c]
11.	Pressurizer Safety Valves	Set point	Every five years [11]
12.	Main steam Safety Valves	Set Point	Every five years [11]
13.	Containment Isolation Trip	Functioning	Each refueling shutdown
14.	Refueling System Interlocks	Functioning	Each refueling shutdown
15.	Service Water System	Functioning	Each refueling shutdown
16.	Primary System Leakage	Evaluate	Monthly [6]
17.	Diesel Fuel Supply	Fuel inventory	Daily
18.	Turbine Stop and Governor Valves	Functioning	Annually [6]
19.	Low Pressure Turbine Rotor Inspection [5]	Visual and magnetic particle or liquid penetrant	Every five years
20.	Boric Acid System	Storage Tank Temperature	Daily
21.	Boric Acid System	Visual observation of piping temperatures (all $\geq$ 145°F)	Daily
22.	Boric Acid Piping Heat Tracing	Electrical circuit operability	Monthly
23.	PORV Block Valves	Complete Valve Cycle	Quarterly [6]

TABLE 15.4-2 (Continued)

		Test	Frequency
24.	Integrity of Post Accident Recovery Systems Outside Containment	Evaluate	Each refueling cycle
25.	Containment Purge Supply and Exhaust Isolation Valves	Verify valves are locked closed	Monthly (9)
26.	Reactor Trip Breakers	a. Verify independent operability of automatic shunt and undervoltage trip functions.	Monthly (9)
		b. Verify independent operability of manual trip to shunt and undervoltage trip functions.	Each refueling shutdown
27.	Reactor Trip Bypass Breakers	a. Verify operability of the undervoltage trip function.	Prior to breaker use
		b. Verify operability of the shunt trip functions.	Each refueling shutdown
		c. Verify operability of the manual trip to undervoltage trip functions.	Each refueling shutdown
28.	Atmospheric Steam Dumps	Complete valve cycle	Quarterly
29.	Crossover Steam Dump System	Verify operability of each steam dump valve.	Quarterly
30.	Pressurizer Heaters	Verify that 100KW of heaters are available.	Quarterly
31.	CVCS Charging Pumps	Verify operability of pumps. (12)	Quarterly
32.	Potential Dilution in Progress Alarm	Verify operability of alarm.	Prior to placing plant in cold shutdown.

NOTES USED IN TABLE 15.4.1-2

(1) Required only during periods of power operation.
(2) E determination will be started when the gross activity analysis of a filtered sample indicates ≥10μCi/cc and will be redetermined if the primary coolant gross radioactivity of a filtered sample increases by more than 10μCi/cc.
(3) Drop test shall be conducted at rated reactor coolant flow. Rods shall be dropped under both cold and hot conditions, but cold drop tests need not be timed.
(4) Drop tests will be conducted in the hot condition for rods on which maintenance was performed.
(5) As accessible without disassembly of rotor.
(6) Not required during periods of refueling shutdown.
(7) At least once per week during periods of refueling shutdown.
(8) At least three times per week (with a maximum time of 72 hours between samples) during periods of refueling shutdown.
(9) Not required during periods of cold or refueling shutdown, but must be performed prior to exceeding 200°F if it has not been performed during the previous surveillance period.
(10) Sample to be taken after a minimum of 2 EFPD and 20 days power operation since the reactor was last subcritical for 48 hours or longer.
(11) An approximately equal number of valves shall be tested each refueling outage such that all valves will be tested within a five year period. If any valve fails its tests, an additional number of valves equal to the number originally tested shall be tested. If any of the additional tested valves fail, all remaining valves shall be tested.
(12) Operability of charging pumps is verified by ensuring that the pumps develop the required flowrate, as specified by the In-Service Test program.
(13) Not required to be performed if the reactor is subcritical.