l. Refueling Operation

Refueling operation is any operation involving movement of Reactor Vessel internal components (those that could affect the reactivity of the core) within the containment when the vessel head is unbolted or removed.

m. Rated Power

Rated power is the steady-state reactor system output of 1650 MWt.

n. Conformance to Limiting Conditions for Operation

Limiting conditions for Operation are conformed with whenever the conditions are verified to be in existence by the previous surveillance of the condition and until it is acknowledged that the required condition is not satisfied. Whenever an alternate method of conformance is provided within the specification, conformance to the specification is maintained upon the failure of the primary conformance method if the secondary conformance method is implemented at the acknowledgement of failure of the primary conformance method. 29b

3.5 INSTRUMENTATION SYSTEM

Applicability

Applies to reactor protection and engineered safety features instrumentation systems.

Objective

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 reactor protection instrumentation and engineered safety features circuits necessary to ensure reactor safety.

Specification

a. Setting limits for instrumentation which initiate operation of the engineered safety features shall be as stated in Table TS 3.5-1.

b. For on-line testing or in the event of failure of a sub-system instrumentation channel, plant operation shall be permitted to continue at rated power in accordance with Tables TS 3.5-2 through TS 3.5-5. | 29b

c. If for Tables TS 3.5-2 through TS 3.5-5 the number of channels of a particular sub-system in service falls below the limits given in Column Three, or if the values in Column Four cannot be achieved, operation shall be limited according to the requirement shown in Column 6, as soon as practicable. | 29b

d. In the event of sub-system instrumentation channel failure permitted by Specification 3.5.b, Tables TS 3.5-2 through TS 3.5-5 need not be observed during the short period of time (approximately 4 hours) the operable sub-system channels are tested, where the failed channel must be blocked to prevent unnecessary reactor trip. | 29b

6. The set points and associated ranges for the undervoltage relays have been established to always maintain motor voltages at or above 80% of their nameplate rating and to prevent prolonged operation of motors below 90% of their nameplate rating. All safeguard motors were designed to accelerate their loads to operating speed with 80% nameplate voltage, but not necessarily within their design temperature rise. Prolonged operation below 90% of nameplate voltage may result in shortening of motor insulation life, but short term operation below 90% of nameplate voltage will not result in unacceptable effects due to the service factor provided in the motors and the conservative insulation system used on the motors.

The primary safeguard buses undervoltage trip (87.5% of nominal bus voltage) is designed to protect against a loss of voltage to the safeguard bus and assures that safeguard protection action will proceed as assumed in the FSAR. The associated time delay feature prevents inadvertent actuation of the undervoltage relays from voltage dips, while assuring that the diesel generators will reach full capacity before the safety injection pump loads are sequenced on. 29b

The safeguard buses second level undervoltage trip (95% of nominal bus voltage) is designed to protect against prolonged operation below 90% of nameplate voltage of safeguard pumps. The time delay of less than 30 minutes allows the operator time to restore voltage by minimizing or balancing loads on the safeguard buses while maintaining the preferred source of power. Up to 30 minutes of operation of safeguard pumps between 80% and 90% of nameplate voltage is acceptable due to the service factor and conservative insulation designed into the motors.

Each relay in the undervoltage protection channels will fail safe and is alarmed to alert the operator to the failure. 29b

Instrument Operating Conditions

During plant operations, the complete protective instrumentation systems will normally be in service. Reactor safety is provided by the Reactor Protection Systems, which automatically initiates appropriate action to prevent exceeding established limits. Safety is not compromised, however, by continuing operation with certain instrumentation channels out of service since provisions were made for this in the plant design. This specification outlines limiting conditions for operation necessary to preserve the effectiveness of the Reactor Control and Protection System when any one or more of the channels is out of service.

Almost all reactor protection channels are supplied with sufficient redundancy to provide the capability for channel calibration and test at power. Exceptions are backup channels such as reactor coolant pump breakers. The removal of one trip channel on process control equipment is accomplished by placing that channel bistable is a tripped mode; e.g., a two-out-of-three circuit becomes a one-out-of-two circuit. The source and intermediate range nuclear instrumentation system channels are not intentionally placed in a tripped mode since these are one-out-of-two trips, and the trips are therefore bypassed during testing. Testing does not trip the system unless a trip condition exists in another channel.

References:

(1) FSAR Section 7.5
(2) FSAR Section 14.3
(3) FSAR Section 14.2.5

TABLE TS 3.5-1

(Page 1 of 2)

ENGINEERED SAFETY FEATURES INITIATION INSTRUMENT SETTING LIMITS

NO.	FUNCTIONAL UNIT	CHANNEL	SETTING LIMIT
1	High Containment Pressure (Hi)	Safety Injection (1)	$\leq$ 4 psig
2	High Containment Pressure (Hi-Hi)	a. Containment Spray	$\leq$ 23 psig
		b. Steam Line Isolation of Both Lines	$\leq$ 17 psig
3	Pressurizer Low Pressure	Safety Injection (1)	$\geq$ 1815 psig
4	Low Steam Line Pressure	Safety Injection (1)	$\geq$ 500 psig
		Lead Time Constant	$\geq$ 12 seconds
		Lag Time Constant	$\leq$ 2 second
5	High Steam Flow in a Steam Line Coincident with Safety Injection and Low T_{avg}	Steam Line Isolation of Affected Line (2)	d/p corresponding to 0.745 x 10^6 lb/hr at 1005 psig
			$\geq$ 540°F
6	High-High Steam Flow in a Steam Line Coincident with Safety Injection	Steam Line Isolation of Affected Line (2)	$\leq$ d/p corresponding to 4.5 x 10^6 lb/hr at 735 psig
7	Forebay Level	Trip circ. water pumps	
8	Safeguards Bus Undervoltage (3)	Loss of Power	87.5% $\pm$ 2% of Nominal Bus Voltage
			$\leq$ 2 1/2 seconds Time Delay

TABLE TS 3.5-1 (1 of 2)

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ENGINEERED SAFETY FEATURES INITIATION INSTRUMENT SETTING LIMITS

NO.	FUNCTIONAL UNIT	CHANNEL	SETTING LIMIT
9	Safeguards Bus Second Level[4] Undervoltage	Degraded Grid Voltage	95% ±2% of Nominal Bus Voltage ≤ 30 minutes time delay

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(1) Initiates containment isolation, feedwater line isolation, shield building ventilation, auxiliary building special vent, and starting of all containment fans. In addition, the signal overrides any bypass on the accumulator valves.

(2) Confirm main steam isolation valves closure within 5 seconds when tested. d/p = differential pressure

(3) This undervoltage protection channel ensures ESF equipment will perform as assumed in the FSAR.

(4) This undervoltage protection channel protects ESF equipment from long term low voltage operation.

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TABLE TS 3.5-5

INSTRUMENT OPERATION CONDITIONS FOR SAFEGUARDS BUS POWER SUPPLY FUNCTIONS

NO.	FUNCTIONAL UNIT	1 NO. OF CHANNELS	2 NO. OF CHANNELS TO TRIP	3 MINIMUM OPERABLE CHANNELS	4 MINIMUM DEGREE OF REDUNDANCY	5 PERMISSIBLE BYPASS CONDITIONS	OPERATOR ACTION IF CONDITIONS OF COLUMN 3 OR 4 CANNOT BE MET
1	Safeguards Bus Undervoltage	2/Bus(1)	1/Bus	1/Bus(2)	--		Maintain hot shutdown or operate the diesel generator
2	Safeguards Bus Second Level Undervoltage	1/Bus(3)	1/Bus	--	--		When one of the two 6 second time delay relays is out of service, place that relay in the tripped condition.

(1) Each channel consists of one instantaneous and one time delayed relay connected in series.

(2) When one component of a channel is taken out of service, that component shall be in the TRIPPED condition.

(3) Each channel has 2 time delay relays in parallel which are in series with a third time delay relay.

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4.6 PERIODIC TESTING OF EMERGENCY POWER SYSTEM

Applicability

Applies to periodic testing and surveillance requirements of the emergency power system.

Objective

To verify that the emergency power sources and equipment are operable.

Specification

The following tests and surveillance shall be performed:

a. Diesel Generators

1. Manually-initiated start of each diesel generator, and assumption of load by the diesel generator. This test shall be conducted monthly in accordance with the intent of Paragraph 6.4.1 and 6.4.3 of IEEE 387-1977.

2. Automatic start of each diesel generator, load shedding, and restoration to operation of particular vital equipment, all initiated by a simulated loss of all normal a-c station service power supplies together with a simulated safety injection signal. This test will be conducted at each refueling interval to assure that each diesel generator will start and assume required loads to the extent possible within one minute, and operate for $\geq$ 5 minutes while loaded with the emergency loads. | 29b

3. Each diesel generator shall be inspected at each major refueling outage.

4. Diesel generator load rejection test in accordance with IEEE 387-1977, section 6.4.5 shall be performed at least once per 18 months.

5. Safeguard Bus Undervoltage and Safeguard Bus Second Level Undervoltage relays shall be calibrated at least once per refueling cycle (not to exceed 18 months). 29b

6. During each refueling, a checkout of emergency lighting will be performed. 29b

b. Station Batteries

1. The voltage of each cell shall be measured to the nearest hundredth volt each month. An equalizing charge shall be applied if the lowest cell in the battery falls below 2.13 volts. The temperature and specific gravity of a pilot cell in each battery shall be measured.

2. The following additional measurements shall be made every three months: the specific gravity and height of electrolyte in every cell and the temperature of every fifth cell.

3. All measurements shall be recorded and compared with previous data to detect signs of deterioration.

4. The batteries shall be subjected to a load test during the first refueling and once every five years thereafter. Battery voltage shall be monitored as a function of time to establish that the battery performs as expected during heavy discharge and that all electrical connections are tight.

Basis

The monthly tests specified for the diesel generators will demonstrate their continued capability to start and carry rated load. The fuel supplies and starting circuits and controls are continuously monitored, and abnormal conditions in these systems would be indicated by an alarm without need for test startup.

The less frequent overall system test will demonstrate that the emergency power system and the control system for the engineered safety features equipment will function automatically in the event of loss of all other sources of a-c power, and that the diesel generators will start automatically in the event of a loss-of-coolant accident. This test will demonstrate proper tripping of motor feeder breakers, main supply and tie breakers on the affected bus, and sequential starting of essential equipment, to the extent possible, as well as the operability of the diesel generators. A separate test will demonstrate that the emergency lighting system functions properly. 29b

The specified test frequencies provide reasonable assurance that any mechanical or electrical deficiency will be detected and corrected before it can result in failure of one emergency power supply to respond when called upon to function. Its possible failure to respond is, of course, anticipated by providing two diesel generators, each supplying through an independent bus, a complete and adequate set of engineered safety features equipment. Further, both diesel generators are provided as backup to multiple sources of external power, and this multiplicity of sources should be considered with regard to adequacy of test frequency.

Each diesel generator can start and be ready to accept full load within 10 seconds, and will sequentially start and supply the power requirements for one complete set of engineered safety features equipment in approximately one minute. (1)

Reference:

(1) FSAR Section 8.2

Station batteries will deteriorate with time, but precipitous failure is extremely unlikely. The surveillance specified is that which has been demonstrated over the years to provide indication of a cell becoming unserviceable long before it fails.

If a battery cell has deteriorated, or if a connection is loose, the voltage under load will drop excessively, indicating need for replacement or maintenance.