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TABLE 4.3.2.1-1

ISOLATION ACTUATION INSTRUMENTATION SURVEILLANCE REQUIREMENTS

TRIP FUNCTION	CHANNEL CHECK	CHANNEL FUNCTIONAL TEST	CHANNEL CALIBRATION	OPERATIONAL CONDITIONS IN WHICH SURVEILLANCE REQUIRED
1. PRIMARY CONTAINMENT ISOLATION				
a. Reactor Vessel Water Level - Low, Level 2	S	M	R(b)	1, 2, 3 and #
b. Drywell Pressure - High	S	M	R(b)	1, 2, 3
c. Containment and Drywell Purge Exhaust Plenum Radiation - High	S	M	R	1, 2, 3 and *
d. Reactor Vessel Water Level - Low, Level 1	S	M	R(b)	1, 2, 3 and #
e. Manual Initiation	NA	R	NA	1, 2, 3 and *
2. MAIN STEAM LINE ISOLATION				
a. Reactor Vessel Water Level - Low, Level 1	S	M	R(b)	1, 2, 3
b. Main Steam Line Radiation - High	S	[illegible]	R	1, 2
c. Main Steam Line Pressure - Low	S	M	R(b)	1
d. Main Steam Line Flow - High	S	M	R(b)	1, 2, 3
e. Condenser Vacuum - Low	S	M	R(b)	1, 2**, 3**
~~f. Main Steam Line Tunnel Temperature - High~~	~~S~~	~~M~~	~~R~~	~~1, 2, 3~~
~~g. Main Steam Line Tunnel Δ Temperature - High~~	~~S~~	~~M~~	~~R~~	~~1, 2, 3~~
h. Turbine Building Main Steam Line Temperature - High	S	M	R	1, 2, 3
i. Manual Initiation	NA	R	NA	1, 2, 3

Replace with Insert

TRIP FUNCTION	CHANNEL CHECK	CHANNEL FUNCTIONAL TEST	CHANNEL CALIBRATION	OPERATIONAL CONDITIONS IN WHICH SURVEILLANCE REQUIRED
f. Main Steam Line Tunnel Temperature - High				
1. Division 1 and 2	S	~~M~~ SA	R	1, 2, 3
2. Division 3 and 4	S	M	R	1, 2, 3
g. Main Steam Line Tunnel Δ Temperature - High				
1. Division 1 and 2	S	~~M~~ SA	R	1, 2, 3
2. Division 3 and 4	S	M	R	1, 2, 3

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TABLE 4.3.2.1-1 (Continued)

ISOLATION ACTUATION INSTRUMENTATION SURVEILLANCE REQUIREMENTS

TRIP FUNCTION	CHANNEL CHECK	CHANNEL FUNCTIONAL TEST	CHANNEL CALIBRATION	OPERATIONAL CONDITIONS IN WHICH SURVEILLANCE REQUIRED
3. SECONDARY CONTAINMENT ISOLATION				
a. Reactor Vessel Water Level - Low, Level 2	S	M	R(b)	1, 2, 3 and #
b. Drywell Pressure - High	S	M	R(b)	1, 2, 3
c. Manual Initiation	NA	R	NA	1, 2, 3 and *
4. REACTOR WATER CLEANUP SYSTEM ISOLATION				
a. Δ Flow - High	S	M	R	1, 2, 3
b. Δ Flow Timer	NA	M	R	1, 2, 3
c. Equipment Area Temperature - High	S	~~M~~ SA	R	1, 2, 3
d. Equipment Area Ventilation Δ Temperature - High	S	~~M~~ SA	R	1, 2, 3
e. Reactor Vessel Water Level - Low, Level 2	S	M	R(b)	1, 2, 3
f. Main Steam Line Tunnel Ambient Temperature - High	S	~~M~~ SA	R	1, 2, 3
g. Main Steam Line Tunnel Δ Temperature - High	S	~~M~~ SA	R	1, 2, 3
h. SLCS Initiation	NA	M(a)	NA	1, 2, 3
i. Manual Initiation	NA	R	NA	1, 2, 3

TABLE 4.3.2.1-1 (Continued)

ISOLATION ACTUATION INSTRUMENTATION SURVEILLANCE REQUIREMENTS

TRIP FUNCTION	CHANNEL CHECK	CHANNEL FUNCTIONAL TEST	CHANNEL CALIBRATION	OPERATIONAL CONDITIONS IN WHICH SURVEILLANCE REQUIRED
5. REACTOR CORE ISOLATION COOLING SYSTEM ISOLATION				
a. RCIC Steam Line Flow - High	S	M	R(b)	1, 2, 3
b. RCIC Steam Supply Pressure - Low	S	M	R(b)	1, 2, 3
c. RCIC Turbine Exhaust Diaphragm Pressure - High	S	M	R(b)	1, 2, 3
d. RCIC Equipment Room Ambient Temperature - High	S	~~M~~ SA	R	1, 2, 3
e. RCIC Equipment Room Δ Temperature - High	S	~~M~~ SA	R	1, 2, 3
f. Main Steam Line Tunnel Ambient Temperature - High	S	~~M~~ SA	R	1, 2, 3
g. Main Steam Line Tunnel Δ Temperature - High	S	~~M~~ SA	R	1, 2, 3
h. Main Steam Line Tunnel Temperature Timer	NA	~~M~~ SA	R	1, 2, 3
i. RHR Equipment Room Ambient Temperature - High	S	~~M~~ SA	R	1, 2, 3
j. RHR Equipment Room Δ Temperature - High	S	~~M~~ SA	R	1, 2, 3
k. RCIC Steam Line Flow High Timer	NA	M	R	1, 2, 3
l. Drywell Pressure - High	S	M	R(b)	1, 2, 3
m. Manual Initiation	NA	R	NA	1, 2, 3

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TABLE 4.3.2.1-1 (Continued)

ISOLATION ACTUATION INSTRUMENTATION SURVEILLANCE REQUIREMENTS

TRIP FUNCTION	CHANNEL CHECK	CHANNEL FUNCTIONAL TEST	CHANNEL CALIBRATION	OPERATIONAL CONDITIONS IN WHICH SURVEILLANCE REQUIRED
6. RHR SYSTEM ISOLATION				
a. RHR Equipment Area Ambient Temperature - High	S	~~M~~ SA	R	1, 2, 3
b. RHR Equipment Area Δ Temperature - High	S	~~M~~ SA	R	1, 2, 3
c. RHR/RCIC Steam Line Flow - High	S	M	R(b)	1, 2, 3
d. Reactor Vessel Water Level - Low, Level 3	S	M	R(b)	1, 2, 3
e. Reactor Vessel (RHR Cut-in Permissive) Pressure - High	S	M	R(b)	1, 2, 3
f. Drywell Pressure - High	S	M	R(b)	1, 2, 3
g. Manual Initiation	NA	R	NA	1, 2, 3

*When handling irradiated fuel in the primary containment and during CORE ALTERATIONS and operations with a potential for draining the reactor vessel.

**When any turbine stop valve is greater than 90% open and/or the key locked bypass switch is in the normal position.

#During CORE ALTERATION and operations with a potential for draining the reactor vessel.

(a) Each train or logic channel shall be tested at least every other 31 days.

(b) Calibrate trip unit setpoint at least once per 31 days.

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SIGNIFICANT HAZARDS CONSIDERATION

The standards used to arrive at a determination that a request for amendment involves no significant hazards considerations are included in the Commission's Regulations, 10 CFR 50.92, which state that the operation of the facility in accordance with the proposed amendment would not (1) involve a significant increase in the probability or consequences of an accident previously evaluated, (2) create the possibility of a new or different kind of accident from any previously evaluated, or (3) involve a significant reduction in a margin of safety. A brief description of the proposed changes and the reasons for upgrading to the NUMAC Leak Detection Monitor design is presented below.

The Riley leak detection temperature modules within the Leak Detection System (LDS) are being replaced because they have been a source of spurious trip signals which have caused system isolations at the plant. These problems have also been identified in Information Notice 86-69 and General Electric Service Information Letter (SIL) Number 416. Two NUMAC digital Leak Detection Monitors (LDMs) will replace the vast majority of the Riley temperature modules to provide divisional monitoring and, when necessary, isolation signals to close either the inboard or outboard containment isolation valves for a specific system, when high ambient or differential temperature is sensed. This license amendment includes both divisions of the two division LDS instrumentation for the Reactor Core Isolation Cooling (RCIC), Residual Heat Removal (RHR) and Reactor Water Cleanup (RWCU) Systems. It also includes the Division 1 and 2 logic (two of the four divisions) for the Main Steam Line Tunnel areas. The Riley Temperature Modules used to monitor the Main Steam Line Tunnel (Division 3 and 4) and the Main Steam Lines in the Turbine Building Area (Divisions 1 through 4) are located in other panels and not being replaced. No changes are being made in the systems/areas being monitored or the corresponding instrumentation setpoints.

The proposed amendment has been reviewed with respect to the three factors discussed in 10 CFR 50.92 and it has been determined that the proposed changes do not involve a significant hazard because:

1. The proposed changes do not involve a significant increase in the probability or consequences of an accident previously evaluated.

   The Technical Specifications are proposed to be revised to perform a CHANNEL FUNCTIONAL TEST on a semiannual frequency versus the current monthly frequency for both ambient and differential temperature and for the MSL tunnel temperature timer functions, for the above listed piping lines. Additionally, this evaluation addresses the potential for, and implications of, common mode failures due to software, hardware and/or electromagnetic and radio-frequency interference (EMI/RFI).

   The NUMAC instrumentation has certain design features which contribute to its reliability. The replacement NUMAC LDMs are digital instruments that use a microcomputer to monitor the ambient and differential temperatures (also the MSL tunnel temperature timer) and provide outputs and automatic self-testing and calibration. A description of the major design features include: a) isolation of the essential microcomputer by a serial data

link from the front panel display (and display microcomputer), b) a self-test system feature that provides automatic testing of internal circuits and reports failures, c) thermocouple failure detection, d) provisions to test the output relays without the use of jumpers (reducing the threat of spurious isolations), and e) two independent built-in instrument power supplies (that automatically switchover to the other supply in the event of failure). Also, several features that reduce the likelihood of common mode software/hardware failures have been included, among these, a) a hardware "watchdog" timer to monitor against software cycling in continuous loops, and b) software structured with the safety-related essential tasks running at the highest priority in the system. These capabilities increase the reliability of the collected data, reduce the possibility of inadvertent isolations and plant shutdowns, reduce the need for frequent ca[illegible]cations, and reduce the likelihood of common mode failures.

The NUMAC Leak Detection Monitors will maintain the same environmental and electrical and physical independence criteria (qualifications) as the existing Leak Detection System components. The LDMs, the associated thermocouple input units (TCIUs), and relay output units (ROUs) will be mounted seismically such that qualification of these components and the Control Room panels will be maintained. The LDMs are qualified for the PNPP Control Room environment. The LDMs (one per division) will be physically and electrically independent of each other and do not share power supplies, thermocouple inputs, output relays, microcomputer logic units, display units or enclosures and mounting locations. A postulated gross failure of any one NUMAC LDM, such as gross malfunction of the input unit, microcomputer logic unit or the relay output unit, will not propagate to the other NUMAC LDM. Thus, a failure within one NUMAC LDM will not prevent or disable the function of the other NUMAC LDM. A failure within one NUMAC LDM may cause the loss of one division of the isolation trip logic. However, since the other redundant division (the MSLs have three other divisions) will not be affected by this failure, the Leak Detection System will still be able to perform its designed safety-related function and provide the necessary system isolations. This is the same as the current Leak Detection System design basis.

The possibility of a common mode failure of both NUMAC LDM divisions is minimized by the design of the NUMAC hardware and software, the verification and validation (V&V) of the software to reduce the likelihood of errors, the testing of the software (to discover and eliminate errors), and the design of and testing of the hardware to demonstrate its resistance to EMI/RFI. The NUMAC instrument design features, by effectively eliminating the potential for common mode failures, maintain the Leak Detection System within its current licensing basis. (A discussion of common mode failure protection is presented in more detail in the answer to question two.) Therefore, the design, isolation and separation criteria remain the same.

Additionally, as described within Chapter 7 of the Updated Safety Analysis Report (USAR), diversity is provided to the ambient and differential temperature monitoring trip functions for the various systems by

alternative leak detection methods (such as measuring steam line flow or pressure) that provide backup in the event of the loss of both divisions of the NUMAC Leak Detection Monitors. These alternative leak detection methods are physically separate from those being performed by the NUMAC LDM and constitute a diverse, redundant, safety related backup capable of responding to a design basis line break for the various systems. Therefore, a common mode failure of both LDM divisions would not prevent any of the necessary system isolations from occurring.

No changes are being made to the isolation logic of the Leak Detection System. No accident initiators or precursors are affected by the proposed changes to the CHANNEL FUNCTIONAL TEST surveillance intervals for the various trip functions. One purpose of a CHANNEL FUNCTIONAL TEST is to check the instrument setpoints. The NUMAC instrument setpoints are set digitally and do not drift. An engineering evaluation has established that the CHANNEL FUNCTIONAL TEST surveillance interval can be extended from one to six months. The potential for common mode failures has been accounted for in the design and measures have been taken to lower the probability of this to an acceptable level (see the answer to question two). Also, alternative leak detection methods exist for this eventuality. Since the NUMAC Leak Detection Monitoring equipment meets or exceeds the design and licensing criteria specified for the Leak Detection System, the proposed upgrade cannot increase the probability of occurrence of any accident previously evaluated.

A portion of the Leak Detection System logic causes a closure of the Main Steam Isolation Valves on a steam leak signal. This transient, described in Chapter 15 of the USAR, may also occur due to a LDS equipment malfunction. Since this modification replaces some of the existing Riley temperature monitoring instrumentation with more reliable instrumentation the probability of this transient is reduced (no radiological consequences are associated with this event). The LDS is also used to mitigate the consequences of a pipe break outside primary containment by isolating the affected system connected to the Reactor Coolant Pressure Boundary (RCPB). The replacement of the Riley instrumentation with NUMAC LDMs will not change, degrade, or prevent the Leak Detection System response to mitigate the radiological consequences of an accident. Therefore, replacement of the Riley temperature modules with NUMAC Leak Detection Monitors will not significantly increase the consequences of any accident previously evaluated.

2. The proposed changes do not create the possibility of a new or different kind of accident from any accident previously evaluated.

   The single failure criterion requires that any single failure within a safety-related system not prevent proper protective action of the overall system when the system is required to function. The Leak Detection System design is such that a failure of one division will not prevent the system from performing its safety function. Common mode failure protection provisions have been addressed in the NUMAC LDM design.

The comprehensive General Electric software V&V and configuration management control programs minimize, although they cannot entirely eliminate, the likelihood of a common mode NUMAC instrument failure due to software problems. The hardware (firmware) and software for the PNPP NUMAC Leak Detection Monitors will undergo a formal software verification and validation (V&V) process by General Electric, that is to be completed by the end of the year, equivalent to the one reviewed and approved by the NRC for the safety-related Wide Range Neutron Monitor.

The NUMAC instruments are designed to minimize both their susceptibility to, and generation of, electromagnetic and radio-frequency interference (EMI/RFI) to prevent spurious operations and allow their use in safety-related systems. As part of a broader plan by GE to improve the testing base for the NUMAC instrumentation product line, additional testing has been performed by GE on the Leak Detection Monitor configuration in order to both expand the overall qualification region, and to obtain test data specific to this application. This testing ensures the qualification of the Thermocouple Input Unit (TCIU), a NUMAC circuit board which is unique to the LDM application, and also extends the NUMAC EMI/RFI qualification region to include both higher and lower frequencies than previously tested.

The NUMAC instrument design concept has undergone review by the NRC, and the initial instruments of the NUMAC product line (the Logarithmic Radiation Monitor and Wide Range Neutron Monitoring System) have received NRC approval via Safety Evaluations of the associated GE Licensing Topical Reports. The various types of NUMAC equipment in operation at other nuclear power plants have components and software modules which are similar to and in some instances identical to the NUMAC LDMs. Therefore, based on the NRC reviewed and approved NUMAC software and hardware control programs instituted by GE, the design features to minimize software/hardware (or their interface) problems, design features to minimize susceptibility to EMI/RFI, and testing to demonstrate resistance to EMI/RFI, installation of NUMAC Leak Detection Monitors at the PNPP does not create the possibility of a new or different kind of accident from any previously evaluated.

3. The proposed changes do not involve a significant reduction in a margin of safety.

The replacement of the analog Riley temperature modules with the microcomputer based NUMAC Leak Detection Monitors will not affect any design conditions or impact the margins of safety for the various Leak Detection System monitored parameters in the Technical Specifications. The instrument setpoints specified in Technical Specification Table 3.3.2-2 will not be changed or affected by this modification. Only the CHANNEL FUNCTIONAL test interval is being extended.

The NUMAC Leak Detection Monitor design, with the attention paid towards minimizing the potential for, and the effect of, software/hardware and/or EMI/RFI related problems or common mode failures and resulting operational experience has demonstrated that replacement of the existing Riley temperature modules with NUMAC Leak Detection Monitors would not result in a significant reduction in the margin of safety.

Leak Detection Monitor (LDM)
Results of EMI Testing

A Leak Detection Monitor (LDM) instrumentation system underwent testing to demonstrate its immunity to electromagnetic interference (EMI). The system consisted of an LDM, a Thermocouple Input Unit, a Relay Output Unit, and a RWCU Unit interconnected and mounted in a small (5 foot high) cabinet. In addition, a 5 ampere power line fuse was installed in the cabinet. Testing was performed between June 11 and August 18, 1993.

Signal wiring to and from the interface units was accomplished with shielded wires and thermocouples using standard wiring installation practices. A fiber optic output to a separate display was added to the LDM so that the LDM's screen could be monitored remotely (necessary during radio frequency testing).

Thermocouple input signals to the LDM were simulated using battery operated potentiometers. RWCU input flow signals were developed using the LDM's internal +/- 15 volt supplies (as would be the case in the field) and external resistors. Relay output contacts were connected to 120 Vac (as would also be the case in the field) and were monitored using lamps.

The following were the results of the EMI testing performed on the Leak Detection Monitor:

1. <u>IEC 801-2: Electrostatic Discharge</u>

   The LDM was tested for immunity to high voltage (up to 20 kV) electrostatic discharges. The test simulates what would happen when a person who has accumulated electrostatic charges (e.g., by walking on a carpet) touches the LDM instrument by hand or via a hand tool (e.g., a screwdriver). In the test, a probe is capacitively charged to a specified voltage and then allowed to discharge by direct contact or via an air gap to selected portions of the LDM chassis.

   The LDM was tested while it was inserted in a cabinet (operating position) and while it was withdrawn from the cabinet on its slides (maintenance position). Discharges were made at various points on the LDM's front panel, top cover, sides, rear connector bracket, and shells of connectors mounted on the bracket.

There are four severity levels associated with this test:

Level 1	Contact = 2 kV	Air Gap = 2 kV
Level 2	Contact = 4 kV	Air Gap = 4 kV
Level 3	Contact = 6 kV	Air Gap = 8 kV
Level 4	Contact = 8 kV	Air Gap = 15 kV

The LDM operated correctly and without failure at all four levels. In addition, the LDM operated correctly and without failure for an air gap discharge of 20 kV. The added test was performed because of concerns that voltages in excess of 15 kV might exist in some control room situations.

2. IEC 801-4: Electrical Fast Transients/Bursts

The LDM was tested for immunity to repetitive bursts of high frequency voltage transients on its power and signal lines. Pulse rise times were 5 nS and widths 50 nS. Pulse bursts were 50 mS long and there was a burst every 300 mS. Each sequence of bursts lasted one minute. Pulses were injected asynchronously at the cabinet power input connector and via capacitive coupling clamps at the signal cables (note, however, that the signal cables were shielded). Both positive and negative pulse sequences were used.

There are four severity levels associated with this test:

Level 1	Power Supply Pulses = 0.5 kV Signal Pulses = 0.25 kV
Level 2	Power Supply Pulses = 1 kV Signal Pulses = 0.5 kV
Level 3	Power Supply Pulses = 2 kV Signal Pulses = 1 kV
Level 4	Power Supply Pulses = 4 kV Signal Pulses = 2 kV

The LDM operated correctly and without failure at all four levels.

3. IEC 801-5: Surge Immunity

The LDM was tested for immunity to surge pulses such as those that might arise from lightning or power switching transients.

Surge pulses were applied to the connector of the three-wire power cord coming into the cabinet (before the cabinet fuse). Pulses had a risetime of 8 uS open circuit (1.2 uS short circuit), had a width of 50 uS open circuit (20 uS short circuit), and were applied at a maximum repetition rate of 1 Pulse per Minute between each combination of two wires. Pulses were applied at 0, 90, 180 and 270 degree phase shifts with respect to line voltage. Both positive and negative pulse sequences were used.

There are four severity levels associated with this test:

Level 1	Power Supply Pulses = 0.5 kV
Level 2	Power Supply Pulses = 1 kV
Level 3	Power Supply Pulses = 2 kV
Level 4	Power Supply Pulses = 4 kV

The LDM operated correctly and without failure at Levels 1 and 2. At Level 3 (2000 Volts), when the third of 5 negative pulses at a phase shift of 180 degrees was applied between line and ground, one of the LDM's low voltage power supplies was damaged and the cabinet fuse (5 ampere) blew. The reason for this failure was the inability of the line protection device, a metal oxide varistor (MOV) between line and neutral at the LDM's line input, to absorb all the energy contained in the surge pulses. Consequently, two additional MOVs were added, one between line and ground, the other between neutral and ground. Testing at Levels 3 and 4 was then performed without failure. Therefore, the LDM is qualified to Level 2 of IEC 801-5 "as is", and to Level 4 when the two additional MOVs are added. The PNPP LDM configuration includes the two additional metal oxide varistors.

4. Mil-Std-462D/CS101: Conducted Susceptibility, Power Leads, 30 Hz to 50 kHz

The LDM was tested to demonstrate its immunity to low frequency signals coupled onto its input power leads. Sine waves from 30 Hz to 50 kHz were injected onto the "high" side of the cabinet's input power leads via a coupling transformer. The applied signal varied from 136 dBuV at 30 Hz to 116 dBuV at 50 kHz. The signal was not modulated between 30 Hz and 10 kHz and was 80% modulated with a 1 kHz sine wave between 10 kHz and 50 kHz.

The equipment under test operated within specification at all times.

5. Mil-Std-462D/RS103: Electric Field, 10 kHz to 18 GHz

Preliminary testing indicated that the LDM system was susceptible to certain frequencies above 30 MHz. The principal cause of this susceptibility was traced to the reference temperature sensing elements (which are active semiconductor devices) located in the Thermocouple Input and RWCU Units. RF energy was being picked up by the two wires that connect to each element. This RF would cause the reference elements to oscillate and send erroneous signals to the LDM. This, in turn, affected the ambient temperature readings associated with the reference elements. It should be noted that differential temperature measurements (which do not require temperature reference elements) were not affected by the above mentioned phenomenon.

A design change was made which placed a small RC filter at each of the temperature reference elements (six in the Thermocouple Input Unit, one in the RWCU Unit). With this change, the LDM instrument and interface units operated within specification under the following conditions (radiation applied via antenna placed in front of the test cabinet):

Frequency Band	Field Strength
10 kHz to 30 MHz	50 Volts/Meter
30 MHz to 1 GHz	1 Volt/Meter
1 GHz to 18 GHz	50 Volts/Meter

6. Mil-Std-462D/RS101: Magnetic Field, 30 Hz to 100 kHz

The LDM was tested to demonstrate its immunity to low frequency magnetic fields. A 12 cm radiating loop was placed 5 cm away from various portions of the equipment under test. At each loop placement, a frequency sweep from 30 Hz at 180 pT (178 dBuA/M) to 100 kHz at 116 pT (118 dBuA/M) was made.

The equipment under test operated within specification at all times.