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3.3 INSTRUMENTATION

3.3.11 Automatic Feedwater Isolation System (AFIS) Instrumentation

LCO 3.3.11 Four AFIS analog instrumentation channels per steam generator (SG) shall be OPERABLE.

-----NOTE-----
Not applicable on each Unit until after completion of the Automatic Feedwater Isolation System modification on the respective Unit.

APPLICABILITY: MODES 1 and 2,
MODE 3 with main steam header pressure \geq 700 psig.

ACTIONS

-----NOTE-----
Separate Condition entry is allowed for each SG.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One analog channel inoperable or tripped.	A.1 Place channel in bypass.	4 hours
B. Two analog channels inoperable. <u>OR</u> Required Action and associated Completion Time of Condition A not met.	B.1 Restore channel(s) to operable status.	72 hours

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
C. Required Action and associated Completion Time of Condition B not met.	C.1 Be in MODE 3.	12 hours
	<u>AND</u> C.2 Reduce main steam header pressure to <700 psig.	18 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY
SR 3.3.11.1 Perform CHANNEL CHECK.	12 hours
SR 3.3.11.2 Perform CHANNEL FUNCTIONAL TEST.	31 days
SR 3.3.11.3 Perform CHANNEL CALIBRATION.	18 months

3.3 INSTRUMENTATION

3.3.12 Automatic Feedwater Isolation System (AFIS) Manual Initiation

LCO 3.3.12 Two AFIS Manual Initiation switches per steam generator (SG) shall be OPERABLE.

-----NOTE-----
Not applicable on each Unit until after completion of the Automatic Feedwater Isolation System modification on the respective Unit.

APPLICABILITY: MODES 1 and 2,
MODE 3 with main steam header pressure \geq 700 psig.

ACTIONS

-----NOTE-----
Separate Condition entry is allowed for each SG.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One manual initiation switch per SG inoperable.	A.1 Restore manual initiation switch to OPERABLE status.	72 hours
B Two manual initiation switches per SG inoperable. <u>OR</u> Required Action and associated Completion Time of Condition A not met.	B.1 Be in MODE 3. <u>AND</u> B.2 Reduce main steam header pressure to < 700 psig.	12 hours 18 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY
SR 3.3.12.1 Perform CHANNEL FUNCTIONAL TEST.	18 months

3.3 INSTRUMENTATION

3.3.13 Automatic Feedwater Isolation System (AFIS) Digital Channels |

LCO 3.3.13 Two AFIS digital channels per steam generator (SG) shall be OPERABLE. |

-----NOTE-----
Not applicable on each Unit until after completion of the Automatic Feedwater Isolation System modification on the respective Unit.

APPLICABILITY: MODES 1 and 2,
MODE 3 with main steam header pressure \geq 700 psig. |

ACTIONS

-----NOTE-----
Separate Condition entry is allowed for each SG.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One digital channel inoperable.	A.1 Restore digital channel to OPERABLE status.	72 hours

(continued) |

Actions (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
<p>B. Two digital channels inoperable.</p> <p><u>OR</u></p> <p>Required Action and associated Completion Time of Condition A not met.</p>	<p>B.1 Be in MODE 3.</p> <p><u>AND</u></p> <p>B.2 Reduce main steam header pressure to < 700 psig.</p>	<p>12 hours</p> <p>18 hours</p>

SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY
<p>SR 3.3.13.1 Perform CHANNEL FUNCTIONAL TEST.</p>	<p>18 months</p>

Not Used |
3.3.24 |

3.3 INSTRUMENTATION |

3.3.24 Not Used |

3.3 INSTRUMENTATION

3.3.25 Main Steam Line Break (MSLB) Detection and Feedwater Isolation Instrumentation

LCO 3.3.25 Three MSLB Detection and Feedwater Isolation instrumentation channels per steam generator (SG) shall be OPERABLE.

-----NOTE-----
Applicable on each Unit until after completion of the Automatic Feedwater Isolation System modification on the respective Unit.

APPLICABILITY: MODES 1 and 2,
MODE 3 with main steam header pressure \geq 700 psig except when all main feedwater control valves (MFCVs) and startup feedwater control valves (SFCVs) are closed.

ACTIONS

-----NOTE-----
Separate Condition entry is allowed for each SG (Feedwater Isolation Function).

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One or more Feedwater Isolation Functions with one channel inoperable.	A.1 Place channel(s) in trip.	4 hours
B. One or more Feedwater Isolation Functions with two or more channels inoperable. <u>OR</u> Required Action and associated Completion Time not met.	B.1 Be in MODE 3.	12 hours
	<u>AND</u> B.2.1 Reduce main steam header pressure to < 700 psig.	18 hours
	<u>OR</u> B.2.2 Close all MFCVs and SFCVs.	18 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.3.25.1	Perform CHANNEL CHECK.	12 hours
SR 3.3.25.2	<p>-----NOTE----- Only applicable when modifications are implemented that allow online testing. -----</p> Perform CHANNEL FUNCTIONAL TEST.	31 days
SR 3.3.25.3	Perform CHANNEL CALIBRATION.	18 months

3.3 INSTRUMENTATION

3.3.26 Main Steam Line Break (MSLB) Detection and Feedwater Isolation Manual Initiation

LCO 3.3.26 Two MSLB Detection and Feedwater Isolation manual initiation switches shall be OPERABLE.

-----NOTE-----

Applicable on each Unit until after completion of the Automatic Feedwater Isolation System modification on the respective Unit.

APPLICABILITY: MODES 1 and 2,
MODE 3 with main steam header pressure \geq 700 psig except when all main feedwater control valves (MFCVs) and startup feedwater control valves (SFCVs) are closed.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One manual initiation switch inoperable.	A.1 Restore manual initiation switch to OPERABLE status.	72 hours
B. Two manual initiation switches inoperable. <u>OR</u> Required Action and associated Completion Time of Condition A not met.	B.1 Be in MODE 3. <u>AND</u> B.2.1 Reduce main steam header pressure to < 700 psig. <u>OR</u> B.2.2 Close all MFCVs and SFCVs.	12 hours 18 hours 18 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.3.26.1	Perform CHANNEL FUNCTIONAL TEST.	18 months

3.3 INSTRUMENTATION

3.3.27 Main Steam Line Break (MSLB) Detection and Feedwater Isolation Logic Channels

LCO 3.3.27 Two MSLB Detection and Feedwater Isolation Logic channels shall be OPERABLE.

-----NOTE-----

Applicable on each Unit until after completion of the Automatic Feedwater Isolation System modification on the respective Unit.

APPLICABILITY: MODES 1 and 2,
MODE 3 with main steam header pressure \geq 700 psig except when all main feedwater control valves (MFCVs) and startup feedwater control valves (SFCVs) are closed.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One logic channel inoperable.	A.1 Restore channel to OPERABLE status.	72 hours
B. Two logic channels inoperable. <u>OR</u> Required Action and associated Completion Time of Condition A not met.	B.1 Be in MODE 3.	12 hours
	<u>AND</u>	
	B.2.1 Reduce main steam header pressure to < 700 psig.	18 hours
	<u>OR</u>	
	B.2.2 Close all MFCVs and SFCVs.	18 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.3.27.1	Perform CHANNEL FUNCTIONAL TEST.	18 months

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B 3.3 INSTRUMENTATION

B 3.3.11 Automatic Feedwater Isolation System (AFIS) Instrumentation

BASES

BACKGROUND

A Main Steam Line Break (MSLB) can lead to containment overpressure, unacceptable thermal stresses to the steam generator tubes, and significant core overcooling. Main and Emergency Feedwater must be promptly isolated to limit the effects of a MSLB. The AFIS instrumentation is designed to provide automatic termination of feedwater flow to the affected steam generator. The AFIS instrumentation automatically terminates Main Feedwater (MFW) by tripping both MFW pumps and closing the affected steam generator's main and startup feedwater control valves and block valves. Although the main and startup feedwater block valves are automatically closed, their closure is not credited for mitigation of a MSLB. The AFIS instrumentation automatically terminates emergency feedwater (EFW) by stopping the turbine-driven emergency feedwater pump (TDEFWP) and tripping the motor-driven emergency feedwater pump (MDEFWP) aligned to the affected steam generator. Manual overrides for the TDEFWP and MDEFWP's are provided to allow the operator to subsequently start the EFW pumps if necessary for decay heat removal.

In addition, AFIS instrumentation provides runout protection for the EFW pumps in the event of a MSLB and certain large break MFW line breaks with the pump in the automatic mode of operation.

Main Steam header pressure is used as input signals to the AFIS circuitry. There are four pressure transmitters per steam generator with each feeding a steam pressure signal to a signal isolator. The output of the signal isolator provides an analog signal to a processor module that actuates isolation functions at desired setpoints. One pressure transmitter per steam generator, associated signal isolator(s) and processor module inputs constitute an AFIS detection analog channel.

The four AFIS analog channels per steam generator feed two redundant digital channels. Each digital channel provides independent circuit functions to isolate each steam generator. If the logic is satisfied, a trip output is energized. The use of an energized to trip processor module ensures that a loss of power to the digital channel will not result in an inadvertent feedwater isolation. If either digital channel is actuated, feedwater is isolated to the affected steam generator. Energizing the trip outputs results in closure of contacts in various control circuits for systems and components used for the MSLB and feedwater line break mitigation. Therefore, when the trip outputs are actuated, the systems and

BASES

BACKGROUND
(continued)

components perform their isolation functions. Other features of the digital channels include a test/manual initiation pushbutton and an "enable" or "arming" switch. The AFIS digital channel is defined as the analog isolation modules, the digital 2 out of 4 logic modules, the Enable/Disable pushbutton, the associated output relays, the trip relay outputs to the feedwater pumps, the redundant switchgear trips for the MDEFWP, the solenoid valves for the MFCV & SFCV, the trip solenoid valves for the feedwater pumps, and the TDEFWP trip function. While AFIS provides isolation of the feedwater block valves, this is not a credited function and is not a requirement for digital channel operability.

The AFIS digital channels are enabled and disabled administratively rather than automatically. Appropriate operating procedures contain provisions to enable/disable the digital channels.

APPLICABLE
SAFETY ANALYSES

Based on the containment pressure response reanalysis, the containment design pressure would be exceeded for a MSLB inside containment without immediate operator or automatic action to isolate main feedwater to the affected steam generator.

In addition, prompt operator or automatic action would be required to isolate EFW to the affected steam generator to limit the resultant thermal stresses on the steam generator tubes following a MSLB.

Main Steam header pressure is used as input signals to the AFIS circuitry. When a MSLB is sensed, or upon manual actuation, main feedwater is terminated by tripping both MFW pumps and closing the affected steam generators main and startup feedwater control valves and block valves. Although the main and startup feedwater block valves are automatically closed, they are not credited for mitigation of a MSLB. In addition, EFW is terminated by stopping the TDEFWP and tripping the MDEFWP aligned to the affected steam generator. Manual overrides for the TDEFWP and MDEFWP are provided to allow the operator to subsequently start the EFW pumps if necessary for decay heat removal.

The AFIS Instrumentation satisfies Criterion 3 of 10 CFR 50.36 (Ref. 3).

LCO

This LCO requires that instrumentation necessary to initiate a MFW and EFW isolation shall be OPERABLE. Failure of any instrument renders the affected analog channel(s) inoperable and reduces the reliability of the Function.

BASES

LCO
(continued)

Four analog channels per SG are required to be OPERABLE to ensure that no single failure prevents Feedwater isolation. Each AFIS analog channel includes the sensor, signal isolator and processor module.

This LCO is modified by a Note which indicated the requirements are applicable to a Unit after completion of the AFIS modification on the respective unit. This is necessary since the specification is based on the Unit's design after implementation of the modification.

APPLICABILITY

The AFIS Function shall be OPERABLE in MODES 1 and 2, and MODE 3 with main steam header pressure ≥ 700 psig because the SG inventory can be at a high energy level and contribute significantly to the peak pressure with a secondary side break. Feedwater must be able to be isolated on each SG to limit mass and energy releases to the reactor building. Once the SG pressures have decreased below 700 psig, the AFIS Function can be bypassed to avoid actuation during normal unit cooldowns. In MODES 4, 5, and 6, the energy level is low and the secondary side feedwater flow rate is low or nonexistent. In MODES 4, 5, and 6, the primary system temperatures are too low to allow the SGs to effectively remove energy and AFIS instrumentation is not required to be OPERABLE.

ACTIONS

If a channel's trip setpoint is found nonconservative with respect to the Allowable Value, or any of the transmitter or signal processing electronics, are found inoperable, then the Function provided by that channel must be declared inoperable and the unit must enter the appropriate Conditions.

A Note has been added to the ACTIONS indicating that a separate Condition entry is allowed for analog channels associated with each SG.

A.1

Condition A applies to failures of a single AFIS analog channel. With one channel inoperable or tripped, the channel(s) must be placed in bypass within 4 hours. Bypassing the affected channel places the Function in a two-out-of-three configuration. Operation in this configuration may continue indefinitely since the AFIS Function is capable of performing its isolation function in the presence of any single random failure. The Completion Time of 4 hours is adequate to perform Required Action A.1.

B.1

With two channels inoperable or if the Required Action and associated

BASES

ACTIONS
(continued)

Completion Time of Condition A can not be met, the channel(s) must be returned to service within 72 hours. An inoperable channel includes any channel bypassed by Condition A.

C.1 and C.2

With the Required Action and associated Completion Time of Condition B not met, the unit must be placed in MODE 3 within 12 hours and main steam header pressure must be reduced to less than 700 psig within 18 hours. The allowed Completion Time is reasonable, based on operating experience, to reach the required unit conditions from full power conditions in an orderly manner and without challenging unit systems.

SURVEILLANCE
REQUIREMENTS

SR 3.3.11.1

Performance of the CHANNEL CHECK once every 12 hours ensures that a gross failure of instrumentation has not occurred. A CHANNEL CHECK is normally a comparison of the parameter indicated on one channel to a similar parameter on other channels. It is based on the assumption that instrument channels monitoring the same parameter should read approximately the same value. Significant deviations between the two instrument channels could be an indication of excessive instrument drift in one of the channels or of something even more serious. CHANNEL CHECK will detect gross channel failure; therefore, it is key in verifying that the instrumentation continues to operate properly between each CHANNEL FUNCTIONAL TEST and CHANNEL CALIBRATION.

Agreement criteria are based on a combination of the channel instrument uncertainties, including isolation, indication, and readability. If a channel is outside the criteria, it may be an indication that the transmitter or the signal processing equipment has drifted outside its limit. If the channels are within the criteria, it is an indication that the channels are OPERABLE. If the channels are normally off scale during times when surveillance is required, the CHANNEL CHECK will only verify that they are off scale in the same direction. Off scale low current loop channels are verified, where practical, to be reading at the bottom of the range and not failed downscale.

A continuous, automatic CHANNEL CHECK function is provided by Software. If a channel is outside the criteria, then an alarm is provided to the control room. Manual performance of the CHANNEL CHECK is acceptable.

The frequency, about once every shift, is based on operating experience that demonstrates channel failure is rare. Since the probability of two random failures in redundant channels in any 12 hour period is extremely

BASES

**SURVEILLANCE
REQUIREMENTS**

SR 3.3.11.1 (continued)

low, the CHANNEL CHECK minimizes the chance of loss of protective function due to failure of redundant channels. The CHANNEL CHECK supplements less formal, but potentially more frequent, checks of channel OPERABILITY during normal operational use of the displays associated with the LCO required channels.

SR 3.3.11.2

A CHANNEL FUNCTIONAL TEST is performed by comparing the test input signal to the value transmitted to the Calibration and Test Computer. This enables verification of the voltage references and the signal commons. This will ensure the channel will perform its intended function.

The Frequency of 31 days is based on operating experience, with regard to channel OPERABILITY and drift, which demonstrates that failure of more than one channel in any 31 day interval is a rare event.

SR 3.3.11.3

CHANNEL CALIBRATION is a complete check of the instrument channel including the sensor. The test verifies the channel responds to a measured parameter within the necessary range and accuracy. CHANNEL CALIBRATION leaves the channels adjusted to account for instrument drift to ensure that the instrument channel remains operational between successive tests. CHANNEL CALIBRATION shall find that measurement errors and setpoint errors are within the assumptions of the setpoint analysis. CHANNEL CALIBRATIONS must be performed consistent with the assumptions of the setpoint analysis.

The Frequency is based on the assumption of an 18 month calibration interval in the determination of the magnitude of equipment drift in the setpoint analysis.

REFERENCES 1. 10 CFR 50.36.

B 3.3 INSTRUMENTATION

B 3.3.12 Automatic Feedwater Isolation System (AFIS) Manual Initiation

BASES

BACKGROUND The AFIS manual initiation capability provides the operator with the capability to actuate the isolation function from the control room. This Function is provided in the event the operator determines that the Function is needed and does not automatically actuate. This is a backup Function to the automatic Feedwater isolation.

The AFIS manual initiation circuitry satisfies the manual initiation and single-failure criterion requirements of IEEE-279-1971 (Ref. 1).

APPLICABLE SAFETY ANALYSES The Feedwater Isolation Function credited in the safety analysis is automatic. However, the manual initiation Function is required by design as backup to the automatic Function and allows operators to actuate Feedwater Isolation whenever the Function is needed. Furthermore, the manual initiation of Feedwater Isolation may be specified in unit operating procedures.

The AFIS manual initiation function satisfies Criterion 3 of 10 CFR 50.36 (Ref. 2).

LCO Two manual initiation switches per steam generator are required to be OPERABLE. The Feedwater Isolation function has two actuation or "trip" digital channels, channels 1 and 2. Within each digital channel actuation logic there are two manual trip switches. When the manual switch is depressed, a full trip of actuation digital channel 1 or 2 occurs.

This LCO is modified by a Note which indicates the requirements are applicable to a Unit after completion of the AFIS modification on the respective Unit. This is necessary since the specification is based on the Unit's design after implementation of the modification.

APPLICABILITY The AFIS manual initiation Function shall be OPERABLE in MODES 1 and 2, and MODE 3 with main steam header pressure ≥ 700 psig because SG inventory can be at a sufficiently high energy level to contribute significantly to the peak containment pressure with a secondary side break. In MODES 4, 5, and 6, the SG energy level is low and secondary side feedwater flow rate is low or nonexistent.

BASES (continued)

ACTIONS

A Note has been added to the ACTIONS indicating that a separate Condition entry is allowed for manual initiation switches associated with each SG.

A.1

With one manual initiation switch per steam generator inoperable, the manual initiation switch must be restored to OPERABLE status within 72 hours. The Completion Time of 72 hours is based on unit operating experience and administrative controls, which provide alternative means of AFIS initiation via individual component controls. The 72 hour Completion Time is consistent with the allowed outage time for the components actuated by the AFIS.

B.1

With both manual initiation switches per steam generator inoperable or the Required Action and associated Completion Time of Condition A not met, the Unit must be placed in MODE 3 within 12 hours and the main steam header pressure reduced to less than 700 psig within 18 hours. The allowed Completion Times are reasonable, based on operating experience, to reach the required MODES from full power conditions in an orderly manner and without challenging Unit systems.

**SURVEILLANCE
REQUIREMENTS**

SR 3.3.12.1

This SR requires the performance of a digital CHANNEL FUNCTIONAL TEST to ensure that the channels can perform their intended functions. The Frequency of 18 months is based on engineering judgment and operating experience that determined testing on an 18 month interval provides reasonable assurance that the circuitry is available to perform its safety function, while the risks of testing during unit operation is avoided.

REFERENCES

1. IEEE-279-1971, April 1972.
2. 10 CFR 50.36.

B 3.3 INSTRUMENTATION

B 3.3.13 Automatic Feedwater Isolation System (AFIS) Digital Channels

BASES

BACKGROUND

The four AFIS analog channels per steam generator feed two redundant feedwater digital channels. Each digital channel provides independent circuit functions to isolate each steam generator. If the logic is satisfied, a trip output is energized. The use of an energized to trip processor module ensures that a loss of power to the digital channels will not result in an inadvertent feedwater isolation. If either digital channel is actuated, feedwater to the affected steam generator is isolated. Energizing the trip outputs results in actuation of contacts in various control circuits for systems and components used for the MSLB and feedwater line break mitigation. Therefore, when the trip outputs are actuated, the systems and components perform their isolation functions. The AFIS digital channel is defined as the analog isolation modules, the digital 2 out of 4 logic modules, the Enable/Disable pushbutton, the associated output relays, the trip relay outputs to the feedwater pumps, the redundant switchgear trips for the MDEFWP, the solenoid valves for the MFCV & SFCV, the trip solenoid valves for the feedwater pumps, and the TDEFWP trip function. While AFIS provides isolation of the feedwater block valves, this is not a credited function and is not a requirement for digital channel operability.

Trip Setpoints and Allowable Values

Trip setpoints are the nominal values that are user defined in AFIS software. AFIS software is considered to be properly adjusted when the "as left" value is within the band for CHANNEL CALIBRATION accuracy.

The trip setpoints used in the AFIS software are selected such that adequate protection is provided when all sensor and processing time delays are taken into account. To allow for calibration tolerances, instrumentation uncertainties, instrument drift, and severe environment induced errors for AFIS channels that must function in harsh environments as defined by 10 CFR 50.49, the Allowable Values specified are conservatively adjusted with respect to the analytical limits. The actual nominal trip setpoint entered into the software for low MS pressure is 550 psig and the rate of depressurization setpoint will be 3 psi/sec. A channel is inoperable if its actual trip setpoint is not within its required Allowable Value.

Setpoints, in accordance with the Allowable Values, ensure that the
(continued)

BASES (continued)

BACKGROUND

Trip Setpoints and Allowable Values (continued)

consequences of accidents will be acceptable, providing the unit is operated from within the LCOs at the onset of the accident and the equipment functions as designed.

Each channel can be tested online to verify that the setpoint accuracy is within the specified allowance requirements. The CHANNEL FUNCTIONAL TEST is performed by comparing the test input signal to the value transmitted to the Calibration and Test Computer. This enables verification of the voltage references and the signal commons to ensure the channel will perform its intended function. A continuous, automatic CHANNEL CHECK is provided by AFIS software. If the channel is outside acceptance criteria, an alarm is provided to the control room.

APPLICABLE
SAFETY ANALYSES

AFIS circuitry is installed equipment necessary to automatically isolate main and emergency feedwater to the affected steam generator following a MSLB. The AFIS circuitry provides protection against exceeding containment design pressure for MSLB's inside containment and provides protection against exceeding allowable thermal stresses on the steam generator tubes following a MSLB.

Main Steam header pressure is used as input signals to the AFIS circuitry. When a MSLB is sensed, or upon manual actuation, MFW is terminated by tripping both MFW pumps and closing the affected steam generator's main and startup feedwater control valves and block valves. Although the main and startup feedwater block valves are automatically closed, they are not credited for mitigation of a MSLB. In addition, EFW is terminated by stopping the TDEFWP and tripping the MDEFWP aligned to the affected steam generator. Manual overrides for the TDEFWP and MDEFWP's are provided to allow the operator to subsequently start the emergency feedwater pumps if necessary for decay heat removal.

The AFIS logic channels satisfy Criterion 3 of 10 CFR 50.36 (Ref. 1).

LCO

Two digital channels of AFIS logic shall be OPERABLE. There are two redundant digital channels of automatic actuation logic.

This LCO is modified by a Note which indicates the requirements are applicable to a Unit after completion of the AFIS modification on the respective Unit. This is necessary since the specification is based on the Units design after implementation of the modification.

BASES (continued)

APPLICABILITY The AFIS digital channels shall be OPERABLE in MODES 1 and 2, and MODE 3 with main steam header pressure ≥ 700 psig because SG inventory can be at a high energy level and can contribute significantly to the peak containment pressure during a secondary side line break. In MODES 4, 5, and 6, the energy level is low and the secondary side feedwater flow rate is low or nonexistent.

ACTIONS A Note has been added to the ACTIONS indicating that a separate Condition entry is allowed for logic channels associated with each SG.

A.1

With one digital channel inoperable, the inoperable digital channel must be restored to OPERABLE status within 72 hours. The Completion Time of 72 hours is based on unit operating experience and administrative controls, which provide alternative means of AFIS initiation via individual component controls. The 72 hour Completion Time is consistent with the allowed outage time for the components actuated by AFIS.

B.1 and B.2

With both digital channels inoperable or the Required Action and associated Completion Time not met, the Unit must be placed in MODE 3 within 12 hours and the main steam header pressure must be reduced to less than 700 psig within 18 hours. The allowed Completion Times are reasonable, based on operating experience, to reach the required MODES from full power conditions in an orderly manner and without challenging Unit systems.

BASES (continued)

SURVEILLANCE
REQUIREMENTS

SR 3.3.13.1

This SR requires the performance of a CHANNEL FUNCTIONAL TEST to ensure that the digital channels can perform their intended functions. The Frequency of 18 months is based on engineering judgment and operating experience that determined testing on an 18 month interval provides reasonable assurance that the circuitry is available to perform its safety function, while the risks of testing during Unit operation is avoided.

REFERENCES

1. 10 CFR 50.36.
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Not Used |
B 3.3.24 |

B 3.3 INSTRUMENTATION

B 3.3.24 Not Used

B 3.3 INSTRUMENTATION

B 3.3.25 Main Steam Line Break (MSLB) Detection and Feedwater Isolation Instrumentation

BASES

BACKGROUND The MSLB Detection and Feedwater Isolation instrumentation is designed to address containment overpressurization and steam generator tube load concerns by isolating main feedwater (MFW) and stopping the turbine-driven emergency feedwater pump (TDEFW) from delivering feedwater to both steam generators during an MSLB and to mitigate core overcooling concerns. In addition, the MSLB Detection and Feedwater Isolation instrumentation provides runout protection for the TDEFW pump in the event of a MSLB and certain large MFW line breaks with the pump in the automatic mode of operation.

Steam generator header pressure is used as input signals to the MSLB circuitry for detection and feedwater isolation. When a MSLB is sensed, or upon manual actuation, the main feedwater control valves (MFCVs) and startup feedwater control valves (SFCVs) will be closed to isolate the MFW flow paths to both steam generators. In addition, the MFW pumps are tripped. The TDEFW pump will be inhibited from auto-starting or will be auto-stopped if it has already started. A manual override for the TDEFW pump inhibit is provided to allow the operator to subsequently start the TDEFW pump if necessary for decay heat removal. These functions are credited for mitigating an MSLB. The function of closing the main and startup feedwater block valves is not credited in the MSLB analysis. However, the MSLB Detection and Feedwater Isolation circuitry performs this function.

There are three pressure transmitters per steam generator with each feeding a steam pressure signal to a signal isolator (when used) and bistable. These bistables are calibrated to provide an ON/OFF signal at the desired setpoint for actuation of the feedwater isolation circuitry. A pressure transmitter and its associated signal isolator(s) and bistable(s) constitute a MSLB detection analog channel.

The six MSLB detection analog channels feed two redundant feedwater isolation digital channels consisting of two single failure proof two-out-of-three logic circuits. If the logic is satisfied, a master relay coil is energized. The use of an energized master relay ensures that a loss of power to the

BASES

BACKGROUND
 (continued)

digital channels will not result in an inadvertent feedwater isolation. If either digital channel is actuated, a feedwater isolation (i.e., MFW pumps trip, MFCVs and SFCVs close, and TDEFW pump inhibited from auto-starting or auto-stopped if running) will occur. Energizing the master relay results in closure of contacts in various control circuits for systems and components. Therefore, when the master relay is energized, the systems and components perform their isolation functions. Other features of the digital channels include a test/manual actuation pushbutton, a circuit seal-in after the master relay is energized, a 2 second time delay to prevent spurious actuation, and an "enable" or "arming" switch. The two two-out-of-three logic circuits, along with their associated enable switch, master relay, seal-in, time delay, and test/manual actuation pushbutton are considered a feedwater isolation digital channel.

The feedwater isolation digital channels are enabled and disabled administratively rather than automatically. Appropriate operating procedures contain provisions to enable/disable the digital channels.

APPLICABLE
SAFETY ANALYSES

The MSLB Detection and Feedwater Isolation instrumentation is utilized to isolate main feedwater and stop the TDEFW pump from supplying feedwater to both steam generators in the event a MSLB occurs. This function is credited in the MSLB analyses regarding containment response and steam generator tube loads.

Steam generator header pressure is used as input to the MSLB circuitry for detection and feedwater isolation. When a MSLB is sensed, or upon manual actuation, the MFCVs and SFCVs are closed to isolate the MFW flow paths to both steam generators. In addition, the MFW pumps are tripped. The TDEFW pump will be inhibited from auto-starting or will be auto-stopped if it has already started. A manual override for the TDEFW pump inhibit is provided to allow the operator to subsequently start the TDEFW pump if necessary for decay heat removal. All of these functions are credited for mitigating a MSLB inside containment.

The MSLB Detection and Feedwater Isolation Instrumentation satisfies Criterion 3 of 10 CFR 50.36 (Ref. 1).

LCO

This LCO requires that instrumentation necessary to initiate a feedwater isolation (i.e., trip the MFW pumps, close the MFCVs and SFCVs, inhibit the auto-start of or auto-stop the TDEFW pump) shall be OPERABLE. Failure of any instrument renders the affected channel(s) inoperable and reduces the reliability of the Function.

BASES

LCO
(continued)

Three analog channels per SG are required to be OPERABLE to ensure that no single failure prevents actuation of the MSLB Detection and Feedwater Isolation instrumentation. Each MSLB Detection and Feedwater Isolation instrumentation channel includes the sensor and measurement channel.

This LCO is modified by a Note, which indicates the requirements are not applicable to a Unit after the completion of the Automatic Feedwater Isolation System Modification on the respective Unit. This is necessary since the specification is no longer based on the Unit's design after implementation of the modification.

APPLICABILITY

The MSLB Detection and Feedwater Isolation Function shall be OPERABLE in MODES 1 and 2, and MODE 3 with main steam header pressure ≥ 700 psig, because there is significant mass and energy in the RCS and steam generators. Once the steam header pressure has decreased below 700 psig, additional time is available for the operator to manually isolate main and emergency feedwater to the affected steam generator. Thus, the Feedwater Isolation Function can be bypassed to avoid actuation during normal unit cooldowns. Also during MODE 3, the Feedwater Isolation Function is not required to be OPERABLE when all main feedwater control valves (MFCVs) and startup feedwater control valves (SFCVs) are closed since the function of the instrumentation is already fulfilled. In MODE 3 when the turbine header pressure is < 885 psig, automatic actuation of the TDEFW pump is blocked. In MODES 4, 5, and 6, the energy level is low and the secondary side feedwater flow rate is low or nonexistent. In MODES 4, 5, and 6, the primary system temperatures are too low to allow the SGs to effectively remove energy and MSLB Detection and Feedwater Isolation instrumentation is not required to be OPERABLE.

ACTIONS

If a channel's trip setpoint is found nonconservative with respect to the Allowable Value, or any of the transmitter or signal processing electronics, are found inoperable, then the Function provided by that channel must be declared inoperable and the unit must enter the appropriate Conditions.

A Note has been added to the ACTIONS indicating that a separate Condition entry is allowed for instrumentation channels associated with each SG (feedwater isolation function).

BASES

A.1

Condition A applies to failures of a single MSLB Detection and Feedwater Isolation instrumentation channel in one or more Feedwater Isolation Functions.

With one channel inoperable in one or more MSLB Detection and Feedwater Isolation Function, the channel(s) must be placed in trip within 4 hours. Tripping the affected channel places the Function in a one-out-of-two configuration. Operation in this configuration may continue indefinitely since the MSLB Detection and Feedwater Isolation Function is capable of actuating in the presence of any single random failure. The Completion Time of 4 hours is adequate to perform Required Action A.1.

B.1, B.2.1, and B.2.2

With two channels in one or more MSLB Detection and Feedwater Isolation Function inoperable or the Required Action and associated Completion Time of Condition A not met, the unit must be placed in MODE 3 within 12 hours and main steam header pressure must be reduced to less than 700 psig or all MFCVs and SFCVs must be closed within 18 hours. The allowed Completion Time is reasonable, based on operating experience, to reach the required unit conditions from full power conditions in an orderly manner and without challenging unit systems.

SURVEILLANCE
REQUIREMENTS

SR 3.3.25.1

Performance of the CHANNEL CHECK once every 12 hours ensures that a gross failure of instrumentation has not occurred. A CHANNEL CHECK is normally a comparison of the parameter indicated on one channel to a similar parameter on other channels. It is based on the assumption that instrument channels monitoring the same parameter should read approximately the same value. Significant deviations between the two instrument channels could be an indication of excessive instrument drift in one of the channels or of something even more serious. CHANNEL CHECK will detect gross channel failure; therefore, it is key in verifying that the instrumentation continues to operate properly between each CHANNEL FUNCTIONAL TEST and CHANNEL CALIBRATION.

Agreement criteria are based on a combination of the channel instrument uncertainties, including isolation, indication, and readability. If a channel is outside the criteria, it may be an indication that the transmitter or the signal processing equipment has drifted outside its limit. If the channels are

BASES

within the criteria, it is an indication that the channels are OPERABLE. If the channels are normally off scale during times when surveillance is required, the CHANNEL CHECK will only verify that they are off scale in the same direction. Off scale low current loop channels are verified, where practical, to be reading at the bottom of the range and not failed downscale.

The Frequency, about once every shift, is based on operating experience that demonstrates channel failure is rare. Since the probability of two random failures in redundant channels in any 12 hour period is extremely low, the CHANNEL CHECK minimizes the chance of loss of protective function due to failure of redundant channels. The CHANNEL CHECK supplements less formal, but potentially more frequent, checks of channel OPERABILITY during normal operational use of the displays associated with the LCO required channels.

SR 3.3.25.2

A CHANNEL FUNCTIONAL TEST is performed on each required instrumentation channel to ensure the channel will perform its intended function.

The Frequency of 31 days is based on operating experience, with regard to channel OPERABILITY and drift, which demonstrates that failure of more than one channel in any 31 day interval is a rare event.

This SR is modified by a Note indicating that it is only applicable when modifications are implemented that allow online testing.

SR 3.3.25.3

CHANNEL CALIBRATION is a complete check of the instrument channel including the sensor. The test verifies the channel responds to a measured parameter within the necessary range and accuracy. CHANNEL CALIBRATION leaves the channels adjusted to account for instrument drift to ensure that the instrument channel remains operational between successive tests. CHANNEL CALIBRATION shall find that measurement errors and bistable setpoint errors are within the assumptions of the setpoint analysis. CHANNEL CALIBRATIONS must be performed consistent with the assumptions of the setpoint analysis.

The Frequency is based on the assumption of an 18 month calibration interval in the determination of the magnitude of equipment drift in the setpoint analysis.

BASES (continued)

- REFERENCES
1. 10 CFR 50.36.
 2. UFSAR Section 6.2.1.4.
 3. UFSAR Section 5.2.3.4.
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B 3.3 INSTRUMENTATION

B 3.3.26 Main Steam Line Break (MSLB) Detection and Feedwater Isolation Manual Initiation

BASES

BACKGROUND The MSLB Detection and Feedwater Isolation manual initiation capability provides the operator with the capability to actuate the isolation function from the control room. This Function is provided in the event the operator determines that the Function is needed and does not automatically actuate. This is a backup Function to the automatic Feedwater isolation.

The MSLB Detection and Feedwater Isolation manual initiation circuitry satisfies the manual initiation and single-failure criterion requirements of IEEE-279-1971 (Ref. 1).

APPLICABLE SAFETY ANALYSES The Feedwater Isolation Function credited in the safety analysis is automatic. However, the manual initiation Function is required by design as backup to the automatic Function and allows operators to actuate Feedwater Isolation whenever the Function is needed. Furthermore, the manual initiation of Feedwater Isolation may be specified in unit operating procedures.

The MSLB Detection and Feedwater Isolation manual initiation function satisfy Criterion 3 of 10 CFR 50.36 (Ref. 2).

LCO One manual initiation switch per actuation channel (A and B) is required to be OPERABLE. The Feedwater Isolation function, has two actuation or "trip" channels, channels A and B. Within each channel actuation logic there is one manual trip switch. When the manual switch is depressed, a full trip of actuation channel A or B occurs.

This LCO is modified by a Note, which indicates the requirements are not applicable to a Unit after the completion of the Automatic Feedwater Isolation System Modification on the respective Unit. This is necessary since the specification is no longer based on the Unit's design after implementation of the modification.

APPLICABILITY The Feedwater Isolation manual initiation Function shall be OPERABLE in MODES 1 and 2, and MODE 3 with main steam header pressure ≥ 700 psig because there is significant mass and energy in the RCS and steam

BASES

APPLICABILITY
(continued)

generators. Once the steam header pressure has decreased below 700 psig, additional time is available for the operator to manually isolate main and emergency feedwater to the affected steam generator. Thus, the Feedwater Isolation Function can be bypassed to avoid actuation during normal unit cooldowns. During MODE 3, the Feedwater Isolation manual initiation Function is not required to be OPERABLE when all main feedwater control valves (MFCVs) and startup feedwater control valves (SFCVs) are closed since its function is already fulfilled. In MODE 3 when the turbine header pressure is < 885 psig, automatic actuation of the turbine-driven emergency feedwater pump is blocked. In MODES 4, 5, and 6, the SG energy level is low and secondary side feedwater flow rate is low or nonexistent.

ACTIONS

A.1

With one manual initiation switch inoperable, the manual initiation switch must be restored to OPERABLE status within 72 hours. The Completion Time of 72 hours is based on unit operating experience and administrative controls, which provide alternative means of MSLB Detection and Feedwater Isolation Function initiation via individual component controls. The 72 hour Completion Time is consistent with the allowed outage time for the components actuated by the MSLB Detection and Feedwater Isolation Function.

B.1

With both manual initiation switches inoperable or the Required Action and associated Completion Time of Condition A not met, the unit must be placed in MODE 3 within 12 hours and the main steam header pressure reduced to less than 700 psig or all MFCVs and SFCVs must be closed within 18 hours. The allowed Completion Times are reasonable, based on operating experience, to reach the required MODES from full power conditions in an orderly manner and without challenging unit systems.

SURVEILLANCE
REQUIREMENTS

SR 3.3.26.1

This SR requires the performance of a CHANNEL FUNCTIONAL TEST to ensure that the channels can perform their intended functions. The Frequency of 18 months is based on engineering judgment and operating experience that determined testing on an 18 month interval provides reasonable assurance that the circuitry is available to perform its safety function, while the risks of testing during unit operation is avoided.

BASES (continued)

- REFERENCES
1. IEEE-279-1971, April 1972.
 2. 10 CFR 50.36.
 3. UFSAR Section 6.2.1.4.
 4. UFSAR Section 5.2.3.4.
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B 3.3 INSTRUMENTATION

B 3.3.27 Main Steam Line Break (MSLB) Detection and Feedwater Isolation Logic Channels |

BASES

BACKGROUND The six MSLB detection analog channels feed two redundant feedwater isolation digital channels consisting of two single failure proof two-out-of-three logic circuits. If the logic is satisfied, a master relay coil is energized. The use of an energized master relay ensures that a loss of power to the digital channels will not result in an inadvertent feedwater isolation. If either digital channel is actuated, a Feedwater isolation will occur. Energizing the master relay results in closure of contacts in various control circuits for systems and components. Therefore, when the master relay is energized, the systems and components perform their isolation functions. Other features of the digital channels include a test/manual actuation pushbutton, a circuit seal-in after the master relay is energized, a 2 second time delay to prevent spurious actuation, and an “enable” or “arming” switch. Each of the two two-out-of-three logic circuits, along with their associated enable switch, master relay, seal-in, and time delay is considered a feedwater isolation digital channel.

APPLICABLE SAFETY ANALYSES The MSLB Detection and Feedwater Isolation instrumentation is utilized to isolate main feedwater and stop the TDEFW pump from supplying feedwater to both steam generators in the event a MSLB occurs. This function is credited in the MSLB analyses regarding containment response and steam generator tube loads.

Steam generator outlet pressure is used as input to the MSLB circuitry for detection and feedwater isolation. When a MSLB is sensed, or upon manual actuation, the MFCVs and SFCVs will be closed to isolate the MFW flow paths to both steam generators. In addition, the MFW pumps are tripped. The TDEFW pump will be inhibited from auto-starting or will be auto-stopped if it has already started and the switch for MS-93 is in the AUTO position. A manual override for the TDEFW pump inhibit is provided to allow the operator to subsequently start the TDEFW pump if necessary for heat removal. All of these functions are credited for mitigating a MSLB inside containment.

The MSLB Detection and Feedwater Isolation logic channels satisfy Criterion 3 of 10 CFR 50.36 (Ref. 1).

BASES (continued)

LCO Two channels of MSLB Detection and Feedwater Isolation automatic actuation logic shall be OPERABLE. There are only two channels of automatic actuation logic. Therefore, violation of this LCO could result in a complete loss of the automatic Function assuming a single failure of the other channel.

This LCO is modified by a Note, which indicates the requirements are not applicable to a Unit after the completion of the Automatic Feedwater Isolation System Modification on the respective Unit. This is necessary since the specification is no longer based on the Unit's design after implementation of the modification.

APPLICABILITY The MSLB Detection and Feedwater Isolation automatic actuation logic channels shall be OPERABLE in MODES 1 and 2, and MODE 3 with main steam header pressure ≥ 700 psig because there is significant mass and energy in the RCS and steam generators. Once the steam header pressure has decreased below 700 psig, additional time is available for the operator to manually isolate main and emergency feedwater to the affected steam generator. Thus, the Feedwater Isolation Function can be bypassed to avoid actuation during normal unit cooldowns. Also, during MODE 3, the Feedwater Isolation function is not required to be OPERABLE when all main feedwater control valves (MFCVs) and startup feedwater control valves (SFCVs) are closed since its function is already fulfilled. In MODE 3 when the turbine header pressure is < 885 psig, automatic actuation of the TDEFW pump is blocked. In MODES 4, 5, and 6, the energy level is low and the secondary side feedwater flow rate is low or nonexistent.

ACTIONS A.1

With one automatic actuation logic channel inoperable, the channel must be restored to OPERABLE status within 72 hours. The Completion Time of 72 hours is based on unit operating experience and administrative controls, which provide alternative means of MSLB Detection and Feedwater Isolation Function initiation via individual component controls. The 72 hour Completion Time is consistent with the allowed outage time for the components actuated by the MSLB Detection and Feedwater Isolation Function.

B.1, B.2.1, and B.2.2

With both logic channels inoperable or the Required Action and associated Completion Time not met, the unit must be placed in MODE 3 within 12 hours and the main steam header pressure must be reduced to less than

BASES (continued)

Actions

B.1, B.2.1, and B.2.2 (continued)

700 psig or all MFCVs and SFCVs must be closed within 18 hours. The allowed Completion Times are reasonable, based on operating experience, to reach the required MODES from full power conditions in an orderly manner and without challenging unit systems.

SURVEILLANCE
REQUIREMENTS

SR 3.3.27.1

This SR requires the performance of a CHANNEL FUNCTIONAL TEST to ensure that the channels can perform their intended functions. This test verifies Feedwater Isolation automatic actuation logics are functional. This test simulates the required inputs to the logic circuit and verifies successful operation of the automatic actuation logic. The Frequency of 18 months is based on engineering judgment and operating experience that determined testing on an 18 month interval provides reasonable assurance that the circuitry is available to perform its safety function, while the risks of testing during unit operation is avoided.

REFERENCES

1. 10 CFR 50.36.
 2. UFSAR Section 6.2.1.4.
 3. UFSAR Section 5.2.3.4
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B 3.7 PLANT SYSTEMS

B 3.7.3 Main Feedwater Control Valves (MFCVs), and Startup Feedwater Control Valves (SFCVs)

BASES

BACKGROUND The main feedwater isolation valves (MFIVs) for each steam generator consist of the MFCVs and the SFCVs. The MFIVs isolate main feedwater (MFW) flow to the secondary side of the steam generators following a high energy line break (HELB). The consequences of events occurring in the main steam lines will be mitigated by their closure. Closing the MFCVs and associated SFCVs valves effectively terminates the addition of feedwater to an affected steam generator, limiting the mass and energy release for steam line breaks (SLBs) inside containment and reducing the cooldown effects for SLBs.

The MFIVs close on receipt of a MSLB detection signal generated by low steam header pressure. The MFIVs can also be closed manually.

APPLICABLE SAFETY ANALYSES The design basis of the MFIVs is established by the containment analysis for the main steam line break (MSLB).

Failure of an MFIV to close following an MSLB, can result in additional mass and energy being delivered to the steam generators, contributing to cooldown. This failure also results in additional mass and energy releases following an MSLB.

The MFIVs satisfy Criterion 3 of 10 CFR 50.36 (Ref. 1).

LCO This LCO ensures that the MFIVs will isolate MFW flow to the steam generators following a main steam line break.

Two MFCVs and two SFCVs are required to be OPERABLE. The MFIVs are considered OPERABLE when the isolation times are within limits and they close on a feedwater isolation actuation signal.

Automatic initiation instrumentation is not required to be OPERABLE in MODE 3 when main steam header pressure is < 700 psig in accordance with either LCO 3.3.11, "Automatic Feedwater Isolation System (AFIS) Instrumentation" or LCO 3.3.25, "Main Steam Line Break (MSLB) Detection

BASES

LCO
(continued) and Main Feedwater (MFW) Isolation Instrumentation." When automatic initiation circuitry is not required to be OPERABLE, the MFCVs and SFCVs are OPERABLE provided manual closure capability is OPERABLE. Automatic initiation is not required in this condition since additional time is available for the operator to manually close the valves if required.

Failure to meet the LCO requirements can result in excessive cooldown and additional mass and energy being released to containment following an MSLB inside containment.

APPLICABILITY The MFCVs and SFCVs must be OPERABLE whenever there is significant mass and energy in the RCS and steam generators.

In MODES 1, 2, and 3, the MFCVs and SFCVs are required to be OPERABLE in order to limit the cooldown and the amount of available fluid that could be added to containment in the case of an MSLB inside containment. When the valves are closed, they are already performing their safety function.

In MODES 4, 5, and 6, feedwater and steam generator energy are low. Therefore, the MFCVs and SFCVs are not required for isolation of potential main steam pipe breaks in these MODES.

ACTIONS The ACTIONS table is modified by a Note indicating that separate Condition entry is allowed for each valve.

A.1 and A.2

With one MFCV in one or more flow paths inoperable, action must be taken to restore the affected valves to OPERABLE status, or to close or isolate inoperable affected valves within 8 hours. When these valves are closed or isolated, they are performing their required safety function.

The 8 hour Completion Time provides a reasonable time to restore an inoperable MFIV to OPERABLE status and is acceptable due to the low probability of an event occurring during this time period that would require isolation of the MFW flow paths.
