

3.5 EMERGENCY CORE COOLING SYSTEMS (ECCS)

file: GX 53502--LB

3.5.2 ECCS—Shutdown

LC0 3.5.2 Two ECCS injection subsystems shall be OPERABLE.

APPLICABILITY: MODE 4,
MODE 5 except with the reactor cavity to dryer/separator
storage pool gate removed and water level ≥ 7.0 m (23
ft) over the top of the reactor pressure vessel flange.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One required ECCS subsystem inoperable.	A.1 Restore required ECCS subsystem to OPERABLE status.	4 hours
B. Required Action and associated Completion Time of Condition A not met.	B.1 Initiate action to suspend operations with a potential for draining the reactor vessel (OPDRVs).	Immediately
C. Two required ECCS subsystems inoperable.	C.1 Initiate action to suspend OPDRVs.	Immediately
	<u>AND</u> C.2 Restore one ECCS subsystem to OPERABLE status.	4 hours

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
D. Required Action C.2 and associated Completion Time not met.	D.1 Initiate action to restore secondary containment to OPERABLE status.	Immediately
	<u>AND</u>	
	D.2 Initiate action to restore one standby gas treatment subsystem to OPERABLE status.	Immediately
	<u>AND</u>	
	D.3 Initiate action to restore one isolation valve and associated instrumentation to OPERABLE status in each secondary containment penetration flow path not isolated.	Immediately

SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY
SR 3.5.2.1 Verify, for each required Low Pressure Core Flooder (LPFL) subsystem, the suppression pool water level is ≥ 7.0 m (23 ft).	12 hours

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SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE	FREQUENCY
<p>SR 3.5.2.2² Verify, for the required High Pressure Core Flooder (HPCF) subsystem, the:</p> <ul style="list-style-type: none"> a. Suppression pool water level is ≥ 7.0 m (23 ft), or b. Condensate storage tank water level is ≥ 4 m (12 ft). 	12 hours
<p>SR 3.5.2.3³ Verify, for each required ECCS injection subsystem, the piping is filled with water from the pump discharge valve to the injection valve.</p>	31 days
<p>SR 3.5.2.4⁴ -----NOTE----- Low Pressure Core Flooder (LPFL) subsystem may be considered OPERABLE during alignment and operation in the decay heat removal shutdown cooling mode, if capable of being manually realigned and not otherwise inoperable. ----- Verify each required ECCS injection subsystem manual, power operated, and automatic valve in the flow path, that is not locked, sealed, or otherwise secured in position, is in the correct position.</p>	31 days

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SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE				FREQUENCY
SR 3.5.2.4 Verify each required ECCS pump develops the specified flow rate against a system head corresponding to the specified reactor pressure.				In accordance with the Inservice Testing Program or 92 days
<u>SYSTEM</u>	<u>FLOW RATE</u>	<u>NO. OF PUMPS</u>	<u>SYSTEM HEAD CORRESPONDING TO A REACTOR PRESSURE OF</u>	
LPFL	$\geq 954 \text{ m}^3/\text{h}$ (4200gpm)	1	$\geq 2.8 \text{ kg/cm}^2\text{g}$ (40psig)	
HPCF	$\geq 181.7 \text{ m}^3/\text{h}$ (800gpm)	1	$\geq 82.7 \text{ kg/cm}^2\text{g}$ (1177psig)	
SR 3.5.2.5 NOTE Vessel injection may be excluded.				
Verify each required ECCS injection/spray subsystem actuates on an actual or simulated automatic initiation signal.				[18] months

B 3.5 EMERGENCY CORE COOLING SYSTEMS (ECCS) AND REACTOR CORE ISOLATION
COOLING (RCIC) SYSTEM

B 3.5.2 ECCS - Shutdown

file: GA 3502--BB

BASES

BACKGROUND

A description of the High Pressure Core Flooder (HPCF) and the Low Pressure Flooder (LPFL) subsystems of the Residual Heat Removal (RHR) System is provided in the Bases for LCO 3.5.1, "ECCS--Operating." The Reactor Core Isolation Cooling (RCIC) system steam driven turbines can not operate with the reactor shutdown and so are not available.

APPLICABLE
SAFETY ANALYSES

ECCS performance is evaluated for the entire spectrum of break sizes for a postulated loss of coolant accident (LOCA). The long-term cooling analysis following a design basis LOCA (Ref. B3.5.2-1) demonstrates that only one motor driven ECCS injection subsystem is required, post LOCA, to maintain the peak cladding temperature below the allowable limit. To provide redundancy, a minimum of two ECCS subsystems are required to be OPERABLE in MODES 4 and 5. Two OPERABLE ECCS injection subsystems also ensure adequate inventory makeup in the reactor pressure vessel (RPV) in the event of an inadvertent vessel draindown.

The ECCS satisfy Criterion 3 of the NRC Policy Statement.

LCO

Two ECCS injection subsystems are required to be OPERABLE. The ECCS injection subsystems are defined as the three LPFL and the two HPCF subsystems. Each LPFL subsystem consists of one motor driven pump, piping, and valves to transfer water from the suppression pool to the RPV. Each HPCF subsystem consists of one motor driven pump, piping, and valves to transfer water from the suppression pool or condensate storage tank (CST) to the RPV.

Any LPFL subsystem may be aligned for the shutdown cooling mode of the decay heat removal system in MODE 4 or 5 and considered OPERABLE for the ECCS function, if it can be manually realigned (remote or local) to the LPFL mode and is not otherwise inoperable. Because of low pressure and low

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BASES

temperature conditions in MODES 4 and 5, sufficient time will be available to manually align and initiate LPFL subsystem operation to provide core cooling prior to postulated fuel uncover.

APPLICABILITY

OPERABILITY of the ECCS injection subsystems is required in MODES 4 and 5 to ensure adequate coolant inventory and sufficient heat removal capability for the irradiated fuel in the core in case of an inadvertent draindown of the vessel. Requirements for ECCS OPERABILITY during MODES 1, 2, and 3 are discussed in the Applicability section of the Bases for LCO 3.5.1. ECCS subsystems are not required to be OPERABLE during MODE 5 with the ~~Spent~~ fuel pool gate removed, and the water level maintained at ≥ 7 m (23 ft) above the RPV flange. This provides sufficient coolant inventory to allow operator action to terminate the inventory loss prior to fuel uncover in case of an inadvertent draindown.

The Automatic Depressurization System is not required to be OPERABLE during MODES 4 and 5 because the RPV pressure is $< 3.5 \text{ Kg/cm}^2 \text{ g}$ (50 psig), and the LPFL and HPCF subsystems can provide core cooling without any depressurization of the primary system.

Because the Reactor Core Isolation Cooling (RCIC) system requires steam to operate, it is not required to be OPERABLE during MODES 4 and 5.

ACTIONS

A.1 and B.1

If any one required ECCS injection subsystem is inoperable, the required inoperable ECCS injection subsystem must be restored to OPERABLE status within 4 hours. In this Condition, the remaining OPERABLE subsystem can provide sufficient RPV flooding capability to recover from an inadvertent vessel draindown. However, overall system reliability is reduced because a single failure in the remaining OPERABLE subsystem concurrent with a vessel draindown could result in the ECCS not being able to perform its intended function. The 4 hour Completion Time for restoring the required ECCS injection/spray subsystem to

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In addition, the automatic isolations of RAR shutdown cooling and the reactor water cleanup system on low RPV water level are required to be OPERABLE (LCO 3.3.1, SSLL sensor instrumentation) during CORE ALTERATIONS or operation with a potential for draining the reactor vessel.

reactor cavity to dryer/separators storage

BASES

OPERABLE status is based on engineering judgment that considered the availability of one subsystem and the low probability of a vessel draindown event.

With the inoperable subsystem not restored to OPERABLE status within the required Completion Time, action must be initiated immediately to suspend operations with a potential for draining the reactor vessel (OPDRVs) to minimize the probability of a vessel draindown and the subsequent potential for fission product release. Actions must continue until OPDRVs are suspended.

C.1, C.2, D.1, D.2, and D.3

If both of the required ECCS injection subsystems are inoperable, all coolant inventory makeup capability may be unavailable. Therefore, actions must be initiated immediately to suspend OPDRVs in order to minimize the probability of a vessel draindown and the subsequent potential for fission product release. Actions must continue until OPDRVs are suspended. One ECCS injection subsystem must also be restored to OPERABLE status within 4 hours.

If at least one ECCS injection subsystem is not restored to OPERABLE status within the 4 hour Completion Time, additional actions are required to minimize any potential fission product release to the environment. This includes initiating immediate action to restore the following to OPERABLE status: secondary containment, one standby gas treatment subsystem, and one isolation valve and associated instrumentation in each secondary containment penetration flow path not isolated. This may be performed by an administrative check, by examining logs or other information, to determine if the components are out of service for maintenance or other reasons. Verification does not require performing the Surveillances needed to demonstrate OPERABILITY of the components. If, however, any required component is inoperable, then it must be restored to OPERABLE status. In this case, the Surveillances may need to be performed to restore the component to OPERABLE status. Actions must continue until all required components are OPERABLE.

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The 4 hour Completion Time to restore at least one ECCS injection subsystem to OPERABLE status ensures that prompt action will be taken to provide the required cooling capacity or to initiate actions to place the plant in a condition that minimizes any potential fission product release to the environment.

SR 3.5.2.1 and SR 3.5.2.2

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SURVEILLANCE
REQUIREMENTS

The minimum water level of 7 m (23 ft) required for the suppression pool is periodically verified to ensure that the suppression pool will provide adequate net positive suction head (NPSH) for the ECCS pumps, recirculation volume, and vortex prevention. With the suppression pool water level less than the required limit, all ECCS injection subsystems are inoperable.

When the suppression pool level is < 7 m (23 ft), the HPCF is considered OPERABLE only if it can take suction from the CST and the CST water level is sufficient to provide the required NPSH for the HPCF pump. Therefore, a verification that either the suppression pool water level is ≥ 7 m (23 ft) or the HPCF System is aligned to take suction from the CST and the CST contains \geq liters ([] gallons) of water, equivalent to []m, ensures that the HPCF System can supply makeup water to the RPV.

The 12 hour Frequency of these SRs was developed considering operating experience related to suppression pool and CST water level variations and instrument drift during the applicable MODES. Furthermore, the 12 hour Frequency is considered adequate in view of other indications in the control room, including alarms, to alert the operator to an abnormal suppression pool or CST water level condition.

SR 3.5.2.3, SR 3.5.2.5, and SR 3.5.2.6

The Bases provided for SR 3.5.1.1, SR 3.5.1.4, and SR 3.5.1.7 are applicable to SR 3.5.2.3, SR 3.5.2.5, and SR 3.5.2.6, respectively.

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BASES

SR 3.5.2.4

Verifying the correct alignment for manual, power operated, and automatic valves in the ECCS flow paths provides assurance that the proper flow paths will exist for ECCS operation. This SR does not apply to valves that are locked, sealed, or otherwise secured in position since these valves were verified to be in the correct position prior to locking, sealing, or securing. A valve that receives an initiation signal is allowed to be in a nonaccident position provided the valve will automatically reposition in the proper stroke time. This SR does not require any testing or valve manipulation; rather, it involves verification that those valves capable of potentially being mispositioned are in the correct position. This SR does not apply to valves that cannot be inadvertently misaligned, such as check valves. The 31 day Frequency is appropriate because the valves are operated under procedural control and the probability of their being mispositioned during this time period is low.

In MODES 4 and 5, the RHR System may operate in the shutdown cooling mode to remove decay heat and sensible heat from the reactor. Therefore, RHR valves that are required for LPFL subsystem operation may be aligned for the shutdown cooling mode. Therefore, this SR is modified by a Note that allows one LPFL subsystem of the RHR System to be considered OPERABLE for the ECCS function if all the required valves in the LPFL flow path can be manually realigned (remote or local) to allow injection into the RPV and the system is not otherwise inoperable. This will ensure adequate core cooling if an inadvertent vessel draindown should occur.

REFERENCES

- ~~APPLICABLE SAFETY ANALYSES~~ ~~e~~
1. ABWR SSAR, Section 6.3.
~~SURVEILLANCE REQUIREMENTS~~ ~~e~~
~~REFERENCES~~ ~~e~~
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ECCS - Shutdown
3.5.2

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3.5 EMERGENCY CORE COOLING SYSTEMS (ECCS)

3.5.2 ECCS - Shutdown

LCO 3.5.2 Two ECCS injection subsystems shall be OPERABLE.

APPLICABILITY: MODE 4,
MODE 5 except with the spent fuel pool gate removed and
water level ≥ 7 m (23 ft) over the top of the reactor
pressure vessel flange.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One required ECCS injection subsystem inoperable.	A.1 Restore required ECCS injection/spray subsystem to OPERABLE status.	4 hours
B. Required Action and associated Completion Time of Condition A not met.	B.1 Initiate action to suspend operations with a potential for draining the reactor vessel (OPDRVs).	Immediately
C. Two required ECCS injection subsystems inoperable.	C.1 Initiate action to suspend OPDRVs.	Immediately
	<u>AND</u> C.2 Restore one ECCS injection subsystem to OPERABLE status.	4 hours

(continued)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
D. Required Action C.2 and associated Completion Time not met.	D.1 Initiate action to restore secondary containment to OPERABLE status.	Immediately
	<u>AND</u>	
	D.2 Initiate action to restore one standby gas treatment subsystem to OPERABLE status.	Immediately
	<u>AND</u>	
	D.3 Initiate action to restore one isolation valve and associated instrumentation to OPERABLE status in each secondary containment penetration flow path not isolated.	Immediately

SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY
SR 3.5.2.1 Verify, for each required low pressure Flooder (LPFL) subsystem, the suppression pool water level is ≥ 7 m (23 ft).	12 hours

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SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE	FREQUENCY
<p>SR 3.5.2.2 Verify, for each required High Pressure Core Flooder (HPCF) System, the:</p> <p> a. Suppression pool water level is ≥ 7 m (23 ft); or</p> <p> b. Condensate storage tank water level is $\geq [\quad]$.</p>	<p>12 hours</p>
<p>SR 3.5.2.3 Verify, for each required ECCS injection/spray subsystem, the piping is filled with water from the pump discharge valve to the injection valve.</p>	<p>31 days</p>
<p>SR 3.5.2.4 -----NOTE----- Low Pressure Flooder (LPFL) subsystems may be considered OPERABLE during alignment and operation for decay heat removal, if capable of being manually realigned and not otherwise inoperable. -----</p> <p>Verify each required ECCS injection subsystem manual, power operated, and automatic valve in the flow path, that is not locked, sealed, or otherwise secured in position, is in the correct position.</p>	<p>31 days</p>

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SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE			FREQUENCY
SR 3.5.2.5	Verify each required ECCS pump develops the specified flow rate [against a system head corresponding to the specified reactor pressure].		In accordance with the Inservice Testing Program or 92 days
		[SYSTEM HEAD CORRESPONDING TO A REACTOR PRESSURE OF]	
	<u>SYSTEM</u>	<u>FLOW RATE</u>	
	LPFL	$\geq [754] \text{ m}^3/\text{min}$	
	HPCF	$\geq [12.11] \text{ m}^3/\text{min}$	
		$\geq [281] \text{ kg/cm}^2$	$\geq [7.03] \text{ kg/cm}^2$
SR 3.5.2.6	-----NOTE----- Vessel injection may be excluded. -----		18 months
	Verify each required ECCS injection subsystem actuates on an actual or simulated automatic initiation signal.		

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ECCS—Shutdown
B 3.5.2

B 3.5 EMERGENCY CORE COOLING SYSTEMS (ECCS)

B 3.5.2 ECCS—Shutdown

file: gxs3502--bb

BASES

BACKGROUND

A description of the High Pressure Core Spray (HPCS) System, Low Pressure Core Spray (LPCS) System, and low pressure coolant injection (LPCI) mode of the Residual Heat Removal (RHR) System is provided in the Bases for LCO 3.5.1, "ECCS—Operating."

APPLICABLE SAFETY ANALYSES

ECCS performance is evaluated for the entire spectrum of break sizes for a postulated loss of coolant accident (LOCA). The long term cooling analysis following a design basis LOCA (Ref. 1) demonstrates that only one ECCS injection/spray subsystem is required, post LOCA, to maintain the peak cladding temperature below the allowable limit. To provide redundancy, a minimum of two ECCS subsystems are required to be OPERABLE in MODES 4 and 5. Two OPERABLE ECCS injection/spray subsystems also ensure adequate inventory makeup in the reactor pressure vessel (RPV) in the event of an inadvertent vessel draindown.

The ECCS satisfy Criterion 3 of the NRC Policy Statement.

LCO

Two ECCS injection/spray subsystems are required to be OPERABLE. The ECCS injection/spray subsystems are defined as the three LPCI subsystems, the LPCS System, and the HPCS System. The LPCS System and each LPCI subsystem consist of one motor driven pump, piping, and valves to transfer water from the suppression pool to the RPV. The HPCS System consists of one motor driven pump, piping, and valves to transfer water from the suppression pool or condensate storage tank (CST) to the RPV.

One LPCI subsystem (A or B) may be aligned for decay heat removal in MODE 4 or 5 and considered OPERABLE for the ECCS function, if it can be manually realigned (remote or local) to the LPCI mode and is not otherwise inoperable. Because of low pressure and low temperature conditions in MODES 4 and 5, sufficient time will be available to manually align

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BASES

LCO
(continued) and initiate LPCI subsystem operation to provide core cooling prior to postulated fuel uncover.

APPLICABILITY OPERABILITY of the ECCS injection/spray subsystems is required in MODES 4 and 5 to ensure adequate coolant inventory and sufficient heat removal capability for the irradiated fuel in the core in case of an inadvertent draindown of the vessel. Requirements for ECCS OPERABILITY during MODES 1, 2, and 3 are discussed in the Applicability section of the Bases for LCO 3.5.1. ECCS subsystems are not required to be OPERABLE during MODE 5 with the upper containment pool gate removed, and the water level maintained at ≥ 7 m (23 ft) above the RPV flange. This provides sufficient coolant inventory to allow operator action to terminate the inventory loss prior to fuel uncover in case of an inadvertent draindown.

The Automatic Depressurization System is not required to be OPERABLE during MODES 4 and 5 because the RPV pressure is $< [3.5 \text{ Kg/cm}^2\text{g (50 psig)}]$, and the LPFL and HPFL subsystems can provide core cooling without any depressurization of the primary system.

ACTIONS A.1 and B.1

If any one required ECCS injection subsystem is inoperable, the required inoperable ECCS injection subsystem must be restored to OPERABLE status within 4 hours. In this Condition, the remaining OPERABLE subsystem can provide sufficient RPV flooding capability to recover from an inadvertent vessel draindown. However, overall system reliability is reduced because a single failure in the remaining OPERABLE subsystem concurrent with a vessel draindown could result in the ECCS not being able to perform its intended function. The 4 hour Completion Time for restoring the required ECCS injection subsystem to OPERABLE status is based on engineering judgment that considered the availability of one subsystem and the low probability of a vessel draindown event.

With the inoperable subsystem not restored to OPERABLE status within the required Completion Time, action must be

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BASES

ACTIONS

A.1 and B.1 (continued)

initiated immediately to suspend operations with a potential for draining the reactor vessel (OPDRVs) to minimize the probability of a vessel draindown and the subsequent potential for fission product release. Actions must continue until OPDRVs are suspended.

C.1, C.2, D.1, D.2, and D.3

If both of the required ECCS injection subsystems are inoperable, all coolant inventory makeup capability may be unavailable. Therefore, actions must be initiated immediately to suspend OPDRVs in order to minimize the probability of a vessel draindown and the subsequent potential for fission product release. Actions must continue until OPDRVs are suspended. One ECCS injection subsystem must also be restored to OPERABLE status within 4 hours.

If at least one ECCS injection subsystem is not restored to OPERABLE status within the 4 hour Completion Time, additional actions are required to minimize any potential fission product release to the environment. This includes initiating immediate action to restore the following to OPERABLE status: secondary containment, one standby gas treatment subsystem, and one isolation valve and associated instrumentation in each secondary containment penetration flow path not isolated. This may be performed by an administrative check, by examining logs or other information, to determine if the components are out of service for maintenance or other reasons. Verification does not require performing the Surveillances needed to demonstrate OPERABILITY of the components. If, however, any required component is inoperable, then it must be restored to OPERABLE status. In this case, the Surveillances may need to be performed to restore the component to OPERABLE status. Actions must continue until all required components are OPERABLE.

The 4 hour Completion Time to restore at least one ECCS injection subsystem to OPERABLE status ensures that prompt action will be taken to provide the required cooling capacity or to initiate actions to place the plant in a

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BASES

ACTIONS

C.1, C.2, D.1, D.2, and D.3 (continued)

condition that minimizes any potential fission product release to the environment.

SURVEILLANCE
REQUIREMENTS

SR 3.5.2.1

The minimum water level of 7 m (23 ft) required for the suppression pool is periodically verified to ensure that the suppression pool will provide adequate net positive suction head (NPSH) for the ECCS pumps, recirculation volume, and vortex prevention. With the suppression pool water level less than the required limit, all ECCS injection subsystems are inoperable.

When the suppression pool level is < 7 m (23 ft), the HPCF System is considered OPERABLE only if it can take suction from the CST and the CST water level is sufficient to provide the required NPSH for the HPCF pump. Therefore, a verification that either the suppression pool water level is ≥ 7 m (23 ft) or the HPCF System is aligned to take suction from the CST and the CST contains $\geq []$ liters ($[]$ gallons) of water, equivalent to $[]$ m ($[]$ ft), ensures that the HPCF System can supply makeup water to the RPV.

The 12 hour Frequency of this SR was developed considering operating experience related to suppression pool and CST water level variations and instrument drift during the applicable MODES. Furthermore, the 12 hour Frequency is considered adequate in view of other indications in the control room, including alarms, to alert the operator to an abnormal suppression pool or CST water level condition.

SR 3.5.2.2, SR 3.5.2.4, and SR 3.5.2.5

The Bases provided for SR 3.5.1.1, SR 3.5.1.4, and SR 3.5.1.7 are applicable to SR 3.5.2.2, SR 3.5.2.4, and SR 3.5.2.5, respectively.

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BASES

SURVEILLANCE
REQUIREMENTS
(continued)

SR 3.5.2.3

Verifying the correct alignment for manual, power operated, and automatic valves in the ECCS flow paths provides assurance that the proper flow paths will exist for ECCS operation. This SR does not apply to valves that are locked, sealed, or otherwise secured in position since these valves were verified to be in the correct position prior to locking, sealing, or securing. A valve that receives an initiation signal is allowed to be in a nonaccident position provided the valve will automatically reposition in the proper stroke time. This SR does not require any testing or valve manipulation; rather, it involves verification that those valves capable of potentially being mispositioned are in the correct position. This SR does not apply to valves that cannot be inadvertently misaligned, such as check valves. The 31 day Frequency is appropriate because the valves are operated under procedural control and the probability of their being mispositioned during this time period is low.

In MODES 4 and 5, the RHR System may operate in the shutdown cooling mode to remove decay heat and sensible heat from the reactor. Therefore, RHR valves that are required for LPFL subsystem operation may be aligned for the shutdown cooling mode. Therefore, this SR is modified by a Note that allows one LPFL subsystem of the RHR System to be considered OPERABLE for the ECCS function if all the required valves in the LPFL flow path can be manually realigned (remote or local) to allow injection into the RPV and the system is not otherwise inoperable. This will ensure adequate core cooling if an inadvertent vessel draindown should occur.

REFERENCES

1. FSAR, Section [6.3.3.4].
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