RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

APR1400 Design Certification

Korea Electric Power Corporation / Korea Hydro & Nuclear Power Co., LTD

Docket No. 52-046

RAI No.:	**498-8595**
SRP Section:	**16 – Technical Specifications**
Application Section:	**16.3.3, 16.3.7.5, 16.3.7.6**
Date of RAI Issue:	**06/30/2016**

Question No. 16-154

Paragraph (a)(11) of 10 CFR 52.47 and paragraph (a)(30) of 10 CFR 52.79 state that a design certification (DC) applicant and a combined license (COL) applicant, respectively, are to propose TS prepared in accordance with 10 CFR 50.36 and 50.36a. 10 CFR 50.36 sets forth requirements for technical specifications to be included as part of the operating license for a nuclear power facility. NUREG-1432, “Standard Technical Specifications-Combustion Engineering Plants,” Rev. 4, provides NRC guidance on format and content of technical specifications as one acceptable means to meet 10 CFR 50.36 requirements. Staff needs to evaluate all technical differences from standard TS (STS) NUREG-1432, STS Combustion Engineering Plants, Rev. 4, which is referenced by the DC applicant in DCD Tier 2 Section 16.1, and the docketed rationale for each difference because conformance to STS provisions is used in the safety review as the initial point of guidance for evaluating the adequacy of the generic TS to ensure adequate protection of public health and safety, and the completeness and accuracy of the generic TS Bases.

In response to Question 16-131 (444-8530/29114) KHNP made many changes to Subsections 3.7.5 and 3.7.6 which need to be modified:

1. In Specification 3.7.5, the phrase “AFW trains” is proposed to be replaced with “AFW flow paths.” Staff finds this confusing, and recommends not using “flow paths” as a synonym for “trains.” Staff also recommends not using “AFW division inoperable” by itself to mean “one AFW division with both trains inoperable.” With changes denoted by markup of generic TS 3.7.5 Rev. 0 (not a markup of TS 3.7.5 as revised in the Question 16-131 response), staff recommends:

   a) Revising LCO 3.7.5:

      Two ~~Four independent~~ auxiliary feedwater (AFW) ~~trains~~ divisions, each with one motor driven train and one turbine driven train, shall be OPERABLE.

And LCO 3.7.5 Note:

> Only ~~one AFW train, which includes a~~ the motor driven ~~pump,~~ train of one AFW division is required to be OPERABLE in MODE 4.

The recommended changes improve the LCO statement and the modifying Note by highlighting the distinguishing design details of the APR1400 AFW system, which by use of consistent phrasing enables stating the action requirements unambiguously

b) Revising generic TS 3.7.5 Action A:

> A. One ~~turbine driven~~ AFW division with one train inoperable ~~due to associated inoperable steam supply~~ in MODE 1, 2, or 3. ~~OR NOTE—Only applicable if MODE 2 has not been entered fllowing refueling.— One turbine driven AFW pump inoperable in Mode 3 following refueling.~~ | A.1 Restore ~~affected equipment~~ train to OPERABLE status. | 7 days

Staff expects that the justification in the Action A.1 Bases for the 7 day completion time will address why 7 days is an acceptable period to be vulnerable to a main steam line break (MSLB) or feed line break (FLB) in the unaffected AFW division's steam generator, assuming no additional single failures. In such a scenario, core heat removal would need to rely on the remaining train in the affected AFW division using the unfaulted steam generator, assuming one AFW train (turbine or motor driven) is capable of maintaining the unit in MODE 3. Usual STS practice for a loss of redundancy in a two division system, is to require restoring redundancy within 72 hours.

c) Revising generic TS 3.7.5 Action B (Suggest renumbering Action B and Action C as Action C and Action B, respectively, since relabeled Action B is recommended to have a completion time less than 72 hours):

> C~~B~~. One AFW division with two trains inoperable in MODE 1, 2, or 3 ~~for reasons other than Condition A~~. | C~~B~~.1 Restore one ~~AFW~~ train of affected AFW division to OPERABLE status. | ~~72 hours~~ 24 hours

In KHNP's proposed revised Action B ("B. One AFW division inoperable in MODE 1, 2, or 3. | B.1 Restore AFW division to OPERABLE status. | 72 hours"), it is unclear whether KHNP had intended to require one or both trains to be made operable within 72 hours. STS convention would dictate restoring one train within 72 hours, with the restoration time for the remaining inoperable train governed by the Required Action A.1 completion time and Specification 1.3.

This recommendation clarifies that one of the inoperable trains in the affected division must be restored to operable status within 24 hours, because this AFW configuration is more equivalent to STS 3.7.5 Condition C ("*Turbine driven AFW train inoperable due to one* inoperable *steam supply. AND One motor driven AFW train inoperable.*"). However, the completion time of less than 72 hours needs to be justified consistent with the Reviewer's Note in the Bases for Required Actions C.1 and C.2 of Specification 3.7.5 of NUREG-1432, Revision 4. If the note's criteria for allowing a 48 hour completion time

are not satisfied, then a 24 hour completion time should be specified. But, if the note's criteria for allowing a 24 hour completion time are also not satisfied, then an even shorter completion time, perhaps 12 hours or 6 hours, should be specified. The applicant may refer to TSTF-412-A, Rev. 3 (Accession No. ML070100363) and the associated model safety evaluation (ML071230105) for additional background information regarding the origin of STS 3.7.5 Action A.

Staff expects that the justification in the Action B.1 (or C.1 as relabeled) Bases for a 48 hour, 24 hour, or shorter completion time will address why the time is an acceptable period to be vulnerable to a main steam line break (MSLB) or feed line break (FLB) in the unaffected AFW division's steam generator, assuming no additional single failures. In such a scenario, AFW function would be lost. Core heat removal would need to initially rely on nonsafety-related secondary heat sink systems using the unfaulted steam generator, but would soon have to rely on the safety injection system and the pressurizer pilot operated safety relief valves (POSRVs), and the incontainment refueling water storage tank cooling mode of the shutdown cooling system or the containment spray system heat exchangers.

Normally, with a loss of redundancy in a two division system, where the limiting postulated accident would make the remaining division inoperable, redundancy must be restored within a short time period; that is, a period of less than 72 hours. In this case, a period of 24 hours or less seems appropriate, but must to be justified.

d) Revising generic TS 3.7.5 Action C (Suggest renumber as Action B):

> B~~C~~. Two AFW divisions with one ~~One turbine driven AFW~~ train inoperable ~~due to associated inoperable steam supply~~ in MODE 1, 2, or 3. ~~AND One motor driven AFW train inoperable.~~ | B~~C~~.1 Restore two ~~steam supply to turbine driven~~ trains of one AFW division to OPERABLE status. | ~~48 hours~~ 72 hours ~~OR C.2 Restore motor driven AFW train to OPERABLE status.~~ | ~~48 hours~~

In KHNP's proposed revised Required Action C.1, KHNP had proposed a completion time of 72 hours; in the following quotation of the proposed revised Required Action C.1 staff inserts "[train]" to highlight the intended meaning of "flow path":

> C. One AFW flow path [train] in each division inoperable in MODE 1, 2, or 3. | C.1 Restore affected AFW flow path [train] to OPERABLE status. | 72 hours

In KHNP's proposed revised Required Action C.1, it is unclear whether KHNP had intended to require one or both inoperable trains to be made operable within 72 hours. This recommendation clarifies that one of the inoperable trains must be restored to operable status within 72 hours. However, the 72 hour completion time needs to be justified.

Staff expects that the justification in the Action C.1 (or B.1 as relabeled) Bases for the 72 hour completion time will address why that time is an acceptable period to be vulnerable to a main steam line break (MSLB) or feed line break (FLB) faulting one steam generator, assuming no additional single failures. In such a scenario, core heat removal would need to rely on the remaining train in one AFW division using the

unfaulted steam generator, assuming one AFW train (turbine or motor driven) is capable of maintaining the unit in MODE 3. Usual STS practice for a loss of redundancy in a two division system is to require restoring redundancy within 72 hours.

In the event of a worst case SLB or FLB postulated accident with the unit in Condition A or Condition C (or B as relabeled), with no additional single failures not caused by the event, one intact steam generator with one turbine or motor driven AFW train will remain operable to mitigate the event by enabling core heat removal using the intact steam generator. Consequently, since AFW function would be maintained, a 72 hour completion time is acceptable for both Required Action A.1 and Required Action C.1 (or B.1 as relabeled).

e) Revising Action D:

> D. Required Action and associated Completion Time of Condition~~s~~ A, B, or C not met with at least one motor driven train OPERABLE. OR ~~Three~~ One AFW division with both trains inoperable and the other AFW division with the turbine driven train inoperable in MODE 1, 2, or 3. | D.1 Be in MODE 3. | 6 hours AND D.2 Be in MODE 4. | 18 hours

This recommendation clarifies that entering MODE 4 from MODE 3 requires having one motor driven train operable. The applicant is requested to confirm that 18 hours is an appropriate time to cool down to MODE 4 for the APR1400 design using (1) two AFW trains and their associated steam generator, or (2) one motor driven train for one steam generator and one turbine driven train for the other steam generator.

f) Inserting a new Action E:

> E. Required Action and associated Completion Time of Condition B not met with both motor driven AFW trains inoperable. OR One AFW division with both trains inoperable and the other AFW division with the motor driven train inoperable in MODE 1, 2, or 3. | E.1 Initiate action to restore one motor driven train to OPERABLE status. | Immediately AND E.2 Be in MODE 3. | 6 hours AND E.3 Be in MODE 4. | 18 hours after restoring at least one motor driven train to OPERABLE status

This recommendation accounts for the need to avoid cooling down to MODE 4 without an operable motor driven train.

g) Revising the previous Action E as Action F:

> F. NOTE–LCO 3.0.3 and all other LCO Required Actions requiring MODE changes are suspended until one AFW train is restored to OPERABLE status. ~~Four~~ Two AFW divisions with two trains inoperable in MODE 1, 2, or 3. | F.1 Initiate action to restore one AFW train to OPERABLE status. | Immediately

Maintaining this Condition for just MODES 1, 2, and 3 allows returning control of unit status to Action D upon restoration of a motor driven train or Action E upon restoration

of a turbine driven train. This Condition should not be merged with a separate Condition for MODE 4.

h) Revising the previous Action F as Action G:

G. NOTE–LCO 3.0.3 and all other LCO Required Actions requiring MODE changes are suspended until one AFW motor driven train is restored to OPERABLE status. Required AFW motor driven train inoperable in MODE 4. | G.1 Initiate action to restore one AFW motor driven train to OPERABLE status. | Immediately

Specifying Action G to separately address non-compliance with the motor driven train operability requirement of the Note to LCO 3.7.5 improves its clarity.

i) Revising SR 3.7.5.1 for clarity and consistency in phrasing:

Verify each ~~AFW~~ manual, power-operated, and automatic valve in the flow path of each AFW train and in ~~each~~ the steam supply flow path ~~to the~~ of each AFW turbine driven ~~turbine driven~~ pump~~s~~, that is not locked, sealed, or otherwise secured in position, is in the correct position.

j) Revising SR 3.7.5.2 Note for consistency in phrasing:

----------NOTE----------

Not required to be performed ~~for the turbine driven~~ AFW turbine driven pumps until 24 hours after reaching 69.25 kg/cm2G (985 psig) ~~985 psig~~ in steam generators.

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k) Revising Note “a” of SR 3.7.5.3 and SR 3.7.5.4 for consistency in phrasing:

----------NOTE----------

a. Not required to be performed for ~~turbine driven~~ AFW turbine driven pumps until 24 hours after reaching 69.25 kg/cm2G (985 psig) ~~985 psig~~ in steam generators.

...

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l) Revising SR 3.7.5.3 for consistency in phrasing:

Verify each AFW automatic valve that is not locked, sealed, or otherwise secured in position, actuates to the correct position on an actual or simulated actuation signal.

m) Revising SR 3.7.5.5: for clarity and consistency in phrasing:

> Verify proper alignment of required ~~AFW~~ flow paths of each train of each AFW division by verifying flow from the associated auxiliary feedwater storage tank to ~~each~~ the associated steam generator.
>
> Prior to entering MODE 2 whenever ~~a~~ the unit has been in MODE 5~~, 6,~~ or 6, or defueled for a cumulative period of > 30 days.

2. The applicant is requested to confirm that automatic actuation of the required AFW motor driven train on Steam Generator Level - Low is not required in MODE 4, which is consistent with Table 3.3.5-1 for AFAS-1 and AFAS-2 ESFAS Functions. Based on this, deletion of the phrase “when in MODE 1, 2, or 3” from the end of the surveillance statement for SR 3.7.5.4, as shown on page 4 of the attachment to the response to RAI 444-8530 - Question 16-131, is acceptable. Staff notes, however, that this change was not in the scope of Question 16-131.

3. The applicant is requested to revise Revision 0 of the Bases of generic TS 3.7.5 to be fully descriptive of and consistent with the suggested changes, stated in Sub-question 1, that the applicant decides to adopt.

4. The applicant is requested to revise Revision 0 of the LCO statement of generic TS 3.7.6, “Auxiliary Feedwater Storage Tank (AFWST),” and the Bases for SR 3.7.6.1 (“Verify each AFWST level is ≥ 1,524,165 L (400,000 gal). | 12 hours”), for clarity, as follows:

> ~~One~~ Two AFWSTs shall be OPERABLE.
>
> This SR verifies that the ~~each~~ AFWST of each AFW division contains the required volume of cooling water. (This level is greater than or equal to 1,524,165 L (400,000 gal).) The ~~12 hour~~ 12 hour Frequency is based on operating experience and the need for operator awareness of unit evolutions that could affect the AFWST inventory between checks. The ~~12 hour~~ 12 hour Frequency is considered adequate in view of other indications in the MCR, including alarms, to alert the operator to abnormal AFWST level deviations.

5. In consideration of the vulnerability of the APR1400 design to a FLB on the steam generator of the unaffected AFW division when both trains in the other AFW division are inoperable (such as when there is insufficient water in the other AFW division’s AFWST), and to justify a 7-day restoration completion time, the staff recommends specifying additional compensatory measures for Condition A (“One AFWST inoperable.”) of generic TS 3.7.6, as follows:

REQUIRED ACTION	COMPLETION TIME

A.1	Verify OPERABILITY of backup water supply for affected AFW division.	4 hours AND Once per 12 hours thereafter
AND		4 hours

REQUIRED ACTION		COMPLETION TIME
A.2~~1~~	Verify OPERABILITY of AFWST of unaffected AFW division.	AND Once per 12 hours thereafter
AND		
A.3~~2~~	Restore AFWST to OPERABLE status.	7 days

The applicant is requested to describe in the Bases the backup water supply for each AFW division, including valve position changes necessary to make each backup water supply operable.

6. The applicant is requested to explain why the 24-hour Completion Time of generic TS 3.7.6 Required Action B.2 is an appropriate time period, given the APR1400 design, to place the unit in MODE 4 without reliance on steam generator for heat removal in the event a Required Action and associated Completion Time of Condition A are not met. This unit cool down would appear to be based on one AFW division with two operable trains and one steam generator.

   However, if two AFWSTs are inoperable, LCO 3.0.3 must be entered. By LCO 3.0.6, LCO 3.7.5 would not be entered, but 13 hours are permitted by LCO 3.0.3 to reach MODE 4 and 37 hours are permitted to reach MODE 5.

Response

1. In Specification 3.7.5, the phrase “flow path” will be replaced with “train” as proposed. For changes denoted by markup of generic TS 3.7.5 Rev.0 (not a markup of TS 3.7.5 as revised in the Question 16-131 response) as staff’s recommendation, KHNP will revise TS 3.7.5 as follows:

   a) LCO 3.7.5 and Note will be revised according to staff’s recommendations.

      Revised LCO 3.7.5 Note, “Only the motor driven train of one AFW division is required to be OPERABLE in MODE 4.” means that one motor driven AFW train shall be operable before entering Mode 4 from Mode 5.

      Also, one turbine driven AFW train of the unaffected AFW division can be operable to supply the required AFW flow by using the steam from the unaffected steam generator only when the decay heat removal from steam generator is required from Mode 3 to the shutdown cooling system entry condition of Mode 4.

   b) The proposed condition A can be misleading, particularly that “One AFW division with one train is inoperable in MODE 1, 2, or 3”. For the condition A, the phrase “division” is not necessary. Therefore, KHNP will revise the condition A, “One train inoperable in MODE 1, 2, or 3”.

      In APR1400 Standard Design, AFWS consists of two divisions. Each division consists of two 100% motor driven pumps and two 100% turbine driven pumps, one 100% AFWST. For the condition A, three 100% pumps and flow paths remain to supply feedwater to the steam generators.

      The 7 day completion time is reasonable based on the redundancy of the AFWS division, and availability of redundant operable AFW flow path within each division of AFWS.

   c) KHNP will change the current condition B to condition C. The revised condition C and required action C.1 will be revised as recommended by NRC staff.

KHNP understands that the 72 hour completion time is reasonable based on the redundant capabilities afforded by the AFWS, the time needed for repairs, and low probability of a DBA event occurring during this period.

The AFWS consists of two divisions. Each division has one motor driven pump and one turbine driven pump. Each pump provides 100% of AFW flow capacity to its respective steam generator as assumed in the accident analysis.

If one AFW division is inoperable, another division which has two 100% AFW trains with diversity is still operable as the redundancy. Also, any 100% AFW pump (motor-driven pump or turbine-driven pump) train can supply the AFW required to the unaffected steam generator until the shutdown cooling system entry condition of Mode 4 from Mode 3. In case of the reference plant of APR1400, Shin Kori Nuclear Power Plant 3&4, KHNP uses the 72 hour completion time based on operating experience for this condition.

d) KHNP will change the current condition C to condition B. Also, the revised condition B and required action B.1 will be revised to avoid misunderstanding as follows:

- Condition B, “A train of each AFW division inoperable in MODE 1, 2, or 3.”
- Required Action B.1. “Restore two trains of an AFW division to OPERABLE status.”

KHNP understands that the 72 hour completion time is reasonable based on one 100% train of each division operable. Therefore, each steam generator can be supplied the AFW from one 100% train of each division during this period.

e) One 100% turbine-driven train can supply the AFW required to the unaffected steam generator until the shutdown cooling system entry condition of Mode 4 from Mode 3. Therefore, one operable motor-driven train may not be required to enter the shutdown cooling system entry condition of Mode 4 from Mode 3.

The 18 hour completion time is reasonable based on operating experience in Korea by KHNP, to reach the unit condition from Mode 3 to Mode 4 in an orderly manner and without challenging unit systems.

f) As described in the response to Sub-question 1.e), one 100% turbine-driven train can supply the AFW required to the unaffected steam generator until the shutdown cooling system entry condition of Mode 4 from Mode 3. Therefore, new Action e proposed by staff is not required.

g) Renumbering is not reflected according to the response to Sub-question 1.f). The condition E will be revised using the phrase “train” proposed by staff.

h) Renumbering is not reflected according to the response to Sub-question 1.f). The proposed condition is not assure that which motor driven train is required. Since the condition does not means the accident condition, the proposed phrase “Required AFW motor driven train” is not appropriate. Because the requirement of the Note to LCO 3.7.5 is for “only the motor driven train of one AFW division”, the proposed condition for

"required one motor driven train inoperable" will not be adopted. Note of Condition F will be revised to improve its clarity.

i) SR 3.7.5.1 will be revised for clarity and consistency in phrasing.

j) SR 3.7.5.2 Note will be revised for consistency in phrasing.

k) Note "a" and "b" of SR 3.7.5.4 will be revised for consistency in phrasing and numbering. Note "a" of SR 3.7.5.3 will be deleted as following reason:

The purpose of Note "a" of SR 3.7.5.3 understands that AFW turbine-driven pumps shall be performed for the surveillance test after the pressure of steam generator is stable condition. The SR 3.7.5.3 is for to verify each AFW automatic valve actuates to the correct position on an actuation signal. This surveillance test is not related with Note a.

l) SR 3.7.5.3 will be revised for consistency in phrasing.

m) SR 3.7.5.5 will be revised for clarity and consistency in phrasing.

2. APR1400 NSSS designer confirms that an AFAS is automatically initiated by the steam generator level-low signal in Mode 4.

   If necessary, please refer to the response of RAI 498-8595, Question No. 16-153 (2 & 3.g).

3. Revision 0 of the Bases of generic TS 3.7.5 is revised to be consistent with the changes stated in the response to Sub-question 1.

4. Revision 0 of the LCO statement of generic TS 3.7.6 is revised as proposed by NRC staff.

5. The 7 day completion time is reasonable, based on an OPERABLE AFWST being available and the low probability of an event requiring the use of the water from the AFWST occurring during this period.

   APR1400 has one 100% AFWST for each division, also a cross connection is provided between the AFWSTs so that either tank can manually supply either division of the AFWS. To verify operability of AFWST (which is a safety and seismic Category I system) of unaffected AFW division is more administrative than to verify operability of backup water supply (which are a non-safety and non-seismic system) for affected AFW division. Also, KHNP understands that the addition of the description for the non-safety backup water supply provision on the TS is not appropriate. Therefore, the proposed required action will not be adopted.

6. Condition B for TS 3.7.6 does not mean that two AFWST tanks are inoperable. This condition B means the fail to restore affected AFWST to operable status within 7 days.

   APR1400 consists of one 100% AFWST of each division and also a cross connection is provided between the AFWSTs so that either tank can manually supply either division of the AFWS. The 24 hour completion time is reasonable based on operating experience in Korea

by KHNP, to reach the unit condition from Mode 3 to Mode 4 in an orderly manner and without challenging unit systems.

Impact on DCD

Same as changes described in the impact on Technical Specifications section.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

TS 3.7.5, 3.7.6, and Bases for TS 3.7.5 and TS 3.7.6 will be revised as indicated in the attachment.

Impact on Technical/Topical/Environmental Reports

There is no impact on any Technical, Topical, or Environmental Report.

3.7 PLANT SYSTEMS

3.7.5 Auxiliary Feedwater System (AFWS)

flow paths

LCO 3.7.5 Four independent auxiliary feedwater (AFW) ~~trains~~ shall be OPERABLE.

flow path

NOTE

Only one AFW ~~train~~, which includes a motor driven pump, is required to be OPERABLE in MODE 4.

APPLICABILITY: MODES 1, 2, and 3,
MODE 4 when a steam generator is relied upon for heat removal.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. ~~One turbine driven AFW train inoperable due to associated inoperable steam supply.~~ ~~OR~~ NOTE ~~Only applicable if MODE 2 has not been entered following refueling.~~ ~~One turbine driven AFW pump inoperable in Mode 3 following refueling.~~	A.1 Restore ~~affected equipment~~ to OPERABLE status.	7 days
B. ~~One AFW train inoperable in MODE 1, 2, or 3 for reasons other than Condition A.~~	B.1 Restore AFW ~~train~~ to OPERABLE status.	72 hours

AFW flow path

One AFW flow path inoperable in MODE 1, 2, or 3.

division

One AFW division inoperable in MODE 1, 2, or 3.

Replace with A

One AFW flow path in each division inoperable in MODE 1, 2, or 3.

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
C. ~~One turbine driven AFW train inoperable due to associated inoperable steam supply.~~ ~~AND~~ ~~One motor driven AFW train inoperable.~~	C.1 ~~Restore steam supply to turbine driven train to OPERABLE status.~~ ~~OR~~ C.2 ~~Restore motor driven AFW train to OPERABLE status.~~	~~48 hours~~ ~~48 hours~~
D. Required Action and associated Completion Time of Conditions A, B, or C not met. OR Three AFW ~~trains~~ inoperable in MODE 1, 2, or 3.	D.1 Be in MODE 3. AND D.2 Be in MODE 4.	6 hours 18 hours
E. ~~Four AFW trains inoperable in MODE 1, 2, or 3.~~	---------- NOTE ---------- LCO 3.0.3 and all other LCO Required Actions requiring MODE changes are suspended until one AFW ~~train~~ is restored to OPERABLE status. ---------- E.1 Initiate action to restore one AFW ~~train~~ to OPERABLE status.	 Immediately

72 hours

OR

flow paths

flow path

flow path

Restore affected AFW flow path to OPERABLE status.

Two AFW divisions inoperable in MODE 1, 2, or 3.

OR

Two AFW flow paths, each of which includes a motor-driven pump inoperable in MODE 4.

Replace with A

RAI 444-8530 - Question 16-131

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ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
~~F. Required AFW train inoperable in MODE 4.~~	~~NOTE~~ ~~LCO 3.0.3 and all other LCO Required Actions requiring MODE changes are suspended until one AFW train is restored to OPERABLE status.~~ ~~F.1 Initiate action to restore one AFW train to OPERABLE status.~~	~~Immediately~~

SURVEILLANCE REQUIREMENTS

	SURVEILLANCE	FREQUENCY
SR 3.7.5.1	Verify each AFW manual, power-operated, and automatic valve in the flow path and in each steam supply flow path to the turbine-driven pumps, that is not locked, sealed, or otherwise secured in position, is in correct position.	31 days
SR 3.7.5.2	NOTE Not required to be performed for the turbine driven AFW pump until 24 hours after reaching 985 psig in steam generators. Verify developed head of each AFW pump at flow test point is greater than or equal to required developed head.	In accordance with Inservice Testing Program

Replace with A

SURVEILLANCE REQUIREMENTS (continued)

	SURVEILLANCE	FREQUENCY
SR 3.7.5.3	NOTE a. Not required to be performed for turbine driven AFW pump until 24 hours after reaching 69.25 kg/cm^{2}G (985 psig) in steam generators. b. Not required to be met in MODE 4 when steam generator is relied upon for heat removal. Verify each AFW automatic valve that is not locked, sealed, or otherwise secured in position, actuates to correct position on an actual or simulated actuation signal.	18 months
SR 3.7.5.4	NOTE a. Not required to be performed for turbine driven AFW pump until 24 hours after reaching 69.25 kg/cm^{2}G (985 psig) in steam generators. b. Not required to be met in MODE 4 when steam generator is relied upon for heat removal. Verify each AFW pump starts automatically on an actual or simulated actuation ~~signal when in MODE 1, 2, or 3.~~ signal.	18 months
SR 3.7.5.5	Verify proper alignment of required AFW flow paths by verifying flow from auxiliary feedwater storage tank to each steam generator.	Prior to entering MODE 2 whenever a unit has been in MODE 5, 6, or defueled for a cumulative period of > 30 days.

S

S

Replace with A

LCO 3.7.5 Two auxiliary feedwater (AFW) divisions, each with one motor driven train and one turbine driven train, shall be OPERABLE.

NOTE
Only the motor driven train of one AFW division is required to be OPERABLE in MODE 4.

APPLICABILITY: MODES 1, 2, and 3,
MODE 4 when a steam generator is relied upon for heat removal.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One AFW train inoperable in MODE 1, 2, or 3.	A.1 Restore train to OPERABLE status.	7 days
B. A train of each AFW division inoperable in MODE 1, 2, or 3.	B.1 Restore two trains of an AFW division to OPERABLE status.	72 hours
C. One AFW division with two trains inoperable in MODE 1, 2, or 3.	C.1 Restore one train of affected AFW division to OPERABLE status.	72 hours
D. Required Action and associated Completion Time of Condition A, B, or C not met. OR One AFW division with both trains inoperable and a train of other AFW division inoperable in MODE 1, 2, or 3.	D.1 Be in MODE 3. AND D.2 Be in MODE 4.	6 hours 18 hours

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
E. Two AFW divisions with two trains inoperable in MODE 1, 2, or 3.	---------- NOTE ---------- LCO 3.0.3 and all other LCO Required Actions requiring MODE changes are suspended until one AFW train is restored to OPERABLE status. ---------- E.1 Initiate action to restore one train of an AFW division to OPERABLE status.	Immediately
F. Two AFW trains, each of which includes a motor driven train inoperable in MODE 4.	---------- NOTE ---------- LCO 3.0.3 and all other LCO Required Actions requiring MODE changes are suspended until one AFW motor driven train is restored to OPERABLE status. ---------- F.1 Initiate action to restore one AFW motor driven train to OPERABLE status.	Immediately

Replacement A (3/4)

RAI 498-8595 - Question 16-154

SURVEILLANCE REQUIREMENTS

	SURVEILLANCE	FREQUENCY
SR 3.7.5.1	Verify each manual, power-operated, and automatic valve in the flow path of each AFW train and in the steam supply flow path of each AFW turbine driven pump, that is not locked, sealed, or otherwise secured in position, is in the correct position.	31 days
SR 3.7.5.2	NOTE Not required to be performed for AFW turbine driven pumps until 24 hours after reaching 69.25 kg/cm^{2}G (985 psig) in steam generators.	
	Verify developed head of each AFW pump at flow test point is greater than or equal to required developed head.	In accordance with Inservice Testing Program
SR 3.7.5.3	NOTE Not required to be met in MODE 4 when steam generator is relied upon for heat removal.	
	Verify each AFW automatic valve that is not locked, sealed, or otherwise secured in position, actuates to the correct position on an actual or simulated actuation signal.	18 months
SR 3.7.5.4	NOTES 1. Not required to be performed for AFW turbine driven pumps until 24 hours after reaching 69.25 kg/cm^{2}G (985 psig) in steam generators. 2. Not required to be met in MODE 4 when steam generator is relied upon for heat removal.	
	Verify each AFW pump starts automatically on an actual or simulated actuation signal.	18 months

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
SR 3.7.5.5	Verify proper alignment of required flow paths of each train of each AFW division by verifying flow from the associated auxiliary feedwater storage tank to the associated steam generator.	Prior to entering MODE 2 whenever the unit has been in MODE 5 or 6, or defueled for a cumulative period of > 30 days.

3.7 PLANT SYSTEMS

3.7.6 Auxiliary Feedwater Storage Tank (AFWST)

LCO 3.7.6 ~~One~~ AFWST shall be OPERABLE.

~~Each~~ Two

APPLICABILITY: MODES 1, 2, and 3,
MODE 4 when a steam generator is relied upon for heat removal.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One AFWST inoperable.	A.1 Verify OPERABILITY of other AFWST. AND A.2 Restore AFWST to OPERABLE status.	4 hours AND Once per 12 hours thereafter 7 days
B. Required Action and associated Completion Time not met.	B.1 Be in MODE 3. AND B.2 Be in MODE 4 without reliance on steam generator for heat removal.	6 hours 24 hours

SURVEILLANCE REQUIREMENTS

	SURVEILLANCE	FREQUENCY
SR 3.7.6.1	Verify each AFWST level is ≥ 1,524,165 L (400,000 gal).	12 hours

RAI 120-7977 - Question 16-24.3
RAI 481-8546 - Question 16-150
RAI 444-8530 - Question 16-131
RAI 498-8595 - Question 16-154

B 3.7 PLANT SYSTEMS

B 3.7.5 Auxiliary Feedwater System (AFWS)

BASES

BACKGROUND

The AFWS automatically supplies feedwater to the steam generators to remove decay heat from the reactor coolant system upon the loss of normal feedwater supply. ~~The auxiliary feedwater (AFW) pumps take suction through separate and independent suction lines from the auxiliary feedwater storage tanks (AFWSTs) (LCO 3.7.6) and pump to the steam generator secondary side via a separate and independent connection to the main feedwater (MFW) piping inside containment.~~ The steam generator functions as a heat sink for core decay heat. The heat load is dissipated by releasing steam to the atmosphere from the steam generators via the main steam safety valves (MSSVs) (LCO 3.7.1) or main steam atmospheric dump valves (MSADVs) (LCO 3.7.4). If the main condenser is available, steam may be released to the main condenser via the turbine bypass valves.

The AFWS is configured into two separate mechanical divisions. Each division consists of one motor driven AFW pump and one turbine driven AFW pump.

~~The AFWS consists of two motor driven AFW pumps and two steam turbine driven pumps configured into four trains.~~ Each motor driven pump provides 100 % of AFW flow capacity and each turbine driven pump provides 100 % of the required capacity to its respective steam generator as assumed in the accident analysis. The pumps are equipped with independent recirculation lines to prevent pump operation against close system.

Each motor driven AFW pump is powered from an independent Class 1E power supply, and feeds one steam generator. One pump at full flow is sufficient to remove decay heat and cool the unit to shutdown cooling system (SCS) entry conditions.

Each turbine driven AFW pump receives steam from an independent main steam line, upstream of the main steam isolation valve (MSIV). Each of the steam feed lines will supply 100 % of the requirements of the turbine driven AFW pump. The turbine driven AFW pump supplies feedwater to the steam generator which provides driving steam, with DC-powered control valves actuated by the auxiliary feedwater actuation signal (AFAS).

The two auxiliary feedwater (AFW) pumps in each mechanical division take suction from a respective common auxiliary feedwater storage tank (AFWST) ~~and have a respective discharge header~~. (LCO 3.7.6) ~~and pump,~~ each pump with a respective discharge header, and pump discharge to a respective steam generator secondary side through a common AFW discharge header, which connects to the steam generator downcomer main feedwater (MFW) piping inside containment.

Each division has two flow paths which are the motor driven AFW pump flow and the turbine driven AFW pump flow, respectively. Each division supplies AFW to the dedicated steam generator.

Replace with B

BASES

BACKGROUND (continued)

The AFW system supplies feedwater to the steam generators upon the loss of normal feedwater supply.

The AFW system is designed to supply sufficient water to the steam generators to remove decay heat with steam generator pressure at the setpoint of the MSSVs.

Subsequently, the AFW system supplies sufficient water to cool the unit to shutdown cooling system entry conditions, and steam is released through the MSADVs.

The AFWS actuates automatically on low steam generator level by the AFAS as described in LCO 3.3.5, “Engineered Safety Feature Actuation System (ESFAS) Instrumentation.” The AFAS logic is designed to feed its respective steam generators with low levels, but the AFW flow to the ruptured steam generator is terminated manually by operator action within 30 minutes after the secondary side pipe rupture event. The AFAS automatically actuates the AFW turbine driven pump and associated DC-operated valves and control when required, to ensure an adequate feedwater supply to the steam generators. DC-operated valves are provided for each AFW line to control the AFW flow to each steam generator.

The AFWS is discussed in Subsection 10.4.9 (Reference 1).

APPLICABLE SAFETY ANALYSES

The AF system mitigates the consequences of any event with a loss of normal feedwater. The design basis of the AFWS is to supply water to the steam generator to remove decay heat and other residual heat, by delivering at least the minimum required flow rate to the steam generators against a steam generator feedwater nozzle pressure of 87.2 kg/cm^{2}A (1,240 psia).

The limiting design basis accidents (DBAs) and transients for the AFWS are as follows:

a. Feedwater line break (FWLB)

b. Loss of normal feedwater

In addition, the minimum available AFW flow and system characteristics are serious considerations in the analysis of a small break loss of coolant accident.

Replace with B

RAI 481-8546 - Question 16-150_Rev.1

RAI 444-8530 - Question 16-131

RAI 498-8595 - Question 16-154

BASES

APPLICABLE SAFETY ANALYSES (continued)

The AFWS design is such that it can perform its function following an FWLB between the main feed water isolation valve and containment, combined with a loss of offsite power following turbine trip, and a single active failure of the turbine driven AFW pump. The AFW flow to the faulted steam generator is terminated manually by the operator action. Sufficient flow would be delivered to the intact steam generator by the redundant AFW pump.

The AFWS satisfies Criterion 3 of 10 CFR 50.36(c)(2)(ii).

LCO

The LCO requires that four independent AFW ~~trains~~ flow paths be OPERABLE to ensure that the AFWS will perform the design safety function to mitigate the consequences of accidents that could result in overpressurization of the reactor coolant pressure boundary. Four independent AFW pumps, ~~in four diverse trains,~~ two divisions, ensure availability of residual heat removal capability for all events accomplished by a loss of offsite power and a single failure. This is accomplished by powering ~~two pumps~~ a motor driven pump in each division from independent emergency buses. ~~The third and fourth AFW pumps are~~ The remainder of the AFW pumps in each division is powered by a diverse means, ~~two steam driven turbines~~ a steam driven turbine supplied with steam from an independent source not isolated by the closure of the MSIVs.

The AFWS is considered to be OPERABLE when the components and flow paths required to provide AFW flow to the steam generators are OPERABLE. This requires that the two motor driven AFW pumps be OPERABLE in two diverse paths, each supplying AFW flow to a separate steam generator. Two turbine driven AFW pumps shall be OPERABLE with steam supplies from the main steam lines upstream of the MSIVs, and each capable of supplying AFW flow to ~~the~~ the dedicated steam generators which provides driving steam. The piping, valves, instrumentation, and controls in the required flow paths shall also be OPERABLE.

The LCO is modified by a Note indicating that one AFW ~~train,~~ flow path, which includes a motor driven pump, is required to be OPERABLE in MODE 4 when a steam generator is relied upon for heat removal. This is because of reduced heat removal requirements, the short period of time in MODE 4 during which AFW is required, and the insufficient steam supply available in MODE 4 to power the turbine driven AFW pump.

insert next page.

Replace with B

BASES

APPLICABILITY

In MODES 1, 2, and 3, the AFWS is required to be OPERABLE and to function in the event that the main feed water is lost. In addition, the AFWS is required to supply enough makeup water to replace steam generator secondary inventory, lost as the unit cools to MODE 4 conditions.

In MODE 4, the AFWS may be used for heat removal via a steam generator.

In MODES 5 and 6, the steam generators are not normally used for decay heat removal, and the AFWS is not required.

ACTIONS

A.1

AFW flow path is inoperable,

If one ~~turbine driven AFW pump is inoperable due to inoperable steam supply, or if a turbine driven pump is inoperable for any reason while in MODE 3 immediately following refueling,~~ action must be taken to restore ~~the inoperable equipment~~ to an OPERABLE status within 7 days. The 7-day Completion Time is reasonable based on the following reasons:

the flow path

a. ~~For the inoperability of one turbine driven AFW pump due to associated inoperable steam supply, the 7-day Completion Time is reasonable due to the redundancy afforded by the remaining OPERABLE turbine driven train.~~

b. ~~For the inoperability of a turbine driven AFW pump while in MODE 3 immediately subsequent to a refueling outage, the 7-day Completion Time is reasonable due to the minimal decay heat levels in this situation.~~

c. ~~For both the inoperability of one turbine driven pump due to inoperable steam supply and an inoperable turbine driven AFW pump while in MODE 3 immediately following a refueling outage, the 7-day Completion Time is reasonable due to the availability of redundant OPERABLE motor driven AFW pumps and due to the low probability of an event requiring the use of the turbine driven AFW pumps.~~

~~Condition A is modified by a Note which limits the applicability of the Condition for an inoperable turbine driven AFW pump in MODE 3 to when the unit has not entered MODE 2 following a refueling. Condition A allows one AFW train to be inoperable for 7 days vice the 72-hour Completion Time in Condition B.~~

Redundancy of the AFWS division, and

Availability of redundant OPERABLE AFW flow path within each division of AFWS.

BASES

ACTIONS (continued)

~~This longer Completion Time is based on the reduced decay heat following refueling and prior to the reactor being critical.~~

B.1

divisions (pump or flow path) inoperable,

With one of the required AFW ~~trains (pump or flow path) inoperable in MODE 1, 2, or 3 for reasons other than Condition A,~~ action must be taken to restore OPERABLE status within 72 hours. The 72-hour Completion Time is reasonable based on the redundant capabilities afforded by the AFWS, the time needed for repairs, and the low probability of a DBA event occurring during this period. ~~Three~~ Two AFW pumps and flow paths remain to supply feedwater to the steam generators.

C.1 ~~and C.2~~

~~With one of the required motor driven AFW trains (pump or flow path) inoperable and one required turbine driven AFW train inoperable due to associated inoperable steam supply, action must be taken to restore the affected equipment to OPERABLE status within 48 hours. Assuming no single active failures when in this condition, the accident (a FLB or MSLB) could result in the loss of the steam supply to the remaining turbine driven AFW pump due to the faulted steam generator (SG). In this condition, the AFWS may no longer be able to meet the required flow to the SGs assumed in the safety analysis, either due to the analysis requiring flow from two AFW pumps or due to the remaining AFW pump having to feed a faulted SG.~~

~~The 48-hour Completion Time is reasonable based on the fact that the remaining motor driven AFW train is capable of providing 100 % of the AFW flow requirements and the low probability of an event occurring that would challenge the AFWS.~~

D.1 and D.2

A.1, B.1, or C.1

When Required Action ~~A.1, B.1, C.1, or C.2~~ cannot be completed within the required Completion Time, the unit must be placed in a MODE in which the LCO does not apply. To achieve this status, the unit must be placed in at least MODE 3 within 6 hours, and MODE 4 within 18 hours.

The allowed Completion Times are reasonable, based on operating experience, to reach the required unit conditions from full power conditions in an orderly manner and without challenging unit systems.

If one AFW flow path in each division is inoperable in MODES 1, 2, and 3, action must be taken to restore an AFW flow path to OPERABLE status within 72 hours. The 72-hours Completion Time is reasonable based on the redundant capabilities afforded by the AFWS, the time needed for repairs, and the low probability of a DBA event occurring during this period. One AFW flow path in each division remains to supply feedwater to the steam generators.

RAI 444-8530 - Question 16-131

RAI 498-8595 - Question 16-154

BASES

ACTIONS (continued)

~~In MODE 4, with three AFW trains inoperable in MODE 1, 2, or 3, operation is allowed to continue because only one motor driven AFW pump is required in accordance with the Note that modifies the LCO. Although it is not required, the unit may continue to cool down and start Shutdown Cooling.~~

E.1

or power reductions are suspended until one AFW flow path

Required Action E.1 is modified by a Note indicating that all required MODE changes ~~are suspended until one AFW train~~ is restored to OPERABLE status.

two AFW divisions

With ~~all four AFW trains~~ inoperable in MODES 1, 2, or 3, the unit is in a seriously degraded condition with no safety related means for conducting a cooldown, and only limited means for conducting a cooldown with non-safety grade equipment. In such a condition, the unit should not be perturbed by any action, including a power change, that may result in a trip. The seriousness of this condition requires that action be started immediately to restore one AFW ~~train~~ to OPERABLE status. LCO 3.0.3 is not applicable as it could force the unit into a less safe condition.

~~F.1~~

flow path

~~Required Action F.1 is modified by a Note indicating that all required MODE changes or power reductions are suspended until one AFW train is restored to OPERABLE status.~~

~~With one AFW train inoperable, action must be taken to immediately restore the inoperable train to OPERABLE status or to immediately verify, by administrative means, the OPERABILITY of a second train. LCO 3.0.3 is not applicable, as it could force the unit into a less safe condition.~~

~~In MODE 4, either the reactor coolant pumps or the SC loops can be used to provide forced circulation as discussed in LCO 3.4.6, "RCS Loops – MODE 4."~~

In MODE 4, with two AFW flow paths, each of which include a motor driven pump, inoperable, action must be taken to immediately restore one flow path, which includes a motor driven pump, to OPERABLE status or to immediately verify, by administrative means, the OPERABILITY of a required AFW flow path.

Replace with B

RAI 444-8530 - Question 16-131

RAI 498-8595 - Question 16-154

BASES

SURVEILLANCE REQUIREMENTS (continued)

The Frequency is reasonable, based on engineering judgment, and other administrative controls to ensure that flow paths remain OPERABLE. To further ensure AFWS alignment, the OPERABILITY of the flow paths is verified following extended outages to determine that no misalignment of valves has occurred. This SR ensures that the flow path from the AFWST to the steam generators is properly aligned by requiring a verification of minimum flow capacity of 650 gpm at 1,240 psia. ~~(This SR is not required by those units that use AFW for normal startup and shutdown.)~~

REFERENCES

1. DCD Tier 2, Subsection 10.4.9.
2. ASME OM Code.

Replace with B

Replacement B (1/10)

B 3.7 PLANT SYSTEMS

B 3.7.5 Auxiliary Feedwater System (AFWS)

BASES

BACKGROUND

The AFWS automatically supplies feedwater to the steam generators to remove decay heat from the reactor coolant system upon the loss of normal feedwater supply. The two auxiliary feedwater (AFW) pumps in each mechanical division take suction from a respective common auxiliary feedwater storage tank (AFWST) (LCO 3.7.6), each pump with a respective discharge header, and discharge to a respective steam generator secondary side through a common AFW discharge header, which connects to the steam generator downcomer main feedwater (MFW) piping inside containment. The steam generator functions as a heat sink for core decay heat. The heat load is dissipated by releasing steam to the atmosphere from the steam generators via the main steam safety valves (MSSVs) (LCO 3.7.1) or main steam atmospheric dump valves (MSADVs) (LCO 3.7.4). If the main condenser is available, steam may be released to the main condenser via the turbine bypass valves.

The AFWS is configured into two separate mechanical divisions, each with one motor driven train and one turbine driven train. Each motor driven pump provides 100 % of AFW flow capacity and each turbine driven pump provides 100 % of the required capacity to its respective steam generator as assumed in the accident analysis. The pumps are equipped with independent recirculation lines to prevent pump operation against close system.

Each motor driven AFW pump is powered from an independent Class 1E power supply, and feeds one steam generator. One pump at full flow is sufficient to remove decay heat and cool the unit to shutdown cooling system (SCS) entry conditions.

Each division has two trains which are the motor driven train and the turbine driven train, respectively. Each division supplies AFW to the dedicated steam generator.

Each turbine driven AFW pump receives steam from an independent main steam line, upstream of the main steam isolation valve (MSIV). Each of the steam feed lines will supply 100 % of the requirements of the turbine driven AFW pump. The turbine driven AFW pump supplies feedwater to the steam generator which provides driving steam, with DC-powered control valves actuated by the auxiliary feedwater actuation signal (AFAS).

Replacement B (2/10)

BASES

BACKGROUND (continued)

The AFWS supplies feedwater to the steam generators upon the loss of normal feedwater supply.

The AFWS is designed to supply sufficient water to the steam generators to remove decay heat with steam generator pressure at the setpoint of the MSSVs.

Subsequently, the AFWS supplies sufficient water to cool the unit to shutdown cooling system entry conditions, and steam is released through the MSADVs.

The AFWS actuates automatically on low steam generator level by the AFAS as described in LCO 3.3.5, "Engineered Safety Features Actuation System (ESFAS) Instrumentation." The AFAS logic is designed to feed its respective steam generators with low levels. The AFAS automatically actuates the AFW turbine driven pump and associated DC-operated valves and control when required, to ensure an adequate feedwater supply to the steam generators. DC-operated valves are provided for each AFW line to control the AFW flow to each steam generator.

The AFWS is discussed in FSAR, Subsection 10.4.9 (Ref. 1).

APPLICABLE SAFETY ANALYSES

The AFWS mitigates the consequences of any event with a loss of normal feedwater. The design basis of the AFWS is to supply water to the steam generator to remove decay heat and other residual heat, by delivering at least the minimum required flow rate to the steam generators at pressure of 87.2 kg/cm^2A (1,240 psia).

The limiting design basis accidents (DBAs) and transients for the AFWS are as follows:

a. Feedwater line break (FWLB)

b. Loss of normal feedwater

In addition, the minimum available AFW flow and system characteristics are serious considerations in the analysis of a small break loss of coolant accident.

BASES

APPLICABLE SAFETY ANALYSES (continued)

The AFWS design is such that it can perform its function following an FWLB between the main feed water isolation valve and containment, combined with a loss of offsite power following turbine trip, and a single active failure of the turbine driven train. The AFW flow to the faulted steam generator is terminated manually by the operator action. Sufficient flow would be delivered to the intact steam generator by the redundant AFW train.

The AFWS satisfies Criterion 3 of 10 CFR 50.36(c)(2)(ii).

LCO

The LCO requires that two AFW divisions, each with one motor driven train and one turbine driven train be OPERABLE to ensure that the AFWS will perform the design safety function to mitigate the consequences of accidents that could result in overpressurization of the reactor coolant pressure boundary. Four independent AFW trains, in two divisions, ensure availability of residual heat removal capability for all events accomplished by a loss of offsite power and a single failure. This is accomplished by powering a motor driven pump in each division from independent emergency buses. The remainder of the AFW pumps in each division is powered by a diverse means, a steam driven turbine supplied with steam from an independent source not isolated by the closure of the MSIVs.

The AFWS is considered to be OPERABLE when the components and flow paths required to provide AFW flow to the steam generators are OPERABLE. This requires that the two motor driven AFW pumps be OPERABLE in two diverse paths, each supplying AFW flow to a separate steam generator. Two turbine driven AFW pumps shall be OPERABLE with steam supplies from the main steam lines upstream of the MSIVs, and each capable of supplying AFW flow to the dedicated steam generators which provides driving steam. The piping, valves, instrumentation, and controls in the required flow paths shall also be OPERABLE.

Assuming a postulated pipe failure concurrent with a single active component failure, four 100 percent capacity pumps are required to be OPERABLE for the AFW system. If one steam generator is not OPERABLE for reactor cooling on an initiating event, the turbine driven pump and the motor-driven pump in that mechanical division are also not OPERABLE due to the respective inoperable steam generator. Concurrent with the initiating event, a single active component failure is considered for the turbine-driven pump or the motor driven pump in the other mechanical division. One AFW pump and the associated SG would remain OPERABLE to provide reactor cooling because of the AFW system design that provides redundant capacity, and motive power that is both independent and diverse. The two 100 percent capacity motor-driven pumps are powered from independent emergency buses and each of the two 100 percent capacity turbine-driven pumps are powered from steam supplied by the respective SG, which provides diversity. This is accomplished by powering two 100 percent capacity motor-driven pumps from independent emergency buses and by a diverse means of steam supply for the two 100 percent capacity turbine-driven pumps.

The LCO is modified by a Note indicating that one AFW flow path, which includes a motor driven pump, is required to be OPERABLE in MODE 4 when a steam generator is relied upon for heat removal. This is because of reduced heat removal requirements, the short period of time in MODE 4 during which AFW is required, and the insufficient steam supply available in MODE 4 to power the turbine driven AFW pump.

Replacement B (5/10)

RAI 498-8595 - Question 16-154

BASES

APPLICABILITY

In MODES 1, 2, and 3, the AFWS is required to be OPERABLE and to function in the event that the main feed water is lost. In addition, the AFWS is required to supply enough makeup water to replace steam generator secondary inventory, lost as the unit cools to MODE 4 conditions.

In MODE 4, the AFWS may be used for heat removal via a steam generator.

In MODES 5 and 6, the steam generators are not normally used for decay heat removal, and the AFWS is not required.

ACTIONS

A.1

If one AFW train is inoperable, action must be taken to restore the flow path to an OPERABLE status within 7 days. The 7 day Completion Time is reasonable based on the following reasons:

a. Redundancy of the AFWS division, and

b. Availability of redundant OPERABLE AFW train within each division of AFWS.

BASES

ACTIONS (continued)

B.1

If a train of each AFW division is inoperable in MODES 1, 2, and 3, action must be taken to restore two trains of an AFW division to OPERABLE status within 72 hours. The 72 hour Completion Time is reasonable based on the redundant capabilities afforded by the AFWS. Each steam generator can be supplied the AFW flow by one 100% train of each division during this period.

One AFW train in each division remains to supply feedwater to the steam generators.

C.1

With one of the required AFW division (pump or flow path) inoperable, action must be taken to restore OPERABLE status within 72 hours. The 72 hour Completion Time is reasonable based on the redundant capabilities afforded by the AFWS, the time needed for repairs, and the low probability of a DBA event occurring during this period.

Two AFW pumps and flow paths remain to supply feedwater to the steam generators.

D.1 and D.2

When Required Action A.1, B.1, or C.1 cannot be completed within the required Completion Time, the unit must be placed in a MODE in which the LCO does not apply. To achieve this status, the unit must be placed in at least MODE 3 within 6 hours, and MODE 4 within 18 hours.

The allowed Completion Times are reasonable, based on operating experience, to reach the required unit conditions from full power conditions in an orderly manner and without challenging unit systems.

BASES

ACTIONS (continued)

E.1

Required Action E.1 is modified by a Note indicating that all required MODE changes or power reductions are suspended until one AFW train is restored to OPERABLE status.

With two AFW divisions inoperable in MODES 1, 2, or 3, the unit is in a seriously degraded condition with no safety related means for conducting a cooldown, and only limited means for conducting a cooldown with non-safety grade equipment. In such a condition, the unit should not be perturbed by any action, including a power change, that may result in a trip. The seriousness of this condition requires that action be started immediately to restore one AFW flow path to OPERABLE status.

LCO 3.0.3 is not applicable as it could force the unit into a less safe condition.

F.1

Required Action F.1 is modified by a Note indicating that all required MODE changes or power reductions are suspended until one AFW motor driven train is restored to OPERABLE status.

With two AFW trains, each of which includes a motor driven train inoperable in MODE 4, action must be taken to immediately restore the inoperable train to OPERABLE status or to immediately verify, by administrative means, the OPERABILITY of a required AFW train.

LCO 3.0.3 is not applicable, as it could force the unit into a less safe condition.

BASES

SURVEILLANCE REQUIREMENTS

SR 3.7.5.1

Verifying the correct alignment for manual, power operated, and automatic valves in the AFW water and steam flow paths provides assurance that the proper flow paths exist for AFW operation. This SR does not apply to valves which are locked, sealed, or otherwise secured in position, since these valves are verified to be in the correct position prior to locking, sealing, or securing. This SR also does not apply to valves that cannot be inadvertently misaligned, such as check valves. This Surveillance does not require any testing or valve manipulations. Rather, it involves verification that those valves capable of potentially being mispositioned are in the correct position.

The 31 day Frequency is based on engineering judgment, is consistent with the procedural controls governing valve operation and ensures correct valve positions.

SR 3.7.5.2

Verifying that each AFW pump's developed head at the flow test point is greater than or equal to the required developed head ensures that AFW pump performance has not degraded during the cycle. Flow and differential head are normal tests of pump performance required by the ASME OM Code (Ref. 2). Because it is undesirable to introduce cold AFW into the steam generators while they are operating, this testing is performed on recirculation flow. This test confirms one point on the pump design curve and is indicative of overall performance. Such in-service tests confirm component OPERABILITY, trend performance, and detect incipient failures by indicating abnormal performance. Performance of in-service testing, discussed in the ASME OM Code (Ref. 2), at 3 month intervals satisfies this requirement.

This SR is modified by a Note indicating that the SR should be deferred until suitable test conditions are established. This deferral is required because there is an insufficient steam pressure to perform the test.

SR 3.7.5.3

This SR ensures that AFW can be delivered to the appropriate steam generator, in the event of any accident or transient that generates an AFAS signal, by demonstrating that each automatic valve in the flow path actuates to its correct position on an actual or simulated actuation signal. This Surveillance is not required for valves that are locked, sealed, or otherwise secured in the required position under administrative controls.

BASES

SURVEILLANCE REQUIREMENTS (continued)

The 18 month Frequency is based on the need to perform this Surveillance under the conditions that apply during a unit outage and the potential for an unplanned transient if the Surveillance were performed with the reactor at power. The 18 month Frequency is acceptable based on the design reliability and operating experience of the equipment.

This SR is modified by a Note that states the SR is not required to be met in MODE 4. In MODE 4, the required AFW train is already aligned and operating.

SR 3.7.5.4

This SR ensures that the AFW pumps will start in the event of any accident or transient that generates an AFAS signal by demonstrating that each AFW pump starts automatically on an actual or simulated actuation signal. The 18 month Frequency is based on the need to perform this Surveillance under the conditions that apply during a unit outage and the potential for an unplanned transient if the Surveillance were performed with the reactor at power. The 18 month Frequency is acceptable based on the design reliability and operating experience of the equipment.

This SR is modified by two Notes. Note 1 indicates that the SR be deferred until suitable test conditions are established. This deferral is required because there is insufficient steam pressure to perform the test. Note 2 states that the SR is not required to be met in MODE 4. In MODE 4, the required pump is already operating.

SR 3.7.5.5

This SR ensures that the AFWS is properly aligned by verifying the flow path to each steam generator prior to entering MODE 2 operation, after 30 days in any combination of MODE 5, 6, or defueled. OPERABILITY of AFW flow paths must be verified before sufficient core heat is generated that would require the operation of the AFWS during a subsequent shutdown.

BASES

SURVEILLANCE REQUIREMENTS (continued)

The Frequency is reasonable, based on engineering judgment, and other administrative controls to ensure that flow paths remain OPERABLE. To further ensure AFWS alignment, the OPERABILITY of the flow paths is verified following extended outages to determine that no misalignment of valves has occurred. This SR ensures that the flow path from the AFWST to the steam generators is properly aligned by requiring a verification of minimum flow capacity of 2,461 L/min (650 gpm) at 87.2 kg/cm^2A (1,240 psia).

BASES

SURVEILLANCE REQUIREMENTS

SR 3.7.6.1

the AFWST of each AFW division

This SR verifies that ~~each AFWST~~ contains the required volume of cooling water. (This level greater than or equal to 1,524,165 L (400,000 gal)) The ~~12 hour~~ Frequency is based on operating experience and the need for operator awareness of unit evolutions that could affect the AFWST inventory between checks. The ~~12 hour~~ Frequency is considered adequate in view of other indications in the MCR, including alarms, to alert the operator to abnormal AFWST level deviations.

12 hour

12 hour

is

REFERENCES

1. DCD Tier 2, Subsection 10.4.9.
2. DCD Tier 2, Chapter 6.
3. DCD Tier 2, Chapter 15.
4. NUREG-0800, BTP 5-4, Rev. 3, March 2007.