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10 CFR 50.12
10 CFR 52.63

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555-0001

LEVY NUCLEAR PLANT, UNITS 1 AND 2
DOCKET NOS. 52-029 AND 52-030
SUBMITTAL OF EXEMPTION REQUEST AND DESIGN CHANGE DESCRIPTION FOR DEPARTURE FROM AP1000 DCD REVISION 19 TO ADDRESS COMPLIANCE WITH IEEE 603-1991

Ladies and Gentlemen:

Duke Energy Florida (DEF) hereby submits our request for exemption and associated design change description to address a design change to the AP1000 Design Control Document (DCD) Revision 19. This design change requires Nuclear Regulatory Commission (NRC) notification and review in accordance with Interim Staff Guidance DC/COL-ISG-011, "Finalizing Licensing-basis Information." The Levy Nuclear Plant (LNP) Combined License Application (COLA) incorporates the AP1000 DCD by reference.

In Enclosure 1, DEF submits an exemption request which includes a revision to Technical Specification Table 3.3.2-1 and the associated Bases, to reflect the addition of Permissive P-8. Enclosure 2 provides the Tier 2 involved changes to the DCD, which includes the Technical Specification and associated bases changes. The corresponding changes to the COLA identified in Enclosure 3 will be included in a future update of the Levy COLA.

If you have any further questions, or need additional information, please contact Bob Kitchen at (704) 382-4046, or me at (704) 382-9248.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on September 1, 2015.

Sincerely,

Robert H. Kitchen for

Christopher M. Fallon
Vice President - Nuclear Development

Enclosures:

1. Request For Exemption Regarding IEEE 603-1991 Compliance
2. Tier 2: Licensing Basis Documents - Proposed Changes
3. Levy Nuclear Plant Units 1 and 2 COLA Revisions

D094
NRO

cc (w/o enclosures): U.S. NRC Region II, Regional Administrator

cc (w/ enclosures): Mr. Donald Habib, U.S. NRC Project Manager

Duke Energy
Enclosure 1
Levy Nuclear Plant Units 1 and 2

Request For Exemption Regarding IEEE 603-1991 Compliance

(13 pages including cover page)

1.0 Summary Description

IEEE 603 - 1991 is a standard for safety systems imposed directly by 10 CFR part 50.55a(h). Clause 6.6 of the standard establishes requirements for "Operating Bypasses". IEEE 603 requires safety systems automatically prevent operating bypass of a safety function whenever applicable permissive conditions are not met; and requires that the safety system either remove the bypass, restore permissive conditions, or actuate appropriate safety functions if plant conditions change such that an activated operating bypass is no longer permissible.

Operating bypasses are included in the AP1000 design to allow functions to be blocked so normal plant operations can occur without unnecessary actuation of safety systems. All of the protective actions initiated by the Protection and Safety Monitoring System (PMS) comply with the criteria of IEEE 603 Clause 6.6 with the exception of the PMS arrangements for blocking the source range neutron flux doubling logic input to Boron Dilution Block shown on DCD Figure 7.2-1 (Sheet 3 of 21).

The block of the flux doubling logic did comply with IEEE 603-1991 with regard to resetting the block when shutting down from power operations. The flux doubling logic would be reset (the block removed) when neutron flux fell below the P-6 setpoint, which satisfied a part of IEEE 603. However, the PMS did not comply with the requirement to impose permissive conditions on block of the flux doubling logic. On the contrary, the operators were able to block the flux doubling logic at any time, as no permissive conditions were programmed into the PMS to permit blocking the flux doubling logic for Boron Dilution Block. In addition, the PMS included no logic to reinstate permissive conditions or actuate the necessary protective functions when the conditions were not met.

Changes are proposed to ensure compliance with IEEE 603 and to support normal plant operation needs:

1) Add a new permissive, P-8, to permit blocking the flux doubling logic during reactor startup. (P-8 provides the logical permissive input to the PMS. P-8 is set to 551°F Reactor Coolant System (RCS) temperature, the minimum temperature for criticality.)
2) Add logic that will cause the PMS to force CVS valves 136A and 136B closed if the flux doubling logic is blocked when reactor temperature is less than P-8. (This ensures a permissible condition exists before flux doubling is bypassed below P-8, which is one option from IEEE 603 - 1991, the other being to perform the appropriate safety functions.)
3) When RCS temperature is below P-8, reset the flux doubling logic if CVS valves 136A and 136B are opened.
4) Add an additional reset of source range flux doubling logic when RCS temperature falls below P-8. Existing PMS design resets flux doubling logic when neutron flux decreases below P-6.
5) Include new permissive and actuation in Tech Specs, and describe the changes in Tier 2 information.

2.0 Description of Licensing Basis Impacts

<u>System Description</u>

The AP1000 CVS is a nonsafety-related system. However, portions of the system are safety-related and perform safety-related functions, such as containment isolation,

termination of inadvertent RCS boron dilution, RCS pressure boundary preservation, and isolation of excessive makeup. Boron dilution events during low power modes can occur for a number of reasons, including malfunctions of the makeup control system. Regardless of the cause, the protection is the same.

The CVS is designed to avoid and/or terminate boron dilution events by isolating sources of unborated water to the RCS during all modes of operation when signaled to do so by the PMS. Specifically, isolation valves APP-CVS-PL-V136A/B on the demineralized water supply line and valves APP-CVS-PL-V090 and APP-CVS-PL-V091 on the makeup discharge header will close upon actuation of the safety–related Boron Dilution Block signal. As described in DCD subsection 7.3.1.2.14, the Boron Dilution Block protection signal is safety-related and is generated upon any reactor trip signal, source-range flux doubling signal, low input voltage to the Class 1E dc and uninterruptible power supply system (IDS) battery chargers, or a safety injection signal. The safety analysis of boron dilution accidents is provided in DCD Chapter 15 and is discussed in subsection 19E.4.5 of DCD Appendix 19E.

During low power and shutdown events, the Boron Dilution Block signal may be provided by the source range neutron flux monitors. In the event of an excessive increasing rate of source range flux doubling signal, the PMS accomplishes the Boron Dilution Block by closing the CVS Makeup Line Isolation Valves (CVS-V090 and CVS-V091) and by closing the two series, safety-related, remotely-operated Demineralized Water Isolation Valves (CVS-V136A/B). The flux doubling signal also provides a nonsafety-related trip of the CVS makeup pumps. (DCD 7.3.1.2.14 Boron Dilution Block).

During shutdown and refueling operations when the source range neutron flux doubling logic is initialized, the source range neutron detectors detect a boron dilution event by averaging of the source range count rate over a time period, and comparing that average to a similar average taken at an earlier time period. If the ratio of the current average count rate to the earlier average count rate is greater than a preset value, a protective signal is generated in the PMS. A detailed description of the flux doubling calculation and accompanying PMS voting logic is provided in DCD subsection 7.3.1.2.14.

The PMS allows manual blocking of the source range flux doubling logic input to the Boron Dilution Block. The manual block is provided to avoid an unnecessary actuation of the Boron Dilution Block during shutdown operations. The Boron Dilution Block signal provided by the source range flux doubling logic could be actuated during operations such as fuel shuffling, control rod testing, boron concentration changes, and RCS heatup from cold shutdown conditions. The operator can block Boron Dilution Block under certain plant conditions. The block of Boron Dilution Block is reset when neutron flux decreases below the P-6 interlock, which falls within the decades of range overlap between the intermediate range neutron flux monitors and the source range neutron flux monitors.

Administrative controls are implemented to assure systems and components needed to mitigate an inadvertent boron dilution event are operable. During shutdown MODES, the ability to terminate inadvertent boron dilution events is assured by satisfying Technical Specifications 3.1.9 and 3.3.2. Technical Specification 3.1.9 requires the Demineralized Water Isolation Valves and CVS Makeup Line Isolation Valves to be OPERABLE in MODES 1, 2, 3, 4, and 5. Technical Specification 3.3.2 requires four source range neutron flux doubling circuits to be OPERABLE under various shutdown modes, with exceptions for the approach to criticality and when the dilution path is isolated (Table 3.3.2-1).

For refueling operations (MODE 6), administrative controls preclude the possibility boron dilutions by verifying CVS valves V092, V108, V126, and V136A/B are closed and locked. These valves block the flow paths that can allow unborated makeup water to reach the RCS. Makeup required during refueling uses borated water supplied from the boric acid tank by the CVS makeup pumps. The potential for an uncontrolled boron dilution event is precluded by isolating these unborated water sources as required by Technical Specification 3.9.2.

Also during refueling operations (MODE 6), two source-range neutron flux monitors are required to be operable to monitor core reactivity. This is required by the plant Technical Specification 3.9.3. The two operable source-range neutron flux monitors provide a signal to alert the operator to unexpected changes in core reactivity, even while the potential for an uncontrolled boron dilution accident is precluded by isolating the unborated water sources in compliance with LCO 3.9.2.

The source range flux doubling signal may be manually blocked to prevent unnecessary actuation of the protective function during plant startup and normal power operation. When the signal is blocked below P-8, the PMS ensures a permissible condition exists by closing valves V136A/B; and does not need to close the makeup line containment isolation valves V091 and V092. While the Boron Dilution Block function terminates an unanticipated dilution, the actions associated with manual block of Boron Dilution Block preclude the possibility of a boron dilution event. When the manual block is activated, valves V091 and V092 do not need to be closed because the makeup line is filled with borated water. During startup the RCS inventory will be replenished by blending the flow of highly borated water from the boric acid storage tank with unborated water from the demineralized water storage tank. (See DCD Figure 9.3.6-1 (Sheet 2 of 2).) This blended flow of makeup water is closely monitored. These startup operations cause the CVS makeup line to be filled with borated water from the reactor coolant system. Below P-8, before blocking the source range neutron flux doubling logic, the operators are directed to close valves V136A/B, thus isolating the sole source of unborated water at that time. As stated previously, the PMS sends a confirmatory signal to close these valves when the flux doubling logic is blocked. Because the CVS makeup lines are filled with borated primary coolant at this time, closure of the demineralized water system isolation valves (CVS-V136A/B) eliminates the possibility of a boron dilution while the flux doubling logic is blocked.

In order to return to power operation, a means to lower RCS boron concentration must be available in order to establish the proper core reactivity conditions for a controlled return to criticality. As the RCS heats above P-8 it is necessary to initiate blended flow of water to the RCS to increase reactor power. The source range flux doubling input to the Boron Dilution Block may be blocked at this time. The operators will be closely monitoring intentional dilution. The potential for inadvertent dilution exists in these situations if some other event occurs to divert the operators' attention away from the dilution operation. Therefore, in response to other plant signals the PMS also initiates preemptive valve closures to preclude the possibility of a dilution event. For example, if a loss of offsite power occurs at this time, the attention of the plant operators could be directed away from a dilution operation to address the event. In addition, if power were to return after some short delay, the operators may not remember that a dilution was in progress. For this reason, Boron Dilution Block is activated by other signals when the RCS is above P-8. Loss of input voltage to the IDS battery chargers will initiate the Boron Dilution Block as described in DCD subsection 7.3.1.2.14. The Boron Dilution Block is activated upon P-4 for similar reasons. Inadvertent dilution events which occur after the flux doubling circuit is blocked for reactor startup are mitigated by the source range, intermediate range and power range (low

setpoint) high flux reactor trips as long as any existing P-4 signal is reset. Inadvertent dilution events at power are mitigated by the overtemperature delta-T reactor trip or by operator action.

The source range neutron flux doubling logical input to the Boron Dilution Block function is automatically reinitialized when reactor power is decreased below the P-6 power level (DCD Table 7.2-3) during shutdown. (DCD 7.3.1.2.14 Boron Dilution Block)

Supporting Technical Details

Design changes are required for the PMS source range neutron flux doubling logic to comply with the requirements of IEEE 603 - 1991, Clause 6.6 (Operating Bypasses). The manual block of the source range flux doubling logic portion of the Boron Dilution Block logic does not comply with the two requirements contained in Clause 6.6 of IEEE 603 - 1991; which requires the PMS: 1) Automatically prevent an operational bypass or initiate appropriate safety functions whenever the permissive conditions are not met, and 2) Automatically remove an activated bypass; restore plant conditions, or initiate the appropriate safety functions when plant conditions change so the bypass is no longer permissible.

The following design changes will ensure verbatim compliance with IEEE 603 and to support normal plant operation needs; 1) Add a new permissive, P-8 (RCS temperature > 551°F), to permit blocking the flux logic during reactor startup; 2) Add logic that will cause the PMS to force CVS valves 136A and 136B closed if the flux doubling logic is blocked during shutdown conditions (RCS temperature < 551°F); 3) Reset the flux doubling logic if the closure signal for CVS valves 136A and 136B is reset when reactor temperature is below P-8; 4) Add reset of flux doubling logic when RCS temperature decreases below P-8; 5) Add a note to Tech Spec Table 3.3.2-1 to permit the flux doubling logic to be blocked in Modes 2, 3, 4 and 5 during shutdown conditions.

The purpose of blocking the source range flux doubling logic during shutdown conditions is to permit necessary plant shutdown, refueling and startup operations that could lead to unnecessary actuation of the Boron Dilution Block (e.g., control rod testing) by the flux doubling algorithm. In this case, the PMS forces the redundant demineralized water isolation valves (CVS-V136A/B) closed to ensure a boron dilution event cannot occur while the protection provided by the flux doubling algorithm is blocked. As soon as the block during shutdown conditions is removed, once again ensuring protection by the flux doubling algorithm, the demineralized water valves can be reopened by the operators as required. Closing the demineralizer water isolation valves eliminates the possibility of a dilution event.

Technical Specification Changes

The Technical Specifications (TS) and TS Bases will be updated as follows:

- Technical Specifications Table 3.3.2-1 (Page 9 of 13), Engineered Safeguards Actuation System Instrumentation, Function 15, Boron Dilution Block-Source Range Neutron Flux Doubling to add that for MODE 3 this function is not applicable for valve isolation functions whose associated flow path is isolated.
- Technical Specifications Table 3.3.2-1 (Page 10 of 13), Engineered Safeguards Actuation System Instrumentation, Function 18, ESFAS Interlocks, insert a new item d. for Reactor Coolant Average Temperature, P-8.

- Tech Spec Bases Section B3.3.2, Applicable Safety Analyses, LCOs, and Applicability, (Page B 3.3.2-36),Subsection 15, revise Boron Dilution Block to clarify the equipment actuated.
- Tech Spec Bases Section B3.2.2, Applicable Safety Analyses, LCOs, and Applicability (Pages B 3.3.2-42 and B 3.3.2-43), add Subsection 18.d., Reactor Coolant Average Temperature, P-8 and change numbering of following sections accordingly.
- Tech Spec Bases Section B3.3.2 under ACTIONS (Page B3.3.2-57), add P-8 to the interlocks applicable to Condition J.

Tier 2 Changes

- Figure 7.2-1 (Sheet 3 of 21); Add logic for condition when source range flux doubling signal may be manually blocked and automatically reset.
- Section 7.3.1.2.14, Boron Dilution Block; Revise discussion of conditions when the source range flux doubling signal may be manually blocked and when it is reinstated.
- Table 7.3-1, Engineered Safety Features Actuation Signals (ESFAS) (Sheet 6 of 9) to replace the permissive for the flux doubling calculation signal for Block of Boron Dilution with one that reflects revised conditions when manual block is permitted and automatic unblock occurs.
- Table 7.3-1 (Sheet 7 of 9) to replace the permissive for the flux doubling calculation signal for Chemical Volume Control System Isolation with the same permissive as was used for the Block of Boron Dilution on Sheet 6 Of 9.
- Table 7.3-2, Interlocks for ESFAS (Sheet 1 of 4) revise to insert new rows for P-8 designations.
- Section 9.3.6.3.7, under Demineralized Water System Isolation Valves, add statement that valves also close during shutdown conditions, whenever the flux doubling signal is blocked to prevent inadvertent boron dilution.
- Section 9.3.6.4.5.1, Boron Dilution Events; add statement when flux doubling signal is blocked during shutdown, the demineralized water system isolation valves are closed to prevent inadvertent boron dilution.
- Section 9.3.6.7, Instrumentation Requirements, under Demineralized Water System Isolation Valves; add statement when flux doubling signal is blocked during shutdown, the demineralized water system isolation valves are closed to prevent inadvertent boron dilution.
- Table 14.3-2 (Sheet 9 of 17), Design Basis Accident Analysis, under reference to Section 7.3.1.2.14; add statement which describes when demineralized water system isolation valves close, that they also close if source range flux doubling is blocked during shutdown conditions.
- Table 14.3-2 (Sheet 12 of 17) under reference to Section 9.3.6.7, Instrument Requirements under discussion for the demineralized water system isolation valves; add statement which describes when isolation valves for the demineralized water system close, that they also close if source range flux doubling is blocked during shutdown conditions.
- Section 19E.2.7.2, Design Features to Address Shutdown Safety (for the demineralized water system); add that the source-range flux-doubling signal "closes the safety related

remotely operated CVS makeup line isolation valves to terminate the event", as well as isolating the line from the demineralized water system "to the makeup pump suction" by closing two safety related remotely operated valves.

3.0 Technical Evaluation

According to IEEE 603:

***operating bypass*:** Inhibition of the capability to accomplish a safety function that could otherwise occur in response to a particular set of generating conditions.

NOTE—An operating bypass is not the same as a maintenance bypass. Different modes of plant operation may necessitate an automatic or manual bypass of a safety function. Operating bypasses are used to permit mode changes (e.g., prevention of initiation of emergency core cooling during the cold shutdown mode).

Clause 6.6 Operating bypasses

Whenever the applicable permissive conditions are not met, a safety system shall automatically prevent the activation of an operating bypass or initiate the appropriate safety function(s). If plant conditions change so that an activated operating bypass is no longer permissible, the safety system shall automatically accomplish one of the following actions:

a) Remove the appropriate active operating bypass(es)

b) Restore plant conditions so that permissive conditions once again exist

c) Initiate the appropriate safety function(s)

<u>Summary</u>

Although there are plant-specific DCD Tier 2 and generic TS changes, the resulting reduction in standardization caused by these changes does not cause a decrease in safety.

The proposed changes ensure the PMS source range flux doubling design functions to prevent an inadvertent dilution of the reactor coolant system are met. The proposed changes include the following design and licensing basis changes for the PMS flux doubling calculation function:

1. An automatic actuation of the isolation function is added if the flux doubling calculation function is bypassed when conditions do not allow.
2. The description of the flux doubling function is provided in sections 7.3 and 9.3.
3. A description of the requirements added to the design and licensing basis in sections 14.3 and 19E.2.

The proposed changes do not adversely affect any safety-related equipment or function, design function, radioactive material barrier or safety analysis.

4.0 Regulatory Evaluation

4.1 Exemption Justification

4.1.1 Pursuant to 10 CFR §52.63(b)(1), an exemption from elements of the design as certified in the 10 CFR Part 52, Appendix D, design certification rule is requested for a departure from the generic TS. These departures are contained in Technical Specifications. This exemption request is in accordance with the provisions of 10 CFR §50.12, 10 CFR §52.7, and 10 CFR Part 52, Appendix D, as demonstrated below.

Applicable Regulation(s): 10 CFR Part 52, Appendix D, Section III.B

Specific wording from which exemption is requested:

"III. Scope and Contents

B. An applicant or licensee referencing this appendix, in accordance with Section IV of this appendix, shall incorporate by reference and comply with the requirements of this appendix, including Tier 1, Tier 2 (including the investment protection short-term availability controls in Section 16.3 of the DCD), and the generic TS except as otherwise provided in this appendix. Conceptual design information in the generic DCD and the evaluation of severe accident mitigation design alternatives in appendix 1B of the generic DCD are not part of this appendix."

4.1.2 DEF evaluated this exemption request in accordance with 10 CFR Part 52, Appendix D, Section VIII.A.4, 10 CFR §50.12, 10 CFR §52.7 and 10 CFR §52.63, which states the NRC may grant exemptions from the requirements of the regulations provided the following six conditions are met: 1) the exemption is authorized by law [§50.12(a)(1)]; 2) the exemption will not present an undue risk to the health and safety of the public [§50.12(a)(1)]; 3) the exemption is consistent with the common defense and security [§50.12(a)(1)]; 4) special circumstances are present [§50.12(a)(2)]; 5) the special circumstances outweigh any decrease in safety that may result from the reduction in standardization caused by the exemption [§52.63(b)(1)]; and 6) the design change will not result in a significant decrease in the level of safety [Part 52, Appendix D, VIII.A.4]. The requested exemption satisfies the criteria for granting specific exemptions, as described below.

1. This exemption is authorized by law

The NRC has authority under 10 CFR §§ 50.12, 52.7, and 52.63 to grant exemptions from the requirements of NRC regulations. Specifically, 10 CFR §§50.12 and 52.7 state the NRC may grant exemptions from the requirements of 10 CFR Part 52 upon a proper showing. No law exists that would preclude the changes covered by this exemption request. Additionally, granting of the proposed exemption does not result in a violation of the Atomic Energy Act of 1954, as amended, or the Commission's regulations.

Accordingly, this requested exemption is "authorized by law," as required by 10 CFR §50.12(a)(1).

2. **This exemption will not present an undue risk to the health and safety of the public**

The proposed exemption from the requirements of 10 CFR 52, Appendix D, Section III.B would allow changes to elements of the generic Technical Specifications to depart from the AP1000 certified (Tier 2) information. The plant-specific Tier 1 DCD will continue to reflect the approved licensing basis for the applicant, and will maintain a consistent level of detail with that which is currently provided elsewhere in Tier 1 of the plant-specific DCD. Because the change to the source range flux doubling function description maintains its design functions, the changed design will ensure the protection of the health and safety of the public. Therefore, no adverse safety impact which would present any additional risk to the health and safety of the public is present. The affected Design Description in the generic Technical Specifications will continue to provide the detail necessary to support the performance of the function requirements.

Therefore, the requested exemption from 10 CFR 52, Appendix D, Section III.B would not present an undue risk to the health and safety of the public.

3. **The exemption is consistent with the common defense and security**

The exemption from the requirements of 10 CFR 52, Appendix D, Section III.B would change elements of the generic Technical Specifications by departing from the AP1000 certified design information relating to the flux doubling function. The exemption does not alter the design, function, or operation of any structures or plant equipment that are necessary to maintain a secure status of the plant. The proposed exemption has no impact on plant security or safeguards procedures.

Therefore, the requested exemption is consistent with the common defense and security.

4. **Special circumstances are present**

10 CFR §50.12(a)(2) lists six "special circumstances" for which an exemption may be granted. Pursuant to the regulation, it is necessary for one of these special circumstances to be present in order for the NRC to consider granting an exemption request. The requested exemption meets the special circumstances of 10 CFR §50.12(a)(2)(ii). That subsection defines special circumstances as when "Application of the regulation in the particular circumstances would not serve the underlying purpose of the rule or is not necessary to achieve the underlying purpose of the rule."

The rule under consideration in this request for exemption from the Tier 2 generic TS is 10 CFR 52, Appendix D, Section III.B, which requires an applicant referencing the AP1000 Design Certification Rule (10 CFR Part 52, Appendix D) shall incorporate by reference and comply with the requirements of Appendix D, including Tier 1 information and generic TS. The Levy Units 1 and 2 COLA references the AP1000 Design Certification Rule and incorporates by reference the requirements of 10 CFR Part 52, Appendix D, including Tier 1 information and generic TS. The underlying purpose of Appendix D, Section III.B is to describe and define the scope and contents of the AP1000 design certification, and to require compliance with

the design certification information in Appendix D to maintain the level of safety in the design.

The proposed changes to the flux doubling logic pertaining to the source range neutron flux doubling maintains the design margins of reactor startup protection. This change does not impact the ability of any structures, systems, or components to perform their functions or negatively impact safety. Accordingly, this departure from the certification information in Tier 2 Sections 7.2, 7.3, 9.3, 14.3 and 19E.2, and TS 3.3.2 will enable the applicant to safely construct and operate the AP1000 facility consistent with the design certified by the NRC in 10 CFR 52, Appendix D.

Therefore, special circumstances are present, because application of the current generic TS as required by 10 CFR Part 52, Appendix D, Section III.B, in the particular circumstances discussed in this request is not necessary to achieve the underlying purpose of the rule.

5. **The special circumstances outweigh any decrease in safety that may result from the reduction in standardization caused by the exemption**

Based on the nature of the changes to the Tier 2 generic TS and the understanding that these changes support the design function of the Source Range flux doubling function, it is likely other AP1000 applicants and licensees will request this exemption. However, if this is not the case, the special circumstances continue to outweigh any decrease in safety from the reduction in standardization because the key design functions of the Source Range flux doubling function associated with this request will continue to be maintained. This exemption request and the associated marked-up table and TS Bases demonstrate the Source Range flux doubling function continues to be maintained following implementation of the change from the generic AP1000 DCD, thereby minimizing the safety impact resulting from any reduction in standardization.

Therefore, the special circumstances associated with the requested exemption outweigh any decrease in safety that may result from the reduction in standardization caused by the exemption. In fact, as described in Condition 6 below, the exemption will result in no reduction in the level of safety.

6. **The design change will not result in a significant decrease in the level of safety.**

The exemption revises the generic Technical Specifications by adding components to TS Table 3.3.2-1. Because the Source Range neutron flux doubling design function is met, there is no reduction in the level of safety.

Therefore, the design change and associated change to the TS will not result in a significant decrease in the level of safety.

As demonstrated above, this exemption request satisfies NRC requirements for an exemption to the design certification rule for the AP1000.

4.2 Significant Hazards Consideration

4.2.1 Does the proposed change involve a significant increase in the probability or consequences of an accident previously evaluated?

No accident previously evaluated in the plant-specific DCD is attributed to the failure of the flux doubling isolation function features of the design. The proposed changes also meet applicable NRC general design criteria requirements. As the proposed changes do not involve any components that could initiate an event by means of component or system failure, the changes do not increase the probability of a previously evaluated accident.

The changes do not alter design features available during normal operation or anticipated operational occurrences. Nonsafety-related features used for reactor coolant activity monitoring, or reactor coolant chemistry control remain unaffected. The changes do not adversely impact accident source term parameters or affect any release paths used in the safety analyses, which could increase radiological dose consequences. Thus the radiological releases associated with the Chapter 15 accident analyses are not affected.

The components added by this change would not increase the consequences of an accident previously evaluated in the plant-specific DCD. Therefore, the proposed changes do not involve a significant increase in the probability or consequences of an accident previously evaluated.

4.2.2 Does the proposed change create the possibility of a new or different kind of accident from any accident previously evaluated?

The new permissive does not interface with PMS functions in other systems that provide safety-related or defense-in-depth support to the plant, thus precluding the possibility of reactor protection features being defeated. The affected equipment does not interface with any component whose failure could initiate an accident. The modified components do not incorporate any active features relied upon to support normal operation. Therefore, the proposed component changes do not introduce new failure modes, interactions or dependencies, the malfunction of which could lead to new accident scenarios. Therefore, the proposed changes do not create the possibility of a new or different kind of accident from any accident previously evaluated.

4.2.3 Does the proposed change involve a significant reduction in a margin of safety?

The proposed changes do not involve a significant reduction in the margin of safety. The proposed changes do not reduce the redundancy or diversity of any safety-related functions. The protection provided by source range flux doubling would continue to meet its acceptance criteria.

The DCD Chapters 6 and 15 analyses results are not affected, thus margins to the regulatory acceptance criteria are unchanged. No design basis safety analysis or acceptance criterion is challenged or exceeded by the proposed changes. Therefore, the proposed changes do not involve a significant reduction in a margin of safety.

4.3 Applicable Regulatory Requirements/Criteria

10 CFR 52, Appendix D, Section VIII.B.5.a requires that an applicant or licensee who references this appendix may depart from Tier 2 information, without prior NRC

approval, unless the proposed departure involves a change to or departure from Tier 1 information, Tier 2* information, or the Technical Specifications, or requires a license amendment under paragraphs B.5.b or B.5.c of that section. When evaluating the proposed departure, an applicant or licensee shall consider all matters described in the plant-specific DCD. This exemption request involves a departure from the Tier 2 generic Technical Specifications Table 3.3.2-1, and Tier 2 involved departures.

4.4 Precedent

No precedent is cited.

4.5 Conclusions

Based on the considerations discussed above:

(1) there is reasonable assurance the health and safety of the public will not be endangered by operation in the proposed manner, and

(2) such activities will be conducted in compliance with the Commission's regulations, and

(3) the issuance of the exemption will not be inimical to the common defense and security or to the health and safety of the public.

The above evaluations demonstrate the requested changes can be accommodated without an increase in the probability or consequences of an accident previously evaluated, without creating the possibility of a new or different kind of accident from any accident previously evaluated, and without a significant reduction in a margin of safety. Having arrived at negative declarations with regard to the criteria of 10 CFR 50.92, this assessment determines the requested change does not involve a Significant Hazards Consideration.

5.0 Risk Assessment

A risk assessment was determined to be not applicable to address the acceptability of this request.

6.0 References

1) Westinghouse Electric Company, AP1000 Design Control Document, Revision 19, June 2011

2) 10 CFR 50.55a(h)

3) IEEE 603 - 1991, IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations

4) Westinghouse Electric Company, Design Change Proposal, APP-GW-GEE-4827, Revision 0, Changes to Ensure PMS Compliance with IEEE 603 Operating Bypass Requirements

5) Westinghouse Electric Company, CAPAL 100016344

Duke Energy

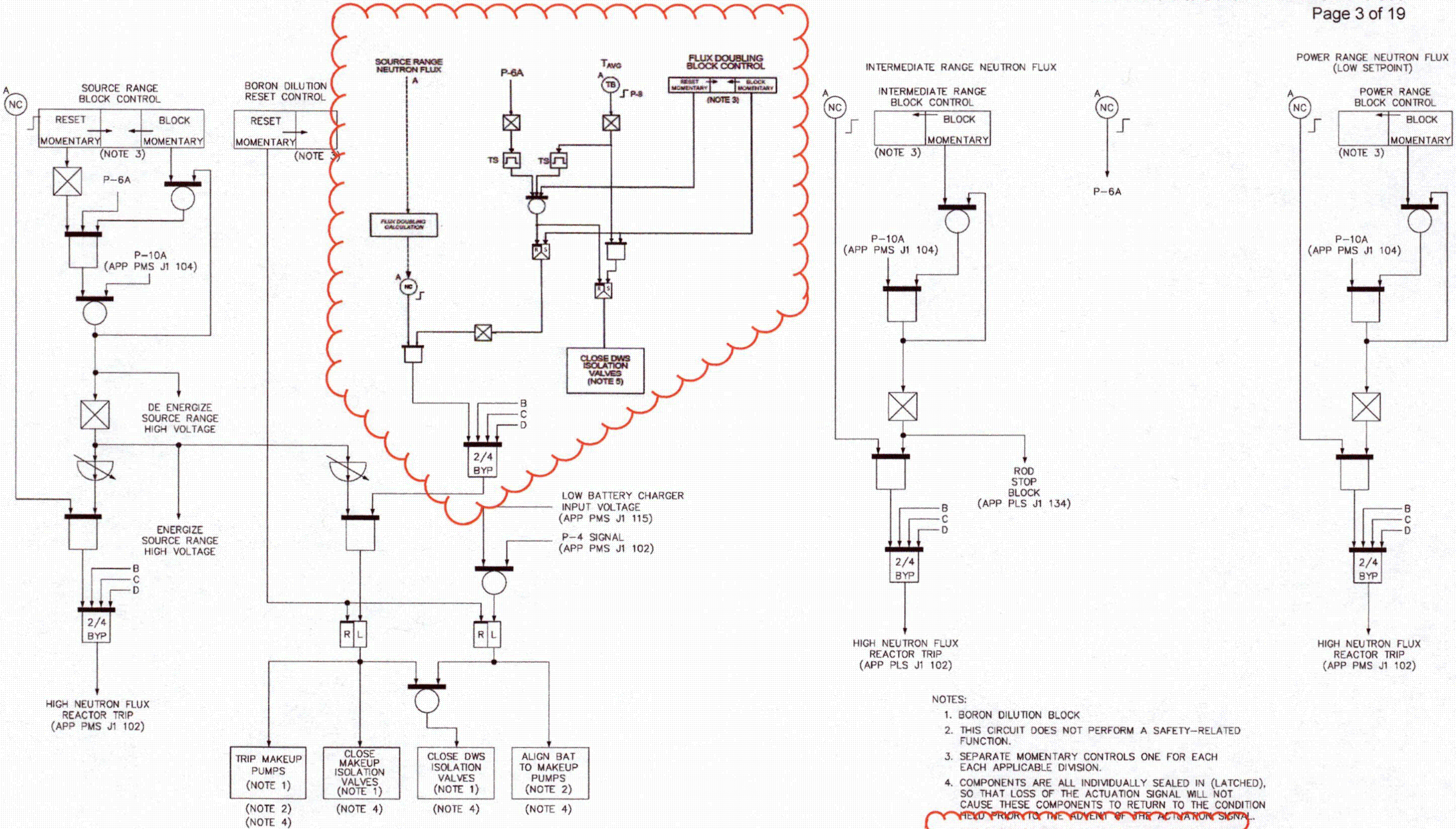
Enclosure 2

Levy Nuclear Plant Units 1 and 2

Tier 2 Licensing Basis Documents - Proposed Changes

(19 pages including cover page)

DCD Tier 2 changes



NOTES:

1. BORON DILUTION BLOCK
2. THIS CIRCUIT DOES NOT PERFORM A SAFETY-RELATED FUNCTION.
3. SEPARATE MOMENTARY CONTROLS ONE FOR EACH EACH APPLICABLE DIVISION.
4. COMPONENTS ARE ALL INDIVIDUALLY SEALED IN (LATCHED), SO THAT LOSS OF THE ACTUATION SIGNAL WILL NOT CAUSE THESE COMPONENTS TO RETURN TO THE CONDITION HELD PRIOR TO THE ADVENT OF THE ACTUATION SIGNAL.
5. THIS CIRCUIT IS NOT PART OF THE ESF ACTUATION FUNCTION.

Figure 7.2-1 (Sheet 3 of 21)

Functional Diagram
Nuclear Startup Protection

terminate the supply of potentially unborated water to the reactor coolant system as quickly as possible.

In the event of a loss of ac power sources or a reactor trip (as indicated by P-4), the block of boron dilution is accomplished by closing the makeup pump suction valves to the demineralized water storage tanks and aligning the boric acid tank to the suction of the makeup pumps. This permits makeup as needed but ensures that it will be from a borated source that will not reduce the available shutdown margin in the reactor core.

Condition 1 is an average of the source range count rate, sampled at least N times over the most recent time period T_1, compared to a similar average taken at time period T_2 earlier. If the ratio of the current average count rate to the earlier average count rate is greater than a preset value, a partial trip is generated in the division. On a coincidence of excessively increasing source range neutron flux in two of the four divisions, boron dilution is blocked. The Flux Doubling function is also delayed from actuating each time the source range detector's high voltage power is energized to prevent a spurious dilution block due to the short term instability of the processed source range values. This source range flux doubling signal may be manually blocked to permit plant startup and normal power operation when reactor coolant average temperature is above the P-8 setpoint. It is automatically reinstated when reactor power is decreased below the P-6 power level during shutdown or reactor coolant average temperature decreases below the P-8 setpoint.

The Flux Doubling function can also be manually blocked during shutdown conditions when below the P-8 reactor coolant average temperature. When blocked during shutdown conditions, the CVS demineralized water system isolation valves are automatically closed to prevent inadvertent boron dilution.

Condition 2 results from the loss of ac power. A short, preset time delay is provided to prevent actuation upon momentary power fluctuations; however, actuation occurs before ac power is restored by the onsite diesel generators. The loss of all ac power is detected by undervoltage sensors that are connected to the input of each of the four Class 1E battery chargers. Two sensors are connected to each of the four battery charger inputs. The loss of ac power signal is based on the detection of an undervoltage condition by each of the two sensors connected to two of the four battery chargers. The two-out-of-four logic is based on an undervoltage to the battery chargers for divisions A or C coincident with an undervoltage to the battery chargers for divisions B or D.

Condition 3 results from a reactor trip as indicated by the P-4 interlock.

The functional logic relating to the boron dilution block is illustrated in Figure 7.2-1, sheets 3 and 15.

7.3.1.2.15 Chemical and Volume Control System Isolation

A signal to close the isolation valves of the chemical and volume control system is generated from any of the following conditions:

1. High-2 pressurizer level
2. High-2 steam generator narrow range water level
3. Automatic or manual safeguards actuation signal (subsection 7.3.1.1) coincident with High-1 pressurizer level

Table 7.3-1 (Sheet 6 of 9)

ENGINEERED SAFETY FEATURES ACTUATION SIGNALS

Actuation Signal	No. of Division/ Controls	Actuation Logic	Permissives and Interlocks
12. Passive Residual Heat Removal (Figure 7.2-1, Sheet 8)			
a. Manual initiation	2 controls	1/2 controls	None
b. Low narrow range steam generator water level coincident with	4/steam generator	2/4-BYP[1] in either steam generator	None
Low startup feedwater flow	2/feedwater line	1/2 in either feedwater line	None
c. Low steam generator wide range water level	4/steam generator	2/4-BYP[1] in either steam generator	None
d. Core makeup tank injection	(See Items 6a through 6e)		
e. Automatic reactor coolant system depressurization (first stage)	(See items 3a through 3c)		
f. High-3 pressurizer level	4	2/4-BYP[1]	Manual block permitted below P-19 Automatically unblocked above P-19
13. Block of Boron Dilution (Figure 7.2-1, Sheets 3 and 15)			
a. Flux doubling calculation	4	2/4-BYP[1]	Manual block permitted above P-8. Automatically unblocked (momentary) below P-6 or below P-8. Demineralized water system isolation valves closed if blocked below P-8~~when critical or intentionally approaching criticality Automatically unblocked below P-6~~
b. Undervoltage to Class 1E battery chargers[(8)]	2/charger	2/2 per charger and 2/4 chargers[5]	None
c. Reactor trip (P-4)	1/division	2/4	None
14. Chemical Volume Control System Isolation (See Figure 7.2-1, Sheets 6 and 11)			
a. High-2 pressurizer water level	4	2/4-BYP[1]	Automatically unblocked above P-19 Manual block permitted below P-19
b. High-2 steam generator narrow range level	4/steam generator	2/4-BYP[1] in either steam generator	None
c. Automatic or manual safeguards actuation signal coincident with	(See items 1a through 1e)		

Table 7.3-1 (Sheet 7 of 9)

ENGINEERED SAFETY FEATURES ACTUATION SIGNALS

Actuation Signal	No. of Divisions/ Controls	Actuation Logic	Permissives and Interlocks
High-1 pressurizer water level	4	2/4-BYP[1]	None
d. High-2 containment radioactivity	4	2/4-BYP[1]	None
e. Manual initiation	2 controls	1/2 controls	None
f. Flux doubling calculation	4	2/4-BYP[1]	Manual block permitted above P-8. Automatically unblocked (momentary) below P-6 or below P-8. Demineralized water system isolation valves closed if blocked below P-8 ~~when critical or intentionally approaching criticality Automatically unblocked below P-6~~
g. High steam generator narrow range level coincident with	4/steam generator	2/4-BYP[1] in either steam generator	None
Reactor trip (P-4)	1/division	2/4	None
15. Steam Dump Block (Figure 7.2-1, Sheet 10)[8]			
a. Low reactor coolant temperature (Low-2 T_{avg})	2/loop	2/4-BYP[1]	None
b. Mode control	2 controls	1/division	None
c. Manual stage 1 cooldown control	2 controls	1/division	None
d. Manual stage 2 cooldown control	2 controls	1/division	None
16. Main Control Room Isolation and Air Supply Initiation (Figure 7.2-1, Sheet 13)			
a. High-2 control room supply air radiation	2	1/2	None
b. Undervoltage to Class 1E battery chargers[8]	2/charger	2/2 per charger and 2/4 chargers[5]	None
c. Manual initiation[8]	2 controls	1/2 controls	None
17. Auxiliary Spray and Purification Line Isolation (Figure 7.2-1, Sheet 12)			
a. Low-1 pressurizer level	4	2/4-BYP[1]	Manual block permitted below P-12 Automatically unblocked above P-12
b. Manual initiation of chemical and volume control system isolation	(See item 14e)		

Table 7.3-2 (Sheet 1 of 4)

INTERLOCKS FOR ENGINEERED SAFETY FEATURES ACTUATION SYSTEM

Designation	Derivation	Function
P-3	Reactor trip breaker open	Permits manual reset of safeguards actuation signal to block automatic safeguards actuation
$\overline{\text{P-3}}$	Reactor trip breakers closed	Automatically resets the manual block of automatic safeguards actuation
P-4	Reactor trip initiated or reactor trip breakers open	(a) Isolates main feedwater if coincident with low reactor coolant temperature (b) Trips turbine (c) Blocks boron dilution
$\overline{\text{P-4}}$	No reactor trip initiated and reactor trip breakers closed	Removes demand for isolation of main feedwater, turbine trip and boron dilution block
P-6	Intermediate range neutron flux channels above setpoint	None
$\overline{\text{P-6}}$	Intermediate range neutron flux channels below setpoint	Automatically resets the manual block of flux doubling actuation of the boron dilution block
P-8	Reactor coolant average temperature above setpoint	Permits manual block of flux doubling actuation of the boron dilution block
$\overline{\text{P-8}}$	Reactor coolant average temperature below setpoint	(a) Automatically resets (momentary) the manual block of flux doubling actuation of the boron dilution block (b) Closes demineralized water system isolation valves if flux doubling actuation of the boron dilution block is blocked below P-8.
P-11	Pressurizer pressure below setpoint	(a) Permits manual block of safeguards actuation on low pressurizer pressure, low compensated steam line pressure, or low reactor coolant inlet temperature (b) Permits manual block of steam line isolation on low reactor coolant inlet temperature (c) Permits manual block of steam line isolation and steam generator power-operated relief valve block valve closure on low compensated steam line pressure (d) Coincident with manual actions of (b) or (c), automatically unblocks steam line isolation on high negative steam line pressure rate (e) Permits manual block of main feedwater isolation on low reactor coolant temperature

boundary. This valve is operated from the main control room and the remote shutdown workstation.

Makeup Line Containment Isolation Valves

These normally open, motor-operated globe valves provide containment isolation of the chemical and volume control system makeup line and automatically close on a high-2 pressurizer level, high steam generator level, or high-2 containment radiation signal from the protection and safety monitoring system. The valves close on a source range flux doubling signal to terminate possible unplanned boron dilution events. The valves also close on a safeguards actuation signal coincident with high-1 pressurizer level. This allows the chemical and volume control system to continue providing reactor coolant system makeup flow, if the makeup pumps are operating following a safeguards actuation signal. These valves are also controlled by the reactor makeup control system and close when makeup to other systems is provided. Manual control is provided in the main control room and at the remote shutdown workstation.

Hydrogen Addition Containment Isolation Valve

This normally open, fail closed, air-operated globe valve is located outside containment in the hydrogen addition line. The valve automatically closes on a containment isolation signal from the protection and safety monitoring system. Manual control is provided in the main control room and at the remote shutdown workstation.

Demineralized Water System Isolation Valves

These normally open, air-operated butterfly valves are located outside containment in the line from the demineralized water storage and transfer system. These valves close on a signal from the protection and safety monitoring system derived by either a reactor trip signal, a source range flux doubling signal, low input voltage (loss of ac power) to the 1E dc and uninterruptable power supply system battery chargers, or a safety injection signal, isolating the demineralized water source to prevent inadvertent boron dilution events and, during shutdown conditions, whenever the flux doubling signal is blocked to prevent inadvertent boron dilution. Manual control for these valves is provided from the main control room and at the remote shutdown workstation.

Makeup Pump Suction Header Valve

This air-operated, three-way valve is automatically controlled by the makeup control system to provide the desired boric acid concentration of makeup to the reactor coolant system (boric acid, demineralized water, or blend based on the desired reactor coolant system boron concentration). The valve fails with the pump suction aligned to the boric acid storage tank on a loss of instrument air. This valve will also align to the boric acid storage tank on either a reactor trip, source range flux doubling signal, low input voltage (loss of ac power) to the 1E dc and uninterruptable power supply system battery chargers, or a safety injection signal from the protection and safety monitoring system. This valve also aligns the makeup pump suction to the boric acid storage tank when low pressure is detected in the demineralized water supply line to protect the pump from a loss of suction supply. Manual control for this valve is provided in the main control room and at the remote shutdown workstation.

9.3.6.4.4 Abnormal Operation

9.3.6.4.4.1 Reactor Coolant System Leak

The chemical and volume control system is capable of making up for a small reactor coolant system leak with either makeup pump at reactor coolant system pressures above the low-pressure setpoint.

9.3.6.4.5 Accident Operation

The chemical and volume control system can provide borated makeup to the reactor coolant system following accidents such as small loss-of-coolant accidents, steam generator tube rupture events, and small steam line breaks. In addition, pressurizer auxiliary spray can reduce reactor coolant system pressure during certain events such as a steam generator tube rupture.

To protect against steam generator overfill, the makeup function is isolated by closing the makeup line containment isolation valves, if a high steam generator level signal is generated. These valves also close and isolate the system on a high pressurizer level signal.

Some of the valves in the chemical and volume control system are required to operate under accident conditions to effect reactor coolant system pressure boundary and containment isolation, as discussed in subsection 9.3.6.3.7.

9.3.6.4.5.1 Boron Dilution Events

The chemical and volume control system is designed to address a boron dilution accident by closing redundant safety-related valves, tripping the makeup pumps and/or aligning the suction of the makeup pumps to the boric acid tank.

For dilution events occurring at power (assuming the operator takes no action), a reactor trip is initiated on either an overpower trip or an overtemperature ΔT trip. Following a reactor trip signal, the line from the demineralized water system is isolated by closing two safety-related, air-operated valves. The three-way pump suction control valve aligns so the makeup pumps take suction from the boric acid tank. If the event occurs while the makeup pumps are operating, the realignment of these valves causes the makeup pumps, if they continue to operate, to borate the plant.

For dilution events during shutdown, the source range flux doubling signal is used to isolate the makeup line to the reactor coolant system by closing the two safety-related, motor-operated valves, isolate the line from the demineralized water system by closing the two safety-related, air-operated valves, and trip the makeup pumps. For refueling operations, administrative controls are used to prevent boron dilutions by verifying the valves in the line from the demineralized water system are closed and secured. In addition, when the flux doubling signal is blocked during shutdown, the demineralized water system isolation valves are closed to prevent inadvertent boron dilution.

9.3.6.5 Design Evaluation

The chemical and volume control system has redundant, safety-related isolation valves and piping to protect the reactor coolant system pressure boundary, and is designed in accordance with ANSI/ANS-51.1 (Reference 4).

The chemical and volume control system lines that penetrate containment incorporate valve and piping arrangements, meeting the containment isolation criteria described in subsection 6.2.3.

The instrumentation also supplies input signals for control purposes to maintain proper system operation and to prevent equipment damage. Some specific control functions are listed below:

- **Purification isolation** – To preserve the reactor coolant pressure boundary in the event of a break in the chemical and volume control system loop piping. The purification stop valves close automatically on a signal from the protection and safety monitoring system generated by a low-1 pressurizer level signal. This isolation also serves as an equipment protection function to prevent uncovering of the heater elements in the pressurizer. One of these valves also closes on high temperature downstream of the letdown heat exchanger, to protect the resin in the mixed bed and cation demineralizers from being exposed to temperatures that could damage the resins.

- **Containment isolation** – To preserve the containment boundary, containment isolation valves are provided in the letdown line to the liquid radwaste system, the chemical and volume control system makeup line, and the hydrogen addition line. These valves are opened or closed manually from the main control room and the remote shutdown workstation. Interlocks are provided to close these valves automatically upon receipt of a containment isolation signal from the protection and safety monitoring system and require operator action to reopen.

- **Letdown isolation valves** – The letdown isolation valves are used to isolate letdown flow to the liquid radwaste system in addition to the containment isolation function described above. The plant control system provides a signal to automatically open these valves on a high-pressurizer level signal derived from the pressurizer level control system. On a containment isolation signal from the protection and safety monitoring system, a high-high liquid radwaste system degassifier level signal (plant control system), or a low-pressurizer level signal (plant control system), these valves automatically close to provide isolation of the letdown line. The letdown isolation valves also receive a signal from the protection and safety monitoring system to automatically close and isolate letdown during midloop operations based on a low hot leg level. Manual control is provided from the main control room and at the remote shutdown workstation. The letdown flow control valve controls reactor coolant system pressure during startup, as described in subsection 9.3.6.4.1.

- **Demineralized water system isolation valves** – To prevent inadvertent boron dilution, the demineralized water system isolation valves close on a signal from the protection and safety monitoring system derived from either a reactor trip signal, a source range flux doubling signal, low input voltage (loss of ac power) to the 1E dc and uninterruptible power supply system battery chargers, or a safety injection signal providing a safety-related method of stopping an inadvertent dilution. In addition, when the flux doubling logic is blocked during shutdown, the valves are closed to prevent inadvertent boron dilution. The main control room and remote shutdown workstation provide manual control for these valves.

- **Makeup isolation valves** – To isolate the makeup flow to the reactor coolant system, two valves are provided in the chemical and volume control system makeup line. These valves automatically close on a signal from the protection and safety monitoring system derived from source range flux doubling, high-2 pressurizer level, high steam generator level, or a safeguards signal coincident with high-1 pressurizer level to protect against pressurizer or steam generator overfill. Manual control for these valves is provided in the main control

Table 14.3-2 (Sheet 9 of 17)
DESIGN BASIS ACCIDENT ANALYSIS

Reference	Design Feature	Value
Section 7.3.1.2.4	The first stage valves of the automatic depressurization system open upon receipt of a signal generated from a core makeup tank injection alignment signal coincident with core makeup tank water level less than the Low-1 setpoint in either core makeup tank via the protection and safety monitoring system.	
Section 7.3.1.2.4	The second and third stage valves open on time delays following generation of the first stage actuation signal via the protection and safety monitoring system.	
Section 7.3.1.2.5	The reactor coolant pumps are tripped upon generation of a safeguards actuation signal or upon generation of a low-2 pressurizer water level signal.	
Section 7.3.1.2.7	The passive residual heat removal heat exchanger control valves are opened on low steam generator water level or on a CMT actuation signal via the protection and safety monitoring system.	
Section 7.3.1.2.9	The containment recirculation isolation valves are opened on a safeguards actuation signal in coincidence with low-3 in-containment refueling water storage tank water level via the protection and safety monitoring system.	
Section 7.3.1.2.14	The demineralized water system isolation valves close on a signal from the protection and safety monitoring system derived from either a reactor trip signal, a source range flux doubling signal, ~~or~~ low input voltage to the 1E dc uninterruptible power supply battery chargers or if the source range flux doubling logic is blocked during shutdown.	
Section 7.3.1.2.15	The chemical and volume control system makeup line isolation valves automatically close on a signal from the protection and monitoring system derived from a source range flux doubling, high-2 pressurizer level, high-2 steam generator level signal, a safeguards signal coincident with high-1 pressurizer level, or high-2 containment radioactivity.	
Section 7.3.2.2.1	The protection and monitoring system automatically generate an actuation signal for an engineered safety feature whenever a monitored condition reaches a preset level.	
Section 7.3.2.2.9	Manual initiation at the system-level exists for the engineered safety features actuation.	

Table 14.3-2 (Sheet 12 of 17)

DESIGN BASIS ACCIDENT ANALYSIS

Reference		Design Feature	Value
Section	9.3.6.7	The demineralized water system isolation valves close on a signal from the protection and safety monitoring system derived from either a reactor trip signal, a source range flux doubling signal, low input voltage to the 1E dc and uninterruptible power supply battery chargers, ~~or~~ a safety injection signal or if the source range flux doubling logic is blocked during shutdown conditions.	
Section	9.3.6.7	The chemical and volume control system makeup line isolation valves automatically close on a signal from the protection and safety monitoring system derived from a source range flux doubling, high-2 pressurizer level, high steam generator level signal, or a safeguards signal coincident with high-1 pressurizer level.	
Section	10.1.2	Safety valves are provided on both main steam lines.	
Section	10.2.2.4.3	The flow of the main steam entering the high-pressure turbine is controlled by four stop valves and four governing control valves. The stop valves are closed by actuation of the emergency trip system devices.	
Section	10.3.1.1	The main steam supply system is provided with a main steam isolation valve and associated MSIV bypass valve on each main steam line from its respective steam generator.	
Section	10.3.1.1	A main steam isolation valve (MSIV) on each main steam line prevents the uncontrolled blowdown of more than one steam generator and isolates nonsafety-related portions of the system.	
Section	10.3.1.2	Power-operated atmospheric relief valves are provided to allow controlled cooldown of the steam generator and the reactor coolant system when the condenser is not available.	
Section	10.3.2.1	The main steam supply system includes: - One main steam isolation valve and one main steam isolation valve bypass valve per main steam line. - Main steam safety valves. - Power-operated atmospheric relief valves and upstream isolation valves.	
Section	10.3.2.3.2	In the event that a design basis accident occurs, which results in a large steam line break, the main steam isolation valves with associated main steam isolation bypass valves automatically close.	

The safety analysis of boron dilution accidents is provided in Chapter 15 and is discussed in subsection 19E.4.5 of this appendix. For dilution events that occur during shutdown, the source-range flux-doubling signal closes the safety-related remotely operated CVS makeup line isolation valves to terminate the event. In addition, the signal is used to isolate the line from the demineralized water system to the makeup pump suction by closing the two safety-related remotely operated valves. The three-way pump suction control valve aligns the makeup pumps to take suction from the boric acid tank and, therefore, stops the dilution.

For refueling operations, administrative controls are used to prevent boron dilutions by verifying that the valves in the line from the demineralized water system are closed and locked. These valves block the flow paths that can allow unborated makeup water to reach the RCS. Makeup required during refueling uses borated water supplied from the boric acid tank by the CVS makeup pumps.

During refueling operations (Mode 6), two source-range neutron flux monitors are operable to monitor core reactivity. This is required by the plant Technical Specifications. The two operable source-range neutron flux monitors provide a signal to alert the operator to unexpected changes in core reactivity. The potential for an uncontrolled boron dilution accident is precluded by isolating the unborated water sources. This is also required by the plant Technical Specifications.

19E.2.8 Spent Fuel Pool Cooling System

19E.2.8.1 System Description

The spent fuel pool cooling system (SFS) is discussed in subsection 9.1.3.

19E.2.8.2 Design Features to Address Shutdown Safety

The AP1000 has incorporated various design features to improve shutdown safety. The SFS features that have been incorporated to address shutdown safety are described in this subsection.

19E.2.8.2.1 Seismic Design

The spent fuel pool, fuel transfer canal (FTC), cask loading pit (CLP), cask washdown pit (CWP), and gates from the spent fuel pool-CLP and FTC-spent fuel pool are all integral with the auxiliary building structure. The auxiliary building is seismic Class I design and is designed to retain its integrity when exposed to a safe shutdown earthquake (SSE). The suction and discharge connections between the spent fuel pool and RNS are safety Class C, which is also seismic Class I. The emergency makeup water line from the PCS water storage tank to the spent fuel pool actually connects with the RNS pump suction line. This emergency makeup line is also safety Class C and seismic Class I. The spent fuel pool level instruments connections to the spent fuel pool are safety Class C, seismic Class I, and have 3/8-inch flow restricting orifices at the pool wall to limit the amount of a leak from the pool if the instrument or its piping develops a leak.

The refueling cavity is integral with the containment internal structure, and as such, is seismic Class I, and is designed to retain its integrity when exposed to an SSE. In addition, the AP1000 has incorporated a permanently welded seal ring to provide the seal between the vessel flange and the refueling cavity floor. This refueling cavity seal is part of the refueling cavity and is seismic Class I. Figure 19E.2-3 is a simplified drawing of the AP1000 permanent reactor cavity seal. The

Table 3.3.2-1 (page 9 of 13)
Engineered Safeguards Actuation System Instrumentation

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	REQUIRED CHANNELS	CONDITIONS	SURVEILLANCE REQUIREMENTS
15. Boron Dilution Block				
a. Source Range Neutron Flux Doubling	$2^{(n)}$,$3^{(n, e)}$,$4^{(e)}$	4	B,T	SR 3.3.2.1 SR 3.3.2.4 SR 3.3.2.5 SR 3.3.2.6
	$5^{(e)}$	4	B,P	SR 3.3.2.1 SR 3.3.2.4 SR 3.3.2.5 SR 3.3.2.6
b. Reactor Trip	Refer to Function 18.b (ESFAS Interlocks, Reactor Trip, P-4) for all requirements.			
16. Chemical Volume and Control System Makeup Isolation				
a. SG Narrow Range Water Level – High 2	1,2,$3^{(e)}$,$4^{(b,e)}$	4 per SG	B,R	SR 3.3.2.1 SR 3.3.2.4 SR 3.3.2.5 SR 3.3.2.6
b. Pressurizer Water Level – High 1	1,2,$3^{(e)}$	4	B,Q	SR 3.3.2.1 SR 3.3.2.4 SR 3.3.2.5 SR 3.3.2.6
Coincident with Safeguards Actuation	1,2,$3^{(e)}$	Refer to Function 1 (Safeguards Actuation) for initiating functions and requirements.		
c. Pressurizer Water Level – High 2	1,2,3,$4^{(b,e,m)}$	4	B,T	SR 3.3.2.1 SR 3.3.2.4 SR 3.3.2.5 SR 3.3.2.6
d. Containment Radioactivity – High 2	1,2,$3^{(e)}$	4	B,Q	SR 3.3.2.1 SR 3.3.2.4 SR 3.3.2.5 SR 3.3.2.6
e. Manual Initiation	1,2,$3^{(e)}$,$4^{(b,e)}$	2 switches	E,R	SR 3.3.2.3
f. Source Range Neutron Flux Doubling	Refer to Function 15.a (Boron Dilution Block, Source Range Neutron Flux Doubling) for all requirements.			
g. SG Narrow Range Water Level High	1,2,$3^{(e)}$,$4^{(b,e)}$	4 per SG	B,R	SR 3.3.2.1 SR 3.3.2.4 SR 3.3.2.5 SR 3.3.2.6
Coincident with Reactor Trip (P-4)	Refer to Function 18.b (ESFAS Interlocks, Reactor Trip, P-4) for all requirements.			

(b) With the RCS not being cooled by the Normal Residual Heat Removal System (RNS).

(e) Not applicable for valve isolation Functions whose associated flow path is isolated.

(m) Above the P-19 (RCS Pressure) interlock.

(n) Not applicable when critical or during intentional approach to criticality.

Table 3.3.2-1 (page 10 of 13)
Engineered Safeguards Actuation System Instrumentation

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	REQUIRED CHANNELS	CONDITIONS	SURVEILLANCE REQUIREMENTS
17. Normal Residual Heat Removal System Isolation				
a. Containment Radioactivity – High 2	1,2,3(e)	4	B,Q	SR 3.3.2.1 SR 3.3.2.4 SR 3.3.2.5 SR 3.3.2.6
b. Safeguards Actuation	1,2,3(e)	Refer to Function 1 (Safeguards Actuation) for all initiating functions and requirements.		
c. Manual Initiation	1,2,3(e)	2 switch sets	E,Q	SR 3.3.2.3
18. ESFAS Interlocks				
a. Reactor Trip Breaker Open, P-3	1,2,3	3 divisions	D,M	SR 3.3.2.3
b. Reactor Trip, P-4	1,2,3	3 divisions	D,M	SR 3.3.2.3
c. Intermediate Range Neutron Flux, P-6	2	4	J,L	SR 3.3.2.1 SR 3.3.2.4 SR 3.3.2.5
d. Reactor Coolant Average Temperature, P-8	2, 3(e), 4(e)	4	J, T	SR 3.3.2.1 SR 3.3.2.4 SR 3.3.2.5
	5(e)	4	J, P	SR 3.3.2.1 SR 3.3.2.4 SR 3.3.2.5
ed. Pressurizer Pressure, P-11	1,2,3	4	J,M	SR 3.3.2.1 SR 3.3.2.4 SR 3.3.2.5
fe. Pressurizer Level, P-12	1,2,3	4	J,M	SR 3.3.2.1 SR 3.3.2.4 SR 3.3.2.5
	4,5,6	4	BB,Y	SR 3.3.2.1 SR 3.3.2.4 SR 3.3.2.5
gf. RCS Pressure, P-19	1,2,3,4(b)	4	J,N	SR 3.3.2.1 SR 3.3.2.4 SR 3.3.2.5
19. Containment Air Filtration System Isolation				
a. Containment Radioactivity – High 1	1,2,3,4(b)	4	B,Z	SR 3.3.2.1 SR 3.3.2.4 SR 3.3.2.5 SR 3.3.2.6
b. Containment Isolation	Refer to Function 3 (Containment Isolation) for initiating functions and requirements.			

(b) With the RCS not being cooled by the Normal Residual Heat Removal System (RNS).

(e) Not applicable for valve isolation Functions whose associated flow path is isolated.

BASES

APPLICABLE SAFETY ANALYSES, LCOs, and APPLICABILITY (continued)

15. Boron Dilution Block

The block of boron dilution is accomplished by closing the CVS makeup line isolation~~suction~~ valves or closing the CVS ~~to~~ demineralized water system isolation ~~storage tanks~~ valves~~, and aligning the boric acid tank to the CVS makeup pumps~~. This Function is actuated by Source Range Neutron Flux Doubling and Reactor Trip.

15.a. Source Range Neutron Flux Doubling

A signal to block boron dilution in MODES 2 or 3, when not critical or during an intentional approach to criticality, and MODES 4 or 5 is derived from source range neutron flow increasing at an excessive rate (source range flux doubling). This Function is not applicable in MODES 4 and 5 if the demineralized water makeup flow path is isolated. The source range neutron detectors are used for this Function. The LCO requires four divisions to be OPERABLE. There are four divisions and two-out-of-four logic is used. On a coincidence of excessively increasing source range neutron flux in two of the four divisions, demineralized water is isolated (CVS demineralized water system isolation valves closed) from the makeup pumps and reactor coolant makeup is isolated (CVS makeup line isolation valves closed) from the reactor coolant system to preclude a boron dilution event. In MODE 6, a dilution event is precluded by the requirement in LCO 3.9.2 to close, lock and secure at least one valve in each unborated water source flow path.

15.b. Reactor Trip (Function 18.b)

Demineralized Water Makeup is also isolated (CVS demineralized water system isolation valves closed and the boric acid tank aligned to the CVS makeup pumps) by all the Functions that initiate a Reactor Trip. The isolation requirements for these Functions are the same as the requirements for the Reactor Trip Function. Therefore, the requirements are not repeated in Table 3.3.2-1. Instead Function 18.b, (P-4 Reactor Trip Breakers), is referenced for all initiating Functions and requirements.

18.d. Reactor Coolant Average Temperature, P-8

The P-8 interlock is provided to permit a manual block of or to reset a manual block of the automatic Source Range Neutron Flux Doubling actuation of the Boron Dilution Block (Function 15.a).

The Boron Dilution Block may be manually blocked to permit plant startup and normal power operation when above the P-8 reactor coolant average temperature.

The Boron Dilution Block is automatically reset upon decrease of the reactor coolant average temperature to below P-8.

Once the reactor coolant average temperature is below P-8, the Source Range Neutron Flux Doubling actuation of the Boron Dilution Block Function may be manually blocked to prevent inadvertent actuation during refueling operations and post-refueling control rod testing.

When the Boron Dilution Block is manually blocked below P-8 during shutdown conditions, the CVS demineralized water system isolation valves are automatically closed to prevent inadvertent boron dilution.

The P-8 interlock is required to be OPERABLE in MODES 2, 3, 4 and 5. This Function is not applicable in MODES 3, 4 and 5, if the demineralized water makeup flow path is isolated. In MODE 6 a dilution event is precluded by the requirement in LCO 3.9.2 to close, lock and secure at least one valve in each unborated water source flow path.

18.~~d~~e. Pressurizer Pressure, P-11

The P-11 interlock permits a normal unit cooldown and depressurization without Safeguards Actuation or main steam line and feedwater isolation. With pressurizer pressure channels less than the P-11 setpoint, the operator can manually block the Pressurizer pressure – Low, Steam Line Pressure – Low, and T_{cold} – Low Safeguards Actuation signals and the Steam Line Pressure – Low and T_{cold} – Low steam line isolation signals. When the Steam Line Pressure – Low is manually blocked, a main steam isolation signal on Steam Line Pressure-Negative Rate – High is enabled. This provides protection for an SLB by closure of the main steam isolation valves. Manual block of feedwater isolation on T_{avg} – Low 1, Low 2, and T_{cold} – Low is also permitted below P-11. With pressurizer pressure channels ≥ P-11 setpoint, the Pressurizer Pressure – Low, Steam Line Pressure – Low, and T_{cold} – Low Safeguards Actuation signals and the Steam Line Pressure Low and T_{cold} – Low steam line isolation signals are automatically enabled. The feedwater isolation signals on T_{cold} – Low, T_{avg} – Low 1 and Low 2 are also automatically enabled above P-11. The operator can also enable these signals by use of the respective manual reset buttons.

When the Steam Line Pressure – Low and T_{cold} – Low steam line isolation signals are enabled, the main steam isolation on Steam Line Pressure-Negative Rate – High is disabled. The Setpoint reflects only steady state instrument uncertainties.

This Function must be OPERABLE in MODES 1, 2, and 3 to allow an orderly cooldown and depressurization of the unit without the Safeguards Actuation or main steam or feedwater isolation. This Function does not have to be OPERABLE in MODE 4, 5, or 6, because plant pressure must already be below the P-11 setpoint for the requirements of the heatup and cooldown curves to be met.

18.fe. Pressurizer Level, P-12

The P-12 interlock is provided to permit midloop operation without core makeup tank actuation, reactor coolant pump trip, CVS letdown isolation, or purification line isolation. With pressurizer level channels less than the P-12 setpoint, the operator can manually block low pressurizer level signal used for these actuations. Concurrent with blocking CMT actuation on low pressurizer level, ADS 4th Stage actuation on Low 2 RCS hot leg level is enabled. Also CVS letdown isolation on Low 1 RCS hot leg level is enabled. When the pressurizer level is above the P-12 setpoint, the pressurizer level signal is automatically enabled and a confirmatory open signal is issued to the isolation valves on the CMT cold leg balance lines. This Function is required to be OPERABLE in MODES 1, 2, 3, 4, 5, and 6.

18.fg. RCS Pressure, P-19

The P-19 interlock is provided to permit water solid conditions (i.e., when the pressurizer water level is >92%) in lower MODES without automatic isolation of the CVS makeup pumps. With RCS pressure below the P-19 setpoint, the operator can manually block CVS isolation on High 2 pressurizer water level, and block Passive RHR actuation and Pressurizer Heater Trip on High 3 pressurizer water level. When RCS pressure is above the P-19 setpoint, these Functions are automatically unblocked. This Function is required to be OPERABLE IN MODES 1, 2, 3, and 4 with the RCS not being cooled by the RNS. When the RNS is cooled by the RNS, the RNS suction relief valve provides the required overpressure protection (LCO 3.4.14).

BASES

ACTIONS (Continued)

J.1 and J.2

Condition J applies to the P-6, P-8, P-11, P-12, and P-19 interlocks. With one or two required channel(s) inoperable, the associated interlock must be verified to be in its required state for the existing plant condition within 1 hour, or any Function channel associated with the inoperable interlock(s) placed in a bypassed condition within 7 hours. Verifying the interlock state manually accomplishes the interlock role.

If one interlock channel is inoperable, the associated Function(s) must be placed in a bypass or trip condition within 7 hours. If one channel is bypassed, the logic becomes two-out-of-three, while still meeting the single failure criterion. (A failure in one of the three remaining channels will not prevent the protective function.) If one channel is tripped, the logic becomes one-out-of-three, while still meeting the single failure criterion. (A failure in one of the three remaining channels will not prevent the protective function.)

If two interlock channels are inoperable, one channel of the associated Function(s) must be bypassed and one channel of the associated Function(s) must be tripped. In this state, the logic becomes one-out-of-two, while still meeting the single failure criterion. The 7 hours allowed to place the inoperable channel(s) in the bypassed or tripped condition is justified in Reference 6.

K.1

LCO 3.0.8 is applicable while in MODE 5 or 6. Since irradiated fuel assembly movement can occur in MODE 5 or 6, the ACTIONS have been modified by a Note stating that LCO 3.0.8 is not applicable. If moving irradiated fuel assemblies while in MODE 5 or 6, the fuel movement is independent of shutdown reactor operations. Entering LCO 3.0.8 while in MODE 5 or 6 would require the optimization of plant safety, unnecessarily.

Condition K is applicable to the MCR Isolation and Air Supply Initiation (Function 20), during movement of irradiated fuel assemblies. If the Required Action and associated Completion Time of the first Condition listed in Table 3.3.2-1 is not met, the plant must suspend movement of the irradiated fuel assemblies immediately. The required action suspends activities with potential for releasing radioactivity that might enter the MCR. This action does not preclude the movement of fuel to a safe position.

Duke Energy
Enclosure 3
Levy Nuclear Plant Units 1 and 2

Figure, Text and Tables
Parts 2, 4, 7 and 10 COL Application Revisions

Design Change to Address Compliance with IEEE 603-1991 for Source Range Neutron Flux Doubling

(25 pages including cover page)

Associated LNP COL Application Revisions:

The following is a list of revisions to the LNP COL application which will be incorporated into the next update of the LNP COLA.

COLA Part 2, FSAR

COLA Part 2, FSAR Chapter 1, Table 1.8-201, Summary of FSAR Departures from the DCD, will be revised to add departure LNP COL 6.4-2, to read as follows:

Departure Number	Departure Description Summary	FSAR Section or Subsection
LNP 7.3-1	Source Range Flux Doubling Permissive The following are departure from the DCD: Tier 2 subsections 7.3.1.2.14, 9.3.6.3.7, 9.3.6.4.5.1, 9.3.6.7 and 19E.2.7.2. Tables 7.3-1 (Sheets 6 and 7 of 9), 7.3-2 (Sheet 1 of 4) and 14.3-2 (Sheets 9 and 12 of 17). Figure 7.2-1 (Sheet 3 of 21), Technical Specification Table 3.3.2-1 (Pages 9 and 10 of 13) and associated section B 3.3.2 Bases.	Subsections 7.3.1.2.14, 9.3.6.3.7, 9.3.6.4.5.1, 9.3.6.7 and 19E.2.7.2. Tables 7.3-201 (Sheets 1 and 2 of 2), 7.3-202 (Sheet 1 of 1) and 14.3-201 (Sheets 1 and 2 of 2). Figure 7.2-201 (Sheet 1 of 1), Technical Specification Table 3.3.2-1 (Pages 9 and 10 of 13) and associated B 3.3.2 Bases.

COLA Part 2, FSAR Sections will be revised to add the departures identified in Table 1.8-201 with a LMA of LNP DEP 7.3-1, as presented below.

- Revise COLA Part 2, FSAR Figure 7.2-201
- Revise COLA Part 2, FSAR Section 7.3
- Revise COLA Part 2, FSAR Tables 7.3-201, 7.3-202
- Revise COLA Part 2, FSAR Table 14.3-201
- Revise COLA Part 2, FSAR Section 9.3
- Revise COLA Part 2, FSAR Section 19E.2
- Revise COLA Part 4, Technical Specification 3.3.2 and Bases 3.3.2
- Revise COLA Part 4 TS 3.3.2, Table 3.3.2-1

Change Descriptions

1. COLA Part 2, Figure 7.2-201 will be revised to show the P-8 permissive to allow blocking of Flux Doubling function
2. COLA Part 2, Subsection 7.3.1.2.14 will be revised to state "This source range flux doubling signal may be manually blocked to permit plant startup and normal power operation when reactor coolant average temperature is above the P-8 setpoint. It is automatically reinstated when reactor power is decreased below the P-6 power level during shutdown or reactor coolant average temperature decreases below the P-8 setpoint. The Flux Doubling function can also be manually blocked during shutdown conditions when

below the P-8 reactor coolant average temperature. When blocked during shutdown conditions, the CVS demineralized water system isolation valves are automatically closed to prevent inadvertent boron dilution."

3. COLA Part 2, Table 7.3-201, Sheet 1 and 2 of 2, add description of P-8 block and P-6 reset of flux doubling calculation.
4. COLA Part 2, Table 7.3-202, Sheet 1 of 1, add description of P-8 permissive above and below setpoint
5. COLA Part 2, Section 9.3, under Demineralized Water System Isolation Valves, add "and, during shutdown conditions, whenever the flux doubling signal is blocked to prevent inadvertent boron dilution" to the end of the 2nd sentence.
6. COLA Part 2, Subsection 9.3.6.4.5.1, add "In addition, when the flux doubling signal is blocked during shutdown, the demineralized water system isolation valves are closed to prevent inadvertent boron dilution." at the end of the subsection.
7. COLA Part 2, Subsection 9.3, under Demineralized Water System Isolation Valves, "In addition, when the flux doubling signal is blocked during shutdown, the demineralized water system isolation valves are closed to prevent inadvertent boron dilution." at the end of the subsection.
8. COLA Part 2, Table 14.3-201 Sheets 1 and 2 of 2, add "or if the source range flux doubling logic is blocked during shutdown." and delete "or" between the 2nd and 3rd choices; for entries for Section 7.3.1.2.14 and 9.3.6.7.
9. COLA Part 2, Subsection 19E.2.7.2, insert "closes the safety-related remotely operated CVS makeup line isolation valves to terminate the event. In addition, the signal is used to isolate the line from the demineralized water system to the makeup pumps suction", in the 2nd sentence.
10. COLA Part 4, Tech Spec Table 3.3.2-1, Function 15.a, add Note e superscript to Mode 3 Applicable MODE.
11. COLA Part 4, Tech Spec Table 3.3.2-1, added Function 18.d for "Reactor Coolant Average Temperature P-8", and updated the lettering for the follow-on functions.
12. COLA Part 4, Tech Spec Bases 3.3.2, Function 15, added new actuation of closing CVS demineralizer water system valves and inserted clarification of demineralizer water is isolated (CVS demineralized water system isolation valves closed); and makeup is isolated (CVS makeup line isolation valves closed).
13. COLA Part 4, Tech Spec Bases 3.3.2, added Function 18.d, for Reactor Coolant Average Temperature, P-8.
14. COLA Part 4, Tech Spec Bases 3.3.2, updated lettering for functions 18.d to 18.e, 18.e to 18.f, and 18.f to 18.g.
15. COLA Part 7, Departure 7.3-1 Exemption Request

NRC Approval Requirement:

This departure requires an exemption from the requirements of 10 CFR Part 52, Appendix D, Section III.B, which requires compliance with Tier 1 requirements of the AP1000 DCD and the generic Technical Specifications. Therefore, an exemption is requested in Part B of this COL Application Part.

B. Levy Nuclear Plant, Units 1 and 2 Exemption Requests

Duke Energy Florida (DEF) requests the following exemptions related to:

1. Not used, and
2. Combined License (COL) Application Organization and Numbering
3. Special Nuclear Material (SNM) Material Control and Accounting Program Description
4. Containment Cooling Changes in regard to Passive Core Cooling System Condensate Return
5. Main Control Room Dose
6. Main Control Room Heatup
7. Combustible Gas Control in Containment
8. Source Range Neutron Flux Doubling Block Permissive

Discussion and justification for each of these requests is provided in the following pages.

8) Source Range Neutron Flux Doubling Block Permissive

NRC Approval Requirement:

This departure requires an exemption from the requirements of 10 CFR Part 52, Appendix D, Section III.B, which requires compliance with Tier 1 requirements of the AP1000 DCD and the generic Technical Specifications. Therefore, an exemption is requested in Part B of this COL Application Part.

1. COLA Part 7, Departures and Exemption Requests, Exemption Request 4 will be revised as follows:

Applicable Regulation(s): 10 CFR Part 52 Appendix D, Section III.B

Specific wording from which exemption is requested:

"III. Scope and Contents

B. An applicant or licensee referencing this appendix, in accordance with Section IV of this appendix, shall incorporate by reference and comply with the requirements of this appendix, including Tier 1, Tier 2 (including the investment protection short-term availability controls in Section 16.3 of the DCD), and the generic TS except as otherwise provided in this appendix. Conceptual design information in the generic DCD and the evaluation of severe accident mitigation design alternatives in appendix 1B of the generic DCD are not part of this appendix."

Pursuant to 10 CFR §52.63(b)(1), an exemption from elements of the design as certified in the 10 CFR Part 52, Appendix D, design certification rule is requested for plant-specific Tier 1 material departures from the AP1000 DCD for Tier 1 information and for a material departure from the generic TS. These material departures are contained in Tier 1 Subsection 2.2.3, Tables 2.2.3-1 and 2.2.3-2, and involve the addition of a permissive to the source range flux doubling function to prevent bypassing the CVS makeup isolation actuation upon a source range flux doubling to more effectively perform its design function and provide reactor protection as analyzed. The departures includes a change to TS Table 3.3.2-1 which involves adding the P-8 permissive to the instrument Table. This exemption request is in accordance with the provisions of 10 CFR §50.12, 10 CFR §52.7, and 10 CFR Part 52, Appendix D.

Discussion:

The changes requested to Tier 2 changes, to Figure 7.2-1 (Sheet 3 of 21),Subsection 7.3.1.2.14,Table 7.3-1 (Sheet 6 of 9), Table 7.3-1 (Sheet 7), Table 7.3.2, (Sheet 1 of 4), Subsection 9.3.6.3.7, Section 9.3.6.4.5.1, Subsection 9.3.6.7, Table 14.3-2 (Sheet 9 of 17), Table 14.3-2 (Sheet 12), Subsection 19E2.7.2, Technical Specifications Table 3.3.2-1 (Page 9, 10 of 13), Tech Spec Bases Section B3.3.2 ACTIONS (Page 3.3.2-57), Tech Spec Bases Section B3.3.2, Subsection 15, Tech Spec Bases Section B3.2.2, add Subsection 18.d. provide additional equipment and TS requirements, provide reasonable assurance that the facility has been constructed and will be operated in conformity with the applicable design criteria, codes and standards, and demonstrates acceptable performance during design basis scenarios and reactor startup.

Conclusion:

This exemption request is evaluated in accordance with 10 CFR Part 52, Appendix D, Section VIII.A.4, 10 CFR §50.12, 10 CFR §52.7 and 10 CFR §52.63, which state that the NRC may grant exemptions from the requirements of the regulations provided the following six conditions are met: 1) the exemption is authorized by law [§50.12(a)(1)]; 2) the exemption will not present an undue risk to the health and safety of the public [§50.12(a)(1)]; 3) the exemption is consistent with the common defense and security [§50.12(a)(1)]; 4) special circumstances are present

[§50.12(a)(2)]; 5) the special circumstances outweigh any decrease in safety that may result from the reduction in standardization caused by the exemption [§52.63(b)(1)]; and 6) the design change will not result in a significant decrease in the level of safety [Part 52, Appendix D, VIII.A.1]. The requested exemption satisfies the criteria for granting specific exemptions, as described below.

1. **This exemption is authorized by law**

   The NRC has authority under 10 CFR §§ 50.12, 52.7, and 52.63 to grant exemptions from the requirements of NRC regulations. Specifically, 10 CFR §§50.12 and 52.7 state that the NRC may grant exemptions from the requirements of 10 CFR Part 52 upon a proper showing. No law exists that would preclude the changes covered by this exemption request. Additionally, granting of the proposed exemption does not result in a violation of the Atomic Energy Act of 1954, as amended, or the Commission's regulations.

   Accordingly, this requested exemption is "authorized by law," as required by 10 CFR §50.12(a)(1).

2. **This exemption will not present an undue risk to the health and safety of the public**

   The proposed exemption from the requirements of 10 CFR 52, Appendix D, Section III.B would allow changes to elements of the plant-specific Tier 2 DCD to depart from the AP1000 certified design information and a change to a TS Instrumentation Requirements to depart from the AP1000 certified (Tier 2) information. The plant-specific Tier 1 DCD will continue to reflect the approved licensing basis for the applicant, and will maintain a consistent level of detail with that which is currently provided elsewhere in Tier 1 of the plant-specific DCD. Because the change to the source range flux doubling portion of the nuclear instrumentation source range description maintains its design functions, the changed design will ensure the protection of the health and safety of the public. Therefore, no adverse safety impact which would present any additional risk to the health and safety is present. The affected Design Description in the plant-specific Tier 1 DCD will continue to provide the detail necessary to support the performance of the associated ITAAC.

   Therefore, the requested exemption from 10 CFR 52, Appendix D, Section III.B would not present an undue risk to the health and safety of the public.

3. **The exemption is consistent with the common defense and security**

   The exemption from the requirements of 10 CFR 52, Appendix D, Section III.B would change elements of the plant-specific Tier 2 DCD by departing from the AP1000 certified design information relating to the flux doubling portion of the source ranges neutron flux and departing from the Tier 2 generic TS to include operability requirements of added plant equipment (P-8 permissive). The exemption does not alter the design, function, or operation of any structures or plant equipment that are necessary to maintain a safe and secure status of the plant. The proposed exemption has no impact on plant security or safeguards procedures. Therefore, the requested exemption is consistent with the common defense and security.

4. **Special circumstances are present**

   10 CFR §50.12(a)(2) lists six "special circumstances" for which an exemption may be granted. Pursuant to the regulation, it is necessary for one of these special circumstances to be present in order for the NRC to consider granting an exemption request. The requested exemption meets the special circumstances of 10 CFR §50.12(a)(2)(ii). That subsection defines special circumstances as when "Application of the regulation in the particular

circumstances would not serve the underlying purpose of the rule or is not necessary to achieve the underlying purpose of the rule."

The rule under consideration in this request for exemption from Tier 2 generic TS is 10 CFR 52, Appendix D, Section III.B, which requires an applicant referencing the AP1000 Design Certification Rule (10 CFR Part 52, Appendix D) shall incorporate by reference and comply with the requirements of Appendix D, including Tier 1 information and generic TS. The Levy Units 1 and 2 COLA references the AP1000 Design Certification Rule and incorporates by reference the requirements of 10 CFR Part 52, Appendix D, including Tier 1 information and generic TS. The underlying purpose of Appendix D, Section III.B is to describe and define the scope and contents of the AP1000 design certification, and to require compliance with the design certification information in Appendix D to maintain the level of safety in the design.

The proposed changes to the source range neutron flux doubling function maintain the design margins. This change does not impact the ability of any structures, systems, or components to perform their functions or negatively impact safety. Accordingly, this exemption from the certification information in Tier 2 TS Table 3.3.2-1 will enable the applicant to safely construct and operate the AP1000 facility consistent with the design certified by the NRC in 10 CFR 52, Appendix D.

Therefore, special circumstances are present, because application of the current generic certified design information in Tier 1 and the generic TS as required by 10 CFR Part 52, Appendix D, Section III.B, in the particular circumstances discussed in this request is not necessary to achieve the underlying purpose of the rule.

5. **The special circumstances outweigh any decrease in safety that may result from the reduction in standardization caused by the exemption**

   Based on the nature of the changes to the plant-specific Tier 2 and the generic TS and the understanding that these changes support the design function of the source range neutron flux doubling, it is likely that other AP1000 applicants and licensees will request this exemption. However, if this is not the case, the special circumstances continue to outweigh any decrease in safety from the reduction in standardization because the key design functions of the source range neutron flux doubling associated with this request will continue to be maintained. This exemption request and the associated TS marked-up tables demonstrate the source range neutron flux doubling function continues to be maintained following implementation of the change from the generic AP1000 DCD, thereby minimizing the safety impact resulting from any reduction in standardization.

   Therefore, the special circumstances associated with the requested exemption outweigh any decrease in safety that may result from the reduction in standardization caused by the exemption. In fact, as described in Condition 6, below, the exemption will result in no reduction in the level of safety.

6. **The design change will not result in a significant decrease in the level of safety.**

   The exemption revises the plant-specific DCD Tier 2 information by adding components to Subsection , which were added to the source range neutron flux doubling design to enable the Source Range neutron flux functions to more effectively perform its design functions. This exemption also revises the generic TS Table 3.3.2-1 to add the P-8 permissive.

Therefore, the design change and associated change to the TS will not result in a significant decrease in the level of safety. As demonstrated above, this exemption request satisfies NRC requirements for an exemption to the design certification rule for the AP1000.

COLA Markup Pages

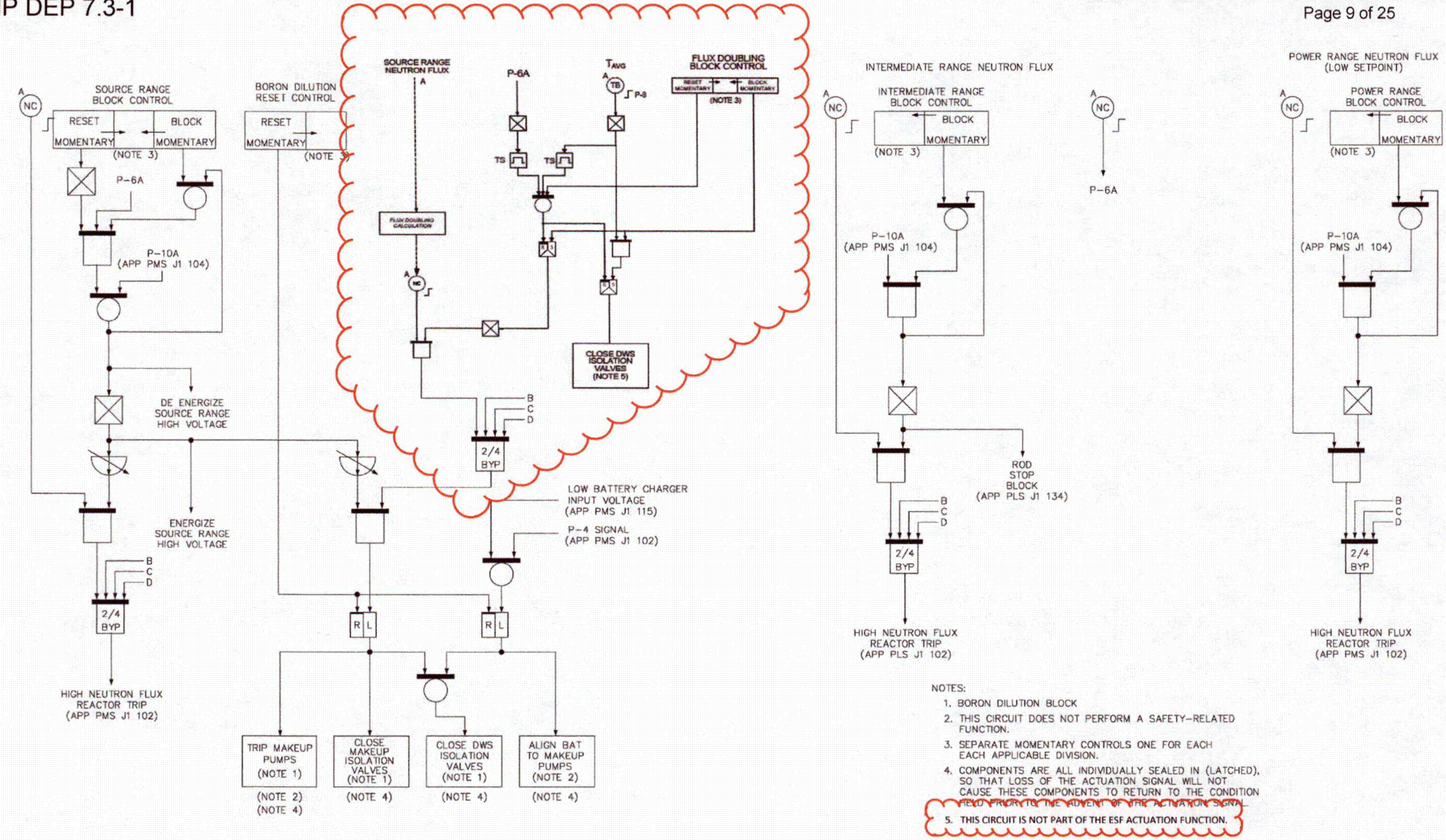


Figure 7.2-201 (Sheet 3 of 21)

Functional Diagram
Nuclear Startup Protection

7. Instrumentation and Controls

terminate the supply of potentially unborated water to the reactor coolant system as quickly as possible.

In the event of a loss of ac power sources or a reactor trip (as indicated by P-4), the block of boron dilution is accomplished by closing the makeup pump suction valves to the demineralized water storage tanks and aligning the boric acid tank to the suction of the makeup pumps. This permits makeup as needed but ensures that it will be from a borated source that will not reduce the available shutdown margin in the reactor core.

Condition 1 is an average of the source range count rate, sampled at least N times over the most recent time period T_1, compared to a similar average taken at time period T_2 earlier. If the ratio of the current average count rate to the earlier average count rate is greater than a preset value, a partial trip is generated in the division. On a coincidence of excessively increasing source range neutron flux in two of the four divisions, boron dilution is blocked. The Flux Doubling function is also delayed from actuating each time the source range detector's high voltage power is energized to prevent a spurious dilution block due to the short term instability of the processed source range values. This source range flux doubling signal may be manually blocked to permit plant startup and normal power operation when reactor coolant average temperature is above the P-8 setpoint. It is automatically reinstated when reactor power is decreased below the P-6 power level during shutdown or reactor coolant average temperature decreases below the P-8 setpoint.

LNP DEP 7.3-1

The Flux Doubling function can also be manually blocked during shutdown conditions when below the P-8 reactor coolant average temperature. When blocked during shutdown conditions, the CVS demineralized water system isolation valves are automatically closed to prevent inadvertent boron dilution.

Condition 2 results from the loss of ac power. A short, preset time delay is provided to prevent actuation upon momentary power fluctuations; however, actuation occurs before ac power is restored by the onsite diesel generators. The loss of all ac power is detected by undervoltage sensors that are connected to the input of each of the four Class 1E battery chargers. Two sensors are connected to each of the four battery charger inputs. The loss of ac power signal is based on the detection of an undervoltage condition by each of the two sensors connected to two of the four battery chargers. The two-out-of-four logic is based on an undervoltage to the battery chargers for divisions A or C coincident with an undervoltage to the battery chargers for divisions B or D.

Condition 3 results from a reactor trip as indicated by the P-4 interlock.

The functional logic relating to the boron dilution block is illustrated in Figure 7.2-1, sheets 3 and 15.

7.3.1.2.15 Chemical and Volume Control System Isolation

A signal to close the isolation valves of the chemical and volume control system is generated from any of the following conditions:

1. High-2 pressurizer level
2. High-2 steam generator narrow range water level
3. Automatic or manual safeguards actuation signal (subsection 7.3.1.1) coincident with High-1 pressurizer level

LNP DEP 7.3-1 Table 7.3-201 (Sheet 1 of 2)

ENGINEERED SAFETY FEATURES ACTUATION SIGNALS

Actuation Signal	**No. of Division/ Controls**	**Actuation Logic**	**Permissives and Interlocks**
12. Passive Residual Heat Removal (Figure 7.2-1, Sheet 8)			
a. Manual initiation	2 controls	1/2 controls	None
b. Low narrow range steam generator water level coincident with	4/steam generator	2/4-BYP[1] in either steam generator	None
Low startup feedwater flow	2/feedwater line	1/2 in either feedwater line	None
c. Low steam generator wide range water level	4/steam generator	2/4-BYP[1] in either steam generator	None
d. Core makeup tank injection	(See Items 6a through 6e)		
e. Automatic reactor coolant system depressurization (first stage)	(See items 3a through 3c)		
f. High-3 pressurizer level	4	2/4-BYP[1]	Manual block permitted below P-19 Automatically unblocked above P-19
13. Block of Boron Dilution (Figure 7.2-1, Sheets 3 and 15)			
a. Flux doubling calculation	4	2/4-BYP[1]	Manual block permitted above P-8. Automatically unblocked (momentary) below P-6 or below P-8. Demineralized water system isolation valves closed if blocked below P-8~~when critical or intentionally approaching criticality Automatically unblocked below P-6~~
b. Undervoltage to Class 1E battery chargers(8)	2/charger	2/2 per charger and 2/4 chargers[5]	None
c. Reactor trip (P-4)	1/division	2/4	None
14. Chemical Volume Control System Isolation (See Figure 7.2-1, Sheets 6 and 11)			
a. High-2 pressurizer water level	4	2/4-BYP[1]	Automatically unblocked above P-19 Manual block permitted below P-19
b. High-2 steam generator narrow range level	4/steam generator	2/4-BYP[1] in either steam generator	None
c. Automatic or manual safeguards actuation signal coincident with	(See items 1a through 1e)		

LNP DEP 7.3-1

Table 7.3-201 (Sheet 2 of 2)

ENGINEERED SAFETY FEATURES ACTUATION SIGNALS

Actuation Signal	No. of Divisions/ Controls	Actuation Logic	Permissives and Interlocks
High-1 pressurizer water level	4	2/4-BYP[1]	None
d. High-2 containment radioactivity	4	2/4-BYP[1]	None
e. Manual initiation	2 controls	1/2 controls	None
f. Flux doubling calculation	4	2/4-BYP[1]	Manual block permitted above P-8. Automatically unblocked (momentary) below P-6 or below P-8. Demineralized water system isolation valves closed if blocked below P-8 ~~when critical or intentionally approaching criticality Automatically unblocked below P-6~~
g. High steam generator narrow range level coincident with	4/steam generator	2/4-BYP[1] in either steam generator	None
Reactor trip (P-4)	1/division	2/4	None
15. Steam Dump Block (Figure 7.2-1, Sheet 10)[(8)]			
a. Low reactor coolant temperature (Low-2 T_{avg})	2/loop	2/4-BYP[1]	None
b. Mode control	2 controls	1/division	None
c. Manual stage 1 cooldown control	2 controls	1/division	None
d. Manual stage 2 cooldown control	2 controls	1/division	None
16. Main Control Room Isolation and Air Supply Initiation (Figure 7.2-1, Sheet 13)			
a. High-2 control room supply air radiation	2	1/2	None
b. Undervoltage to Class 1E battery chargers[(8)]	2/charger	2/2 per charger and 2/4 chargers[5]	None
c. Manual initiation[(8)]	2 controls	1/2 controls	None
17. Auxiliary Spray and Purification Line Isolation (Figure 7.2-1, Sheet 12)			
a. Low-1 pressurizer level	4	2/4-BYP[1]	Manual block permitted below P-12 Automatically unblocked above P-12
b. Manual initiation of chemical and volume control system isolation	(See item 14e)		

LNP DEP 7.3-1 Table 7.3-202 (Sheet 1 of 1)

INTERLOCKS FOR ENGINEERED SAFETY FEATURES ACTUATION SYSTEM

Designation	Derivation	Function
P-3	Reactor trip breaker open	Permits manual reset of safeguards actuation signal to block automatic safeguards actuation
$\overline{\text{P-3}}$	Reactor trip breakers closed	Automatically resets the manual block of automatic safeguards actuation
P-4	Reactor trip initiated or reactor trip breakers open	(a) Isolates main feedwater if coincident with low reactor coolant temperature (b) Trips turbine (c) Blocks boron dilution
$\overline{\text{P-4}}$	No reactor trip initiated and reactor trip breakers closed	Removes demand for isolation of main feedwater, turbine trip and boron dilution block
P-6	Intermediate range neutron flux channels above setpoint	None
$\overline{\text{P-6}}$	Intermediate range neutron flux channels below setpoint	Automatically resets the manual block of flux doubling actuation of the boron dilution block
P-8	Reactor coolant average temperature above setpoint	Permits manual block of flux doubling actuation of the boron dilution block
$\overline{\text{P-8}}$	Reactor coolant average temperature below setpoint	(a) Automatically resets (momentary) the manual block of flux doubling actuation of the boron dilution block (b) Closes demineralized water system isolation valves if flux doubling actuation of the boron dilution block is blocked below P-8.
P-11	Pressurizer pressure below setpoint	(a) Permits manual block of safeguards actuation on low pressurizer pressure, low compensated steam line pressure, or low reactor coolant inlet temperature (b) Permits manual block of steam line isolation on low reactor coolant inlet temperature (c) Permits manual block of steam line isolation and steam generator power-operated relief valve block valve closure on low compensated steam line pressure (d) Coincident with manual actions of (b) or (c), automatically unblocks steam line isolation on high negative steam line pressure rate (e) Permits manual block of main feedwater isolation on low reactor coolant temperature

boundary. This valve is operated from the main control room and the remote shutdown workstation.

Makeup Line Containment Isolation Valves

These normally open, motor-operated globe valves provide containment isolation of the chemical and volume control system makeup line and automatically close on a high-2 pressurizer level, high steam generator level, or high-2 containment radiation signal from the protection and safety monitoring system. The valves close on a source range flux doubling signal to terminate possible unplanned boron dilution events. The valves also close on a safeguards actuation signal coincident with high-1 pressurizer level. This allows the chemical and volume control system to continue providing reactor coolant system makeup flow, if the makeup pumps are operating following a safeguards actuation signal. These valves are also controlled by the reactor makeup control system and close when makeup to other systems is provided. Manual control is provided in the main control room and at the remote shutdown workstation.

Hydrogen Addition Containment Isolation Valve

This normally open, fail closed, air-operated globe valve is located outside containment in the hydrogen addition line. The valve automatically closes on a containment isolation signal from the protection and safety monitoring system. Manual control is provided in the main control room and at the remote shutdown workstation.

Demineralized Water System Isolation Valves

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These normally open, air-operated butterfly valves are located outside containment in the line from the demineralized water storage and transfer system. These valves close on a signal from the protection and safety monitoring system derived by either a reactor trip signal, a source range flux doubling signal, low input voltage (loss of ac power) to the 1E dc and uninterruptable power supply system battery chargers, or a safety injection signal, isolating the demineralized water source to prevent inadvertent boron dilution events and, during shutdown conditions, whenever the flux doubling signal is blocked to prevent inadvertent boron dilution. Manual control for these valves is provided from the main control room and at the remote shutdown workstation.

Makeup Pump Suction Header Valve

This air-operated, three-way valve is automatically controlled by the makeup control system to provide the desired boric acid concentration of makeup to the reactor coolant system (boric acid, demineralized water, or blend based on the desired reactor coolant system boron concentration). The valve fails with the pump suction aligned to the boric acid storage tank on a loss of instrument air. This valve will also align to the boric acid storage tank on either a reactor trip, source range flux doubling signal, low input voltage (loss of ac power) to the 1E dc and uninterruptable power supply system battery chargers, or a safety injection signal from the protection and safety monitoring system. This valve also aligns the makeup pump suction to the boric acid storage tank when low pressure is detected in the demineralized water supply line to protect the pump from a loss of suction supply. Manual control for this valve is provided in the main control room and at the remote shutdown workstation.

9.3.6.4.4 Abnormal Operation

9.3.6.4.4.1 Reactor Coolant System Leak

The chemical and volume control system is capable of making up for a small reactor coolant system leak with either makeup pump at reactor coolant system pressures above the low-pressure setpoint.

9.3.6.4.5 Accident Operation

The chemical and volume control system can provide borated makeup to the reactor coolant system following accidents such as small loss-of-coolant accidents, steam generator tube rupture events, and small steam line breaks. In addition, pressurizer auxiliary spray can reduce reactor coolant system pressure during certain events such as a steam generator tube rupture.

To protect against steam generator overfill, the makeup function is isolated by closing the makeup line containment isolation valves, if a high steam generator level signal is generated. These valves also close and isolate the system on a high pressurizer level signal.

Some of the valves in the chemical and volume control system are required to operate under accident conditions to effect reactor coolant system pressure boundary and containment isolation, as discussed in subsection 9.3.6.3.7.

9.3.6.4.5.1 Boron Dilution Events

The chemical and volume control system is designed to address a boron dilution accident by closing redundant safety-related valves, tripping the makeup pumps and/or aligning the suction of the makeup pumps to the boric acid tank.

For dilution events occurring at power (assuming the operator takes no action), a reactor trip is initiated on either an overpower trip or an overtemperature ΔT trip. Following a reactor trip signal, the line from the demineralized water system is isolated by closing two safety-related, air-operated valves. The three-way pump suction control valve aligns so the makeup pumps take suction from the boric acid tank. If the event occurs while the makeup pumps are operating, the realignment of these valves causes the makeup pumps, if they continue to operate, to borate the plant.

For dilution events during shutdown, the source range flux doubling signal is used to isolate the makeup line to the reactor coolant system by closing the two safety-related, motor-operated valves, isolate the line from the demineralized water system by closing the two safety-related, air-operated valves, and trip the makeup pumps. For refueling operations, administrative controls are used to prevent boron dilutions by verifying the valves in the line from the demineralized water system are closed and secured. In addition, when the flux doubling signal is blocked during shutdown, the demineralized water system isolation valves are closed to prevent inadvertent boron dilution.

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9.3.6.5 Design Evaluation

The chemical and volume control system has redundant, safety-related isolation valves and piping to protect the reactor coolant system pressure boundary, and is designed in accordance with ANSI/ANS-51.1 (Reference 4).

The instrumentation also supplies input signals for control purposes to maintain proper system operation and to prevent equipment damage. Some specific control functions are listed below:

- **Purification isolation** – To preserve the reactor coolant pressure boundary in the event of a break in the chemical and volume control system loop piping. The purification stop valves close automatically on a signal from the protection and safety monitoring system generated by a low-1 pressurizer level signal. This isolation also serves as an equipment protection function to prevent uncovering of the heater elements in the pressurizer. One of these valves also closes on high temperature downstream of the letdown heat exchanger, to protect the resin in the mixed bed and cation demineralizers from being exposed to temperatures that could damage the resins.

- **Containment isolation** – To preserve the containment boundary, containment isolation valves are provided in the letdown line to the liquid radwaste system, the chemical and volume control system makeup line, and the hydrogen addition line. These valves are opened or closed manually from the main control room and the remote shutdown workstation. Interlocks are provided to close these valves automatically upon receipt of a containment isolation signal from the protection and safety monitoring system and require operator action to reopen.

- **Letdown isolation valves** – The letdown isolation valves are used to isolate letdown flow to the liquid radwaste system in addition to the containment isolation function described above. The plant control system provides a signal to automatically open these valves on a high-pressurizer level signal derived from the pressurizer level control system. On a containment isolation signal from the protection and safety monitoring system, a high-high liquid radwaste system degassifier level signal (plant control system), or a low-pressurizer level signal (plant control system), these valves automatically close to provide isolation of the letdown line. The letdown isolation valves also receive a signal from the protection and safety monitoring system to automatically close and isolate letdown during midloop operations based on a low hot leg level. Manual control is provided from the main control room and at the remote shutdown workstation. The letdown flow control valve controls reactor coolant system pressure during startup, as described in subsection 9.3.6.4.1.

- **Demineralized water system isolation valves** – To prevent inadvertent boron dilution, the demineralized water system isolation valves close on a signal from the protection and safety monitoring system derived from either a reactor trip signal, a source range flux doubling signal, low input voltage (loss of ac power) to the 1E dc and uninterruptible power supply system battery chargers, or a safety injection signal providing a safety-related method of stopping an inadvertent dilution. In addition, when the flux doubling. logic is blocked during shutdown, the valves are closed to prevent inadvertent boron dilution. The main control room and remote shutdown workstation provide manual control for these valves.

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- **Makeup isolation valves** – To isolate the makeup flow to the reactor coolant system, two valves are provided in the chemical and volume control system makeup line. These valves automatically close on a signal from the protection and safety monitoring system derived from source range flux doubling, high-2 pressurizer level, high steam generator level, or a safeguards signal coincident with high-1 pressurizer level to protect against pressurizer or steam generator overfill. Manual control for these valves is provided in the main control

LNP DEP 7.3-1	Table 14.3-201 (Sheet 1 of 2) **DESIGN BASIS ACCIDENT ANALYSIS**	
Reference	**Design Feature**	**Value**
Section 7.3.1.2.4	The first stage valves of the automatic depressurization system open upon receipt of a signal generated from a core makeup tank injection alignment signal coincident with core makeup tank water level less than the Low-1 setpoint in either core makeup tank via the protection and safety monitoring system.	
Section 7.3.1.2.4	The second and third stage valves open on time delays following generation of the first stage actuation signal via the protection and safety monitoring system.	
Section 7.3.1.2.5	The reactor coolant pumps are tripped upon generation of a safeguards actuation signal or upon generation of a low-2 pressurizer water level signal.	
Section 7.3.1.2.7	The passive residual heat removal heat exchanger control valves are opened on low steam generator water level or on a CMT actuation signal via the protection and safety monitoring system.	
Section 7.3.1.2.9	The containment recirculation isolation valves are opened on a safeguards actuation signal in coincidence with low-3 in-containment refueling water storage tank water level via the protection and safety monitoring system.	
Section 7.3.1.2.14	The demineralized water system isolation valves close on a signal from the protection and safety monitoring system derived from either a reactor trip signal, a source range flux doubling signal, ~~or~~ low input voltage to the 1E dc uninterruptible power supply battery chargers or if the source range flux doubling logic is blocked during shutdown.	
Section 7.3.1.2.15	The chemical and volume control system makeup line isolation valves automatically close on a signal from the protection and monitoring system derived from a source range flux doubling, high-2 pressurizer level, high-2 steam generator level signal, a safeguards signal coincident with high-1 pressurizer level, or high-2 containment radioactivity.	
Section 7.3.2.2.1	The protection and monitoring system automatically generate an actuation signal for an engineered safety feature whenever a monitored condition reaches a preset level.	
Section 7.3.2.2.9	Manual initiation at the system-level exists for the engineered safety features actuation.	

LNP DEP 7.3-1

Table 14.3-201 (Sheet 2 of 2)

DESIGN BASIS ACCIDENT ANALYSIS

Reference	Design Feature	Value
Section 9.3.6.7	The demineralized water system isolation valves close on a signal from the protection and safety monitoring system derived from either a reactor trip signal, a source range flux doubling signal, low input voltage to the 1E dc and uninterruptible power supply battery chargers, ~~or~~ a safety injection signal or if the source range flux doubling logic is blocked during shutdown conditions.	
Section 9.3.6.7	The chemical and volume control system makeup line isolation valves automatically close on a signal from the protection and safety monitoring system derived from a source range flux doubling, high-2 pressurizer level, high steam generator level signal, or a safeguards signal coincident with high-1 pressurizer level.	
Section 10.1.2	Safety valves are provided on both main steam lines.	
Section 10.2.2.4.3	The flow of the main steam entering the high-pressure turbine is controlled by four stop valves and four governing control valves. The stop valves are closed by actuation of the emergency trip system devices.	
Section 10.3.1.1	The main steam supply system is provided with a main steam isolation valve and associated MSIV bypass valve on each main steam line from its respective steam generator.	
Section 10.3.1.1	A main steam isolation valve (MSIV) on each main steam line prevents the uncontrolled blowdown of more than one steam generator and isolates nonsafety-related portions of the system.	
Section 10.3.1.2	Power-operated atmospheric relief valves are provided to allow controlled cooldown of the steam generator and the reactor coolant system when the condenser is not available.	
Section 10.3.2.1	The main steam supply system includes: - One main steam isolation valve and one main steam isolation valve bypass valve per main steam line. - Main steam safety valves. - Power-operated atmospheric relief valves and upstream isolation valves.	
Section 10.3.2.3.2	In the event that a design basis accident occurs, which results in a large steam line break, the main steam isolation valves with associated main steam isolation bypass valves automatically close.	

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The safety analysis of boron dilution accidents is provided in Chapter 15 and is discussed in subsection 19E.4.5 of this appendix. For dilution events that occur during shutdown, the source-range flux-doubling signal closes the safety-related remotely operated CVS makeup line isolation valves to terminate the event. In addition, the signal is used to isolate the line from the demineralized water system to the makeup pump suction by closing the two safety-related remotely operated valves. The three-way pump suction control valve aligns the makeup pumps to take suction from the boric acid tank and, therefore, stops the dilution.

For refueling operations, administrative controls are used to prevent boron dilutions by verifying that the valves in the line from the demineralized water system are closed and locked. These valves block the flow paths that can allow unborated makeup water to reach the RCS. Makeup required during refueling uses borated water supplied from the boric acid tank by the CVS makeup pumps.

During refueling operations (Mode 6), two source-range neutron flux monitors are operable to monitor core reactivity. This is required by the plant Technical Specifications. The two operable source-range neutron flux monitors provide a signal to alert the operator to unexpected changes in core reactivity. The potential for an uncontrolled boron dilution accident is precluded by isolating the unborated water sources. This is also required by the plant Technical Specifications.

19E.2.8 Spent Fuel Pool Cooling System

19E.2.8.1 System Description

The spent fuel pool cooling system (SFS) is discussed in subsection 9.1.3.

19E.2.8.2 Design Features to Address Shutdown Safety

The AP1000 has incorporated various design features to improve shutdown safety. The SFS features that have been incorporated to address shutdown safety are described in this subsection.

19E.2.8.2.1 Seismic Design

The spent fuel pool, fuel transfer canal (FTC), cask loading pit (CLP), cask washdown pit (CWP), and gates from the spent fuel pool-CLP and FTC-spent fuel pool are all integral with the auxiliary building structure. The auxiliary building is seismic Class I design and is designed to retain its integrity when exposed to a safe shutdown earthquake (SSE). The suction and discharge connections between the spent fuel pool and RNS are safety Class C, which is also seismic Class I. The emergency makeup water line from the PCS water storage tank to the spent fuel pool actually connects with the RNS pump suction line. This emergency makeup line is also safety Class C and seismic Class I. The spent fuel pool level instruments connections to the spent fuel pool are safety Class C, seismic Class I, and have 3/8-inch flow restricting orifices at the pool wall to limit the amount of a leak from the pool if the instrument or its piping develops a leak.

The refueling cavity is integral with the containment internal structure, and as such, is seismic Class I, and is designed to retain its integrity when exposed to an SSE. In addition, the AP1000 has incorporated a permanently welded seal ring to provide the seal between the vessel flange and the refueling cavity floor. This refueling cavity seal is part of the refueling cavity and is seismic Class I. Figure 19E.2-3 is a simplified drawing of the AP1000 permanent reactor cavity seal. The

Table 3.3.2-1 (page 9 of 13)
Engineered Safeguards Actuation System Instrumentation

	FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	REQUIRED CHANNELS	CONDITIONS	SURVEILLANCE REQUIREMENTS
LNP DEP 7.3-1	15. Boron Dilution Block				
	a. Source Range Neutron Flux Doubling	2(n),3(n, e),4(e)	4	B,T	SR 3.3.2.1 SR 3.3.2.4 SR 3.3.2.5 SR 3.3.2.6
		5(e)	4	B,P	SR 3.3.2.1 SR 3.3.2.4 SR 3.3.2.5 SR 3.3.2.6
	b. Reactor Trip	Refer to Function 18.b (ESFAS Interlocks, Reactor Trip, P-4) for all requirements.			
	16. Chemical Volume and Control System Makeup Isolation				
	a. SG Narrow Range Water Level – High 2	1,2,3(e),4(b,e)	4 per SG	B,R	SR 3.3.2.1 SR 3.3.2.4 SR 3.3.2.5 SR 3.3.2.6
	b. Pressurizer Water Level – High 1	1,2,3(e)	4	B,Q	SR 3.3.2.1 SR 3.3.2.4 SR 3.3.2.5 SR 3.3.2.6
	Coincident with Safeguards Actuation	1,2,3(e)	Refer to Function 1 (Safeguards Actuation) for initiating functions and requirements.		
	c. Pressurizer Water Level – High 2	1,2,3,4(b,e,m)	4	B,T	SR 3.3.2.1 SR 3.3.2.4 SR 3.3.2.5 SR 3.3.2.6
	d. Containment Radioactivity – High 2	1,2,3(e)	4	B,Q	SR 3.3.2.1 SR 3.3.2.4 SR 3.3.2.5 SR 3.3.2.6
	e. Manual Initiation	1,2,3(e),4(b,e)	2 switches	E,R	SR 3.3.2.3
	f. Source Range Neutron Flux Doubling	Refer to Function 15.a (Boron Dilution Block, Source Range Neutron Flux Doubling) for all requirements.			
	g. SG Narrow Range Water Level High	1,2,3(e),4(b,e)	4 per SG	B,R	SR 3.3.2.1 SR 3.3.2.4 SR 3.3.2.5 SR 3.3.2.6
	Coincident with Reactor Trip (P-4)	Refer to Function 18.b (ESFAS Interlocks, Reactor Trip, P-4) for all requirements.			

(b) With the RCS not being cooled by the Normal Residual Heat Removal System (RNS).

(e) Not applicable for valve isolation Functions whose associated flow path is isolated.

(m) Above the P-19 (RCS Pressure) interlock.

(n) Not applicable when critical or during intentional approach to criticality.

Table 3.3.2-1 (page 10 of 13)
Engineered Safeguards Actuation System Instrumentation

	FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	REQUIRED CHANNELS	CONDITIONS	SURVEILLANCE REQUIREMENTS
	17. Normal Residual Heat Removal System Isolation				
	a. Containment Radioactivity – High 2	1,2,3[(e)]	4	B,Q	SR 3.3.2.1 SR 3.3.2.4 SR 3.3.2.5 SR 3.3.2.6
	b. Safeguards Actuation	1,2,3[(e)]	Refer to Function 1 (Safeguards Actuation) for all initiating functions and requirements.		
	c. Manual Initiation	1,2,3[(e)]	2 switch sets	E,Q	SR 3.3.2.3
	18. ESFAS Interlocks				
	a. Reactor Trip Breaker Open, P-3	1,2,3	3 divisions	D,M	SR 3.3.2.3
	b. Reactor Trip, P-4	1,2,3	3 divisions	D,M	SR 3.3.2.3
	c. Intermediate Range Neutron Flux, P-6	2	4	J,L	SR 3.3.2.1 SR 3.3.2.4 SR 3.3.2.5
LNP DEP 7.3-1	d. Reactor Coolant Average Temperature, P-8	2, 3[(e)], 4[(e)]	4	J,T	SR 3.3.2.1 SR 3.3.2.4 SR 3.3.2.5
		5[(e)]	4	J,P	SR 3.3.2.1 SR 3.3.2.4 SR 3.3.2.5
	e~~d~~. Pressurizer Pressure, P-11	1,2,3	4	J,M	SR 3.3.2.1 SR 3.3.2.4 SR 3.3.2.5
	f~~e~~. Pressurizer Level, P-12	1,2,3	4	J,M	SR 3.3.2.1 SR 3.3.2.4 SR 3.3.2.5
		4,5,6	4	BB,Y	SR 3.3.2.1 SR 3.3.2.4 SR 3.3.2.5
LNP DEP 7.3-1	g~~f~~. RCS Pressure, P-19	1,2,3,4[(b)]	4	J,N	SR 3.3.2.1 SR 3.3.2.4 SR 3.3.2.5
	19. Containment Air Filtration System Isolation				
	a. Containment Radioactivity – High 1	1,2,3,4[(b)]	4	B,Z	SR 3.3.2.1 SR 3.3.2.4 SR 3.3.2.5 SR 3.3.2.6
	b. Containment Isolation	Refer to Function 3 (Containment Isolation) for initiating functions and requirements.			

(b) With the RCS not being cooled by the Normal Residual Heat Removal System (RNS).

(e) Not applicable for valve isolation Functions whose associated flow path is isolated.

BASES

APPLICABLE SAFETY ANALYSES, LCOs, and APPLICABILITY (continued)

15. Boron Dilution Block

LNP DEP 7.3-1

The block of boron dilution is accomplished by closing the CVS makeup line isolation~~suction~~ valves or closing the CVS ~~to~~ demineralized water system isolation ~~storage tanks~~ valve~~, and aligning the boric acid tank to the CVS makeup pumps~~. This Function is actuated by Source Range Neutron Flux Doubling and Reactor Trip.

15.a. Source Range Neutron Flux Doubling

LNP DEP 7.3-1

A signal to block boron dilution in MODES 2 or 3, when not critical or during an intentional approach to criticality, and MODES 4 or 5 is derived from source range neutron flow increasing at an excessive rate (source range flux doubling). This Function is not applicable in MODES 4 and 5 if the demineralized water makeup flow path is isolated. The source range neutron detectors are used for this Function. The LCO requires four divisions to be OPERABLE. There are four divisions and two-out-of-four logic is used. On a coincidence of excessively increasing source range neutron flux in two of the four divisions, demineralized water is isolated (CVS demineralized water system isolation valves closed) from the makeup pumps and reactor coolant makeup is isolated (CVS makeup line isolation valves closed) from the reactor coolant system to preclude a boron dilution event. In MODE 6, a dilution event is precluded by the requirement in LCO 3.9.2 to close, lock and secure at least one valve in each unborated water source flow path.

15.b. Reactor Trip (Function 18.b)

LNP DEP 7.3-1

Demineralized Water Makeup is also isolated (CVS demineralized water system isolation valves closed and the boric acid aligned to the CVS makeup pumps) by all the Functions that initiate a Reactor Trip. The isolation requirements for these Functions are the same as the requirements for the Reactor Trip Function. Therefore, the requirements are not repeated in Table 3.3.2-1. Instead Function 18.b, (P-4 Reactor Trip Breakers), is referenced for all initiating Functions and requirements.

LNP DEP 7.3-1

18.d. Reactor Coolant Average Temperature, P-8 The P-8 interlock is provided to permit a manual block of or to reset a manual block of the automatic Source Range Neutron Flux Doubling actuation of the Boron Dilution Block (Function 15.3).

The Boron Dilution Block may be manually blocked to permit plant startup and normal power operation when above the P-8 reactor coolant average temperature.

The Boron Dilution Block is automatically reset upon decrease of the reactor coolant average temperatue to below P-8.

Once the reactor coolant average temperature Is below P-8, the Source Range Neutron Flux Doubling actuation of the Boron Dilution Block Function may be manually blocked to prevent inadvertent actuation during refueling operations and post-refueling control rod testing.

When the Boron Dilution Block is manually blocked below P-8 during shutdown conditions, the CVS demineralized water system isolation valves are automatically closed to prevent inadvertent boron dilution.

LNP DEP 7.3-1

The P-8 interlock is required to be OPERABLE in MODES 2, 3, 4 and 5. This Function is not applicable in MODES 3, 4 and 5, if the demineralized water makeup flow path is isolated. In MODE 6, a dilution event is precluded by the requirement in LCO 3.9.2 to close, lock and secure at least one valve in each unborated water source flow path.

LNP DEP 7.3-1

18.~~d~~e. Pressurizer Pressure, P-11

The P-11 interlock permits a normal unit cooldown and depressurization without Safeguards Actuation or main steam line and feedwater isolation. With pressurizer pressure channels less than the P-11 setpoint, the operator can manually block the Pressurizer pressure – Low, Steam Line Pressure – Low, and T_{cold} – Low Safeguards Actuation signals and the Steam Line Pressure – Low and T_{cold} – Low steam line isolation signals. When the Steam Line Pressure – Low is manually blocked, a main steam isolation signal on Steam Line Pressure-Negative Rate – High is enabled. This provides protection for an SLB by closure of the main steam isolation valves. Manual block of feedwater isolation on T_{avg} – Low 1, Low 2, and T_{cold} – Low is also permitted below P-11. With pressurizer pressure channels ≥ P-11 setpoint, the Pressurizer Pressure – Low, Steam Line Pressure – Low, and T_{cold} – Low Safeguards Actuation signals and the Steam Line Pressure Low and T_{cold} – Low steam line isolation signals are automatically enabled. The feedwater isolation signals on T_{cold} – Low, T_{avg} – Low 1 and Low 2 are also automatically enabled above P-11. The operator can also enable these signals by use of the respective manual reset buttons.

When the Steam Line Pressure – Low and T_{cold} – Low steam line isolation signals are enabled, the main steam isolation on Steam Line Pressure-Negative Rate – High is disabled. The Setpoint reflects only steady state instrument uncertainties.

This Function must be OPERABLE in MODES 1, 2, and 3 to allow an orderly cooldown and depressurization of the unit without the Safeguards Actuation or main steam or feedwater isolation. This Function does not have to be OPERABLE in MODE 4, 5, or 6, because plant pressure must already be below the P-11 setpoint for the requirements of the heatup and cooldown curves to be met.

LNP DEP 7.3-1

18.fe. Pressurizer Level, P-12

The P-12 interlock is provided to permit midloop operation without core makeup tank actuation, reactor coolant pump trip, CVS letdown isolation, or purification line isolation. With pressurizer level channels less than the P-12 setpoint, the operator can manually block low pressurizer level signal used for these actuations. Concurrent with blocking CMT actuation on low pressurizer level, ADS 4th Stage actuation on Low 2 RCS hot leg level is enabled. Also CVS letdown isolation on Low 1 RCS hot leg level is enabled. When the pressurizer level is above the P-12 setpoint, the pressurizer level signal is automatically enabled and a confirmatory open signal is issued to the isolation valves on the CMT cold leg balance lines. This Function is required to be OPERABLE in MODES 1, 2, 3, 4, 5, and 6.

LNP DEP 7.3-1

18.fg. RCS Pressure, P-19

The P-19 interlock is provided to permit water solid conditions (i.e., when the pressurizer water level is >92%) in lower MODES without automatic isolation of the CVS makeup pumps. With RCS pressure below the P-19 setpoint, the operator can manually block CVS isolation on High 2 pressurizer water level, and block Passive RHR actuation and Pressurizer Heater Trip on High 3 pressurizer water level. When RCS pressure is above the P-19 setpoint, these Functions are automatically unblocked. This Function is required to be OPERABLE IN MODES 1, 2, 3, and 4 with the RCS not being cooled by the RNS. When the RNS is cooled by the RNS, the RNS suction relief valve provides the required overpressure protection (LCO 3.4.14).

ACTIONS (Continued)

J.1 and J.2

LNP DEP 7.3-1

Condition J applies to the P-6, P-8, P-11, P-12, and P-19 interlocks. With one or two required channel(s) inoperable, the associated interlock must be verified to be in its required state for the existing plant condition within 1 hour, or any Function channel associated with the inoperable interlock(s) placed in a bypassed condition within 7 hours. Verifying the interlock state manually accomplishes the interlock role.

If one interlock channel is inoperable, the associated Function(s) must be placed in a bypass or trip condition within 7 hours. If one channel is bypassed, the logic becomes two-out-of-three, while still meeting the single failure criterion. (A failure in one of the three remaining channels will not prevent the protective function.) If one channel is tripped, the logic becomes one-out-of-three, while still meeting the single failure criterion. (A failure in one of the three remaining channels will not prevent the protective function.)

If two interlock channels are inoperable, one channel of the associated Function(s) must be bypassed and one channel of the associated Function(s) must be tripped. In this state, the logic becomes one-out-of-two, while still meeting the single failure criterion. The 7 hours allowed to place the inoperable channel(s) in the bypassed or tripped condition is justified in Reference 6.

K.1

LCO 3.0.8 is applicable while in MODE 5 or 6. Since irradiated fuel assembly movement can occur in MODE 5 or 6, the ACTIONS have been modified by a Note stating that LCO 3.0.8 is not applicable. If moving irradiated fuel assemblies while in MODE 5 or 6, the fuel movement is independent of shutdown reactor operations. Entering LCO 3.0.8 while in MODE 5 or 6 would require the optimization of plant safety, unnecessarily.

Condition K is applicable to the MCR Isolation and Air Supply Initiation (Function 20), during movement of irradiated fuel assemblies. If the Required Action and associated Completion Time of the first Condition listed in Table 3.3.2-1 is not met, the plant must suspend movement of the irradiated fuel assemblies immediately. The required action suspends activities with potential for releasing radioactivity that might enter the MCR. This action does not preclude the movement of fuel to a safe position.