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Docket Nos.: 52-025
52-026

ND-17-1085
10 CFR 50.90
10 CFR 52.63

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

**Southern Nuclear Operating Company**
**Vogtle Electric Generating Plant Units 3 and 4**
**Request for License Amendment and Exemption:**
**Addition of a Residual Heat Removal Suction Relief Valve**
**for Low-Temperature Overpressure Protection (LAR-17-022)**

Ladies and Gentlemen:

Pursuant to 10 CFR 52.98(c) and in accordance with 10 CFR 50.90, Southern Nuclear Operating Company (SNC) requests an amendment to the combined licenses (COLs) for Vogtle Electric Generating Plant (VEGP) Units 3 and 4 (License Numbers NPF-91 and NPF-92, respectively). The requested amendment proposes to depart from Tier 2 information in the Updated Final Safety Analysis Report (UFSAR) (which includes the plant-specific DCD Tier 2 information) and involves related changes to plant-specific Tier 1 (and associated COL Appendix C) information, and COL Appendix A Technical Specifications. Pursuant to the provisions of 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 also requested for the plant-specific DCD Tier 1 material departures.

The requested amendment proposes changes to add a second normal residual heat removal system (RNS) suction relief valve in parallel to the current RNS suction relief valve, with the necessary piping changes. Additionally, a change is proposed to Tier 1 Figure 2.2.1-1, for penetration P19, to accurately depict the orientation of the class break of containment isolation valve RNS-PL-V061.

Enclosure 1 provides the description, technical evaluation, regulatory evaluation (including the Significant Hazards Consideration) and environmental considerations for the proposed changes.

Enclosure 2 provides the background and supporting basis for the requested exemption.

Enclosure 3 identifies the requested changes and provides markups depicting the requested changes to the VEGP Units 3 and 4 licensing basis documents.

Enclosure 4 provides conforming Technical Specification Bases changes for information only.

Enclosure 5 provides WCAP-15993, Evaluation of the AP1000 Conformance to Inter-System Loss-of-Coolant Accident Acceptance Criteria, Revision 2.

This letter contains no regulatory commitments. This letter has been reviewed and determined not to contain security related information.

SNC requests NRC staff review and approval of the license amendment by December 1, 2017, to support closure of affected ITAAC. Delayed approval of this license amendment could result in a delay in timely closure of the ITAAC. SNC expects to implement the proposed amendment within thirty days of approval. South Carolina Electric & Gas Company (SCE&G) has stated that the current requested approval date for the expected parallel LAR for Virgil C. Summer Nuclear Station (VCSNS) Unit 2 is December 1, 2017.

In accordance with 10 CFR 50.91, SNC is notifying the State of Georgia by transmitting a copy of this letter and its enclosures to the designated State Official.

Should you have any questions, please contact Mr. Christopher L. Whitfield at (205) 992-5071.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 14th of July 2017.

Respectfully submitted,

Brian H. Whitley
Director, Regulatory Affairs
Southern Nuclear Operating Company

Enclosures

1) Vogtle Electric Generating Plant (VEGP) Units 3 and 4 – Request for License Amendment Regarding Changes to Residual Heat Removal Suction Relief Valve (LAR-17-022)

2) Vogtle Electric Generating Plant (VEGP) Units 3 and 4 – Exemption Request: Changes to Residual Heat Removal Suction Relief Valve (LAR-17-022)

3) Vogtle Electric Generating Plant (VEGP) Units 3 and 4 – Proposed Changes to Licensing Basis Documents (LAR-17-022)

4) Vogtle Electric Generating Plant (VEGP) Units 3 and 4- Conforming Technical Specification Bases Changes (For Information Only) (LAR-17-022)

5) Vogtle Electric Generating Plant (VEGP) Units 3 and 4 - WCAP-15993, Evaluation of the AP1000 Conformance to Inter-System Loss-of-Coolant Accident Acceptance Criteria, Revision 2 (LAR-17-022)

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**Southern Nuclear Operating Company**

**ND-17-1085**

**Enclosure 1**

**Vogtle Electric Generating Plant (VEGP) Units 3 and 4**

**Request for License Amendment Regarding**
**Changes to Residual Heat Removal Suction Relief Valve**

**(LAR-17-022)**

(This Enclosure consists of 28 pages, including this cover page.)

## Table of Contents

Pursuant to 10 CFR 52.98(c) and in accordance with 10 CFR 50.90, Southern Nuclear Operating Company (SNC) hereby requests an amendment to Combined License (COL) Nos. NPF-91 and NPF-92 for Vogtle Electric Generating Plant (VEGP) Units 3 and 4, respectively.

## 1. SUMMARY DESCRIPTION

The requested amendment proposes to depart from approved AP1000 Design Control Document (DCD) Tier 2 information (text, tables, and figures) as incorporated into the Updated Final Safety Analysis Report (UFSAR) as plant-specific DCD Tier 2 information, and involves changes to plant-specific Tier 1 (and associated COL Appendix C) information and COL Appendix A, Technical Specifications. The requested amendment proposes changes to add a second normal residual heat removal system (RNS) suction relief valve (RNS-PL-V020) in parallel to the current RNS suction relief valve (RNS-PL-V021), with the necessary piping changes to accommodate the installation as shown in proposed changes to Tier 1 Figures 2.2.1-1 and 2.3.6-1 and Tables 2.3.6-1, 2.3.6-2, and 2.3.6-4. Changes are also proposed to COL Appendix A, Technical Specification 3.4.14 to address the additional relief valve, and additional operational restrictions required when RNS relief valves are utilized for low temperature overpressure protection (LTOP). Additionally, Tier 1 Figure 2.2.1-1, for penetration P19, inaccurately depicts the class break for containment isolation valve RNS-PL-V061. The class break is illustrated backwards. Currently, the figure shows the RNS-PL-V061 as nonsafety (N) breaking to Class 2 (2) piping. A change is proposed to reverse the class break depicted on Tier 1 Figure 2.2.1-1 by showing the class break from 2-to-N instead of the current N-to-2, consistent with Tier 1 Figure 2.3.6-1.

The requested amendment proposes changes to COL Appendix A, COL Appendix C, and corresponding changes to plant-specific Tier 1 information, and the UFSAR. This enclosure requests approval of the license amendment necessary to implement the COL Appendix A, COL Appendix C, and UFSAR changes. Enclosure 2 requests the exemption necessary to implement the involved changes to the plant-specific Tier 1 information.

## 2. DETAILED DESCRIPTION

Low temperature overpressure protection (LTOP) limits reactor coolant system (RCS) pressure at low temperatures so that the integrity of the RCS pressure boundary is not compromised by violating pressure and temperature limits. During operation at or below 350°F, the RNS is operated for decay heat removal. Therefore, the RNS suction isolation valves are open in the piping from the RCS hot legs to the inlet of the RNS. While these valves are open, the RNS suction relief valve, RNS-PL-V021, is exposed to the RCS and able to relieve pressure transients in the RCS, including mass input and heat input.

For the low temperature modes of operation when a water solid pressurizer is possible, the relief valve in the RNS provides LTOP for the RCS. Since the current RNS relief valve, RNS-PL-V021, is designed with a higher rated capacity than any LTOP event or overpressure transient, it may chatter when flow through the valve is less than full rated flow capacity. Valve chatter is the abnormal, rapid, opening/closing oscillation of a relief valve. Extensive chattering is considered a potential mechanism for valve wear and ultimate failure. The valve could possibly chatter enough to fail to perform relief functions.

To reduce chattering of the current relief valve, RNS-PL-V021, a second, smaller relief valve, RNS-PL-V020, is proposed to be added to the RNS suction piping. The proposed new relief valve, RNS-PL-V020, is constructed in accordance with ASME Code Section III, Class 2 requirements and is classified as AP1000 Class B equipment. As identified in UFSAR Subsection 3.2.2.4, Class B is safety-related equipment that limits the leakage of radioactive material from the containment following a design basis accident. The relief valve is required to function following a seismic event and is therefore qualified as seismic Category I. The active function of the new relief valve is to open (“transfer open”) at a nominal set pressure of 470 psig with a flow capacity of 50 gpm. The valve also has the safety function to re-close (“transfer closed”) to restore the isolation boundary. The set pressure of the new RNS relief valve is lower than the current RNS relief valve, RNS-PL-V021, set pressure of 500 psig to provide relief when flows are at less than full rated flow capacity to reduce chattering of the current relief valve. The 1-inch relief valve, RNS-PL-V020, requires less momentum to lift the valve and will lift before the larger, higher capacity, current RNS relief valve, RNS-PL-V021. As pressure increases based on the transient, the current 3-inch RNS relief valve, RNS-PL-V021, will start to relieve pressure. Because the added 1-inch RNS relief valve, RNS-PL-V020, is rated for a lower flow capacity, the valve will reach full open much more quickly than the current 3-inch RNS relief valve, RNS-PL-V021, at the same momentum. Thus, chattering is reduced during the low flow LTOP events. The current 3-inch relief valve, RNS-PL-V021, will work in parallel with the new 1-inch relief valve, RNS-PL-V020, so that chattering does not continue beyond 1000 cycles, which, if such chattering does occur, could potentially cause the valve to lose its capability to open on demand. The new 1-inch relief valve, RNS-PL-V020, provides reliability and stability for the current 3-inch relief valve during LTOP events. Overall, the addition of a small capacity relief valve, with a lower set pressure than RNS-PL-V021, is an improvement in terms of stable valve operation because RNS-PL-V020 is more suitable for low-volume relieving requirements, and reduces the number of cycles required for RNS-PL-V021, which was previously relied upon for the mass injection, heat injection, gate valve seat leakage, thermal expansion of trapped fluid, and RNS initiation events.

The full-open pressure, with accumulation, is 517 psig for the added relief valve, RNS-PL-V020. When relief capabilities are not required, the relief valve is required to remain closed (“maintain closed”). The relief valve discharges into the liquid radwaste system (WLS) containment sump, consistent with the discharge of the current RNS relief valve. The design parameters of the current RNS relief valve, RNS-PL-V021, are not changed by this activity. Consistent with the current RNS relief valve, RNS-PL-V021, the added relief valve, RNS-PL-V020, also acts as a containment isolation boundary, as identified in UFSAR Subsection 5.4.7. This valve requires periodic inservice testing and seat leakage testing for containment isolation functions as further described below. The relief valve is not designed to Class 1E criteria as it is a mechanical component with no electrical characteristics. The relief valve does not have remote operation capabilities.

Technical Specification 3.4.14, Low Temperature Overpressure Protection (LTOP), is revised to reflect the addition of the second RNS suction relief valve, remove the reference to the Pressure and Temperature Limits Report (PTLR) for the relief valve lift settings (Limiting

Condition for Operation (LCO) 3.4.14.a), and identify the Inservice Testing Program (IST) for the RNS suction relief valve lift settings in Surveillance Requirement (SR) 3.4.14.4 (proposed SR 3.4.14.5).

When the RCS is aligned to the RNS with RNS suction relief valves OPERABLE, chemical and volume control system (CVS) valve, CVS-PL-V091, is closed to limit the flow rate to the capacity of the smaller RNS suction relief valve by directing flow to CVS flow-restricting orifice, CVS-PY-R10. During this time, the RCS is not depressurized and an RCS vent of ≥ 4.15 square inches is not established (i.e., LCO 3.4.14.b is not met). A change is proposed to LCO 3.4.14.a to require the CVS makeup line containment isolation valve, CVS-PL-V091, be closed, along with the existing requirement for the RNS suction relief valve(s) to be OPERABLE. A new Condition B is added to Technical Specification 3.4.14 to address the condition in which CVS-PL-V091 is not closed. A Note is added to clarify that this condition is not applicable when an RCS vent of ≥ 4.15 square inches is available. The added Required Action B.1 requires closure of CVS-PL-V091 within a Completion Time of one hour, and the existing Condition C (revised to Condition D) is revised to include the new condition for CVS-PL-V091 closure as one of the reasons that LTOP methods are inoperable. A new surveillance (new SR 3.4.14.3) is added to verify that the CVS makeup line containment isolation valve, CVS-PL-0V91, is closed.

To accommodate installation of the added relief valve, RNS-PL-V020, the inlet to the current 3-inch pipe line to the current RNS relief valve, RNS-PL-V021, is moved to the main 10-inch RNS suction line. In addition, to reduce relief valve chattering due to relief valve inlet pressure drop and ensure stability of valve performance, the 3-inch relief valve is relocated closer to the main process line. This change to reduce valve chattering, increase valve stability, and provide compliance with ASME Section III, NC-7141 requirements is described further below. The inlet pipe to the added RNS relief valve, RNS-PL-V020, is connected to the CVS by the current 3-inch RNS line connection previously used for RNS-PL-V021, as shown in the proposed changes to UFSAR Figure 5.4-7.

Additionally, Tier 1 Figure 2.2.1-1, for penetration P19, inaccurately depicts the class break for containment isolation valve RNS-PL-V061. The class break is illustrated backwards. Currently, the figure shows the RNS-PL-V061 as nonsafety (N) breaking to Class 2 (2) piping. A change is proposed to reverse the class break depicted on Tier 1 Figure 2.2.1-1 by showing the class break from 2-to-N instead of the current N-to-2, consistent with Tier 1 Figure 2.3.6-1.

Licensing Basis Change Descriptions

The following changes are proposed to COL Appendix A information:

COL Appendix A, Technical Specification 3.4.14:

- Revise to address the addition of the new valve. Change “valve” to “valves.” Revise grammar to identify verification of each valve.
- Revise LCO to identify closure of CVS-PL-V091 for LCO 3.4.14.a.
- Add new action to support closure of CVS-PL-V091.
- Add new SR 3.4.14.3.
- Add “in accordance with the Inservice Testing Program” to existing SR 3.4.14.4 (proposed SR 3.4.14.5).

- Reformat numbering as necessary.

The following changes to COL Appendix C (and corresponding Tier 1) information are proposed:

COL Appendix C (and plant-specific Tier 1) Figure 2.2.1-1:
- Add RNS relief valve, RNS-PL-V020, and reconfigure piping.
- Revise class break for RNS-PL-V061 from nonsafety (N) to Class 2 (2), to Class 2 (2) to nonsafety (N).

COL Appendix C (and plant-specific Tier 1) Table 2.3.6-1:
- Add RNS relief valve, RNS-PL-V020, and designated parameters as shown on the markups.

COL Appendix C (and plant-specific Tier 1) Table 2.3.6-2:
- Add the pipe line number, RNS-L090, for RNS suction line LTOP relief.

COL Appendix C (and plant-specific Tier 1) Table 2.3.6-4, ITAAC Nos. 2.3.06.09a.i & 2.3.06.09a.ii:
- Change “valve” to “valves.”
- Specify the valves are inspected, verified for their flow rate capacities, and identified on the report.

COL Appendix C (and plant-specific Tier 1) Figure 2.3.6-1:
- Add RNS relief valve, RNS-PL-V020, and reconfigure piping.

The following changes to Tier 2 information in the UFSAR are proposed:

UFSAR Table 1.6-1:
- Revise WCAP-15993 from “Revision 1, March 2003” to “Revision 2.”

UFSAR Subsection 1.9.4.2.3:
- Change “valve” to “valves” and revise verb usage.

UFSAR Subsection 1.9.6:
- Revise Reference 56 for WCAP-15993 from “Revision 1, March 2003” to “Revision 2.”

UFSAR Table 3.2-3:
- Add RNS relief valve, RNS-PL-V020, and designated design information as shown on the markups.

UFSAR Subsection 3.9.1.1.2.6:
- Change “valve” to “valves” and revise verb usage. Revise “safety” to “relief.”

UFSAR Subsection 3.9.3.3.2:
- Change “valve” to “valves” and revise verb usage.

UFSAR Table 3.9-12:

- Add RNS relief valve, RNS-PL-V020, and designated design information as shown on the markups.

UFSAR Table 3.9-16:

- Add RNS relief valve, RNS-PL-V020, and designated design and inservice testing information as shown on the markups.
- Revise Note 9 to identify plural relief valves.

UFSAR Table 3.11-1:

- Add RNS relief valve, RNS-PL-V020, and designated design information as shown on the markups.

UFSAR Table 3I.6-3:

- Add RNS relief valve, RNS-PL-V020, and designated design information as shown on the markups.

UFSAR Subsection 5.2.2:

- Change “a relief valve” to “relief valves.” Change “valve” to “valves”.

UFSAR Subsection 5.2.2.1:

- Change “valve” to “valves” and revise verb usage. Change “pressure” to “pressures.”
- Change “two makeup pumps” to “one or both makeup pumps.”

UFSAR Subsection 5.2.2.2:

- Change “valve” to “valves” and revise verb usage. Change “pressure” to “pressures.”

UFSAR Subsection 5.2.2.3:

- Change “valve” to “valves.”

UFSAR Subsection 5.2.2.4:

- Change “valve” to “valves” and revise verb usage. Change “component” to “components.”

UFSAR Subsection 5.3.6.1:

- Change “valve” to “valves” and revise verb usage. Change “pressure” to “pressures.”
- Change “LTOP system” to “LTOP analysis.”

UFSAR Subsection 5.4.7.2:

- Change “valve” to “valves” and revise verb usage. Identify two valves instead of one.
- Remove “safety” from description of relief valves.

UFSAR Subsection 5.4.7.2.2:

- Change “valve” to “valves” and revise verb usage.

UFSAR Subsection 5.4.7.6.1.1

- Add RNS relief valve, RNS-PL-V020. Change “valve” to “valves” and revise verb usage. Revise grammar to identify there are two relief valves.
- Change “line” to “lines.”

UFSAR Subsection 5.4.9:

- Change “valve” to “valves” and revise verb usage.

UFSAR Subsection 5.4.9.1:

- Change “valve” to “valves.”
- Revise “safety” to “relief” valve.
- Change “both” to “one or both” to describe makeup pump flow.

UFSAR Subsection 5.4.9.2:

- Change “valve” to “valves” and revise verb usage.
- Change “containment atmosphere” to “containment sump.”

UFSAR Subsection 5.4.9.3:

- Change “valve” to “valves” and revise verb usage. Change “pressure” to “pressures.”

UFSAR Subsection 5.4.9.4:

- Change “valve” to “valves” and revise verb usage.
- Revise grammar to identify there are two relief devices, each with a set pressure less than RCS design pressure.

UFSAR Subsection 5.4.11:

- Change “safety valve” to “relief valves.” Revise verb usage.
- Change “containment atmosphere” to “containment sump.”

UFSAR Table 5.4-17:

- Incorporate design information for RNS-PL-V020 as shown in the markups.

UFSAR Figure 5.4-6:

- Add second RNS relief valve which discharges to the WLS containment sump.

UFSAR Figure 5.4-7:

- Add RNS relief valve, RNS-PL-V020, and reconfigure piping.

UFSAR Table 6.2.3-1:

- Add RNS-PL-V020 and associated table parameters.

UFSAR Subsection 6.3.3.4.2:

- Change “the normal residual heat removal system relief valve” to “one or both of the normal residual heat removal system relief valves.” Revise grammar accordingly.
- Revise text with editorial changes including removing “which” and changing “core make tanks” to “core makeup tanks.”

UFSAR Subsection 14.2.9.2.4:
- Change "valve" to "valves." Revise grammar accordingly.

UFSAR Table 19.59-18:
- Change "valve" to "valves."

UFSAR Subsection 19E.2.2.2.3:
- Change "valve" to "valves." Change "setpoint" to "setpoints."

UFSAR Subsection 19E.2.4.2.7:
- Change "valve" to "valves" and revise verb usage.

UFSAR Subsection 19E.3.1.3.1:
- Change "setpoint" to "setpoints."

UFSAR Subsection 19E.4.6:
- Change "valve" to "valves."

UFSAR Subsection 19E.4.10.1:
- Change "valve" to "valves" and revise verb usage.

WCAP-15993:
- Revise to identify the addition of the second relief valve.

For Information Only:

Technical Specifications Bases 3.4.14:

- Change "valve" to "valves" and revise verb usage. Change one valve to two valves.
- Identify tag number and size of relief valves. Revise grammar for consistency.
- Add identification of CVS-PL-V091 to Background section.
- Revise Applicable Safety Analyses to identify operation of "one or both" CVS makeup pumps during a mass input transient and the limited flow restrictions via CVS-PL-V091 closure.
- Revise LCO description to remove PTLR reference and discuss closure of CVS-PL-V091.
- Revise Actions to include CVS-PL-V091 closure; format as needed and include completion times.
- Add new Surveillance Requirement 3.4.14.3 and associated text. Reformat surveillance requirement numbering as necessary.

## 3. TECHNICAL EVALUATION

As described in UFSAR Subsection 5.4.7, the RNS performs the following applicable functions related to the proposed activity:

- RCS shutdown heat removal – remove heat from the core and the RCS during shutdown operations
- LTOP – provide LTOP for the RCS during refueling, startup, and shutdown operations
- Containment isolation of RNS lines penetrating containment

The safety-related functions of the RNS include isolation of the RNS lines penetrating containment, preservation of the RCS pressure boundary and provision of a flow path for long-term post-accident makeup to the containment inventory. Following cooldown, the RNS removes heat from the core and the RCS during plant shutdown. The system is designed to limit the RCS pressure to within the limits specified in 10 CFR 50, Appendix G. LTOP is currently provided by a relief valve, RNS-PL-V021, in the suction line of the RNS. This relief valve is spring-loaded, self-actuated by direct fluid pressure and discharges to the WLS containment sump. The relief valve also prevents overpressurization of the RNS and serves as a containment isolation valve when isolation of RNS lines is required during accident conditions as identified in UFSAR Subsection 5.4.7.

These design changes are proposed in the following sections of the licensing basis:

<u>COL Appendix A, Technical Specification 3.4.14, Low Temperature Overpressure Protection (LTOP)</u>

Limiting Condition for Operation (LCO) 3.4.14 is revised to reflect the addition of a second RNS suction relief valve. The description “with a lift setting within the limit specified in the [Pressure and Temperature Limits Report] PTLR” is removed as the PTLR does not specifically identify the lift settings of the relief valves. The plant-specific LTOP analysis evaluates the potential LTOP events and provides the lift settings against the pressure/temperature (P/T) curves to provide assurance that the valves will relieve pressure in accordance with their setpoints and pressures observed in the RNS pipe lines. Removing the incorrect reference to the location where the settings are specified does not affect the requirement for the relief valve settings to support LTOP analyses. Including a reference to the Inservice Testing Program for the lift settings in SR 3.4.14.5 (the revised number per this LAR) establishes a presentation consistent with similar surveillance SR 3.4.6.1 for pressurizer safety valves. This change does not adversely affect compliance with LCO 3.4.14 as the RNS suction relief valves remain an overpressure protection method. Lift settings are appropriately verified in Surveillance Requirement (SR) 3.4.14.5 (previously SR 3.4.14.4) consistent with methods used in other Technical Specifications.

LCO 3.4.14.a is revised to require the CVS makeup line containment isolation valve, CVS-PL-V091, be closed, along with the existing requirement for the RNS suction relief valve(s) to be OPERABLE. CVS-PL-V091 is required to be closed when the RNS is aligned to the RCS. During this time, the RCS is not depressurized and an RCS vent of ≥ 4.15 square inches is not established (i.e., LCO 3.4.14.b is not met). The closure of CVS-PL-V091 directs CVS flow to the flow-restricting orifice, CVS-PY-R10, and limits flow to the 50 gpm capacity of the smaller RNS relief valve, RNS-PL-V020, during mass and heat input transients. This change supports LTOP functions and reduces potential chatter in the existing RNS relief valve, RNS-PL-V021, during LTOP events.

The existing LCO 3.4.14.b LTOP method to depressurize the RCS and establish an RCS vent of ≥ 4.15 square inches is not adversely impacted by this change. With the RCS depressurized, a vent size of 4.15 square inches is capable of mitigating a limiting overpressure transient. The area of the vent is equivalent to the area of the inlet pipe to the larger RNS suction relief valve so that the capacity of the vent is greater than the combined choked flow areas of RNS-PL-V020 (0.11 square inches) and RNS-PL-V021 (2.07 square inches). Therefore, if a vent of 4.15 square inches or more is open, the choke flow at ≤ 275°F required to exceed the 470 psig set pressure of RNS-PL-V020 or the reactor vessel pressure limit of 621 psig at 275°F, is much greater than the CVS mass injection capability of the volumetric expansion caused by starting an RCP. Neither the P/T limit curve nor 110% of the design pressure of the RNS is exceeded if a vent of 4.15 square inches is established.

A new Condition B is added to Technical Specification 3.4.14 to address the condition in which CVS-PL-V091 is not closed. A Note is added to clarify that this condition is not applicable when an RCS vent of ≥ 4.15 square inches is available. The added Required Action B.1 requires closure of CVS-PL-V091 within a Completion Time of one hour. Additionally, the existing Condition C (revised to Condition D) is revised to include the new condition for CVS-PL-V091 closure as one of the reasons that LTOP methods are inoperable. The added condition and associated required action assures that LCO 3.4.14.a (i.e., RNS relief valves are OPERABLE and CVS-PL-V091 is closed) is met when the plant operates in applicable MODES of operation. Revision to Required Action D.1 (current Required Action C.1) is proposed to identify the restoration of two RNS suction relief valves. This change is consistent with the addition of the smaller RNS relief valve, which is identified in the proposed change to LCO 3.4.14. The Completion Time of 12 hours is not changed.

A new surveillance (new SR 3.4.14.3) is added to verify that the CVS makeup line containment isolation valve, CVS-PL-0V91, is closed. A Note is added to clarify that this surveillance is only required to be met when complying with LCO 3.4.14.a (i.e., RNS suction relief valves are operable). A Frequency of 12 hours is specified, which is sufficient considering other indications and alarms available to the operator in the main control room to verify the required status of the equipment. The addition of SR 3.4.14.3 limits the potential for an LTOP event by limiting mass and heat injection capabilities to the capacity of the smaller RNS relief valve, RNS-PL-V020, and reducing potential chatter of the current RNS relief valve, RNS-PL-V021. The change to verify the isolation of the CVS valve, CVS-PL-V091, does not adversely impact the function of the containment isolation valve or the CVS.

Surveillance Requirement (SR) 3.4.14.5 (previously SR 3.4.14.4) is revised to verify the lift settings of each RNS suction relief valve, thereby including the addition of the smaller RNS relief valve. The surveillance is also revised to identify lift settings must be verified in accordance with the Inservice Testing (IST) Program. This change to the surveillance is consistent with typical verification of expected valve operation within the Technical Specifications. The frequency is not changed as the frequency of the surveillance is in accordance with the IST Program for both the existing and added RNS relief valves. Adding the verification of the lift setting of the added RNS relief valve, RNS-PL-V020, to the surveillance requirements does not adversely affect the surveillance as it is performed in accordance with the IST Program and in the same manner as the current RNS relief valve, RNS-PL-V021. The surveillance is therefore performed in the same manner for both RNS relief valves.

The changes to the TS do not adversely impact the RNS design function as the overpressure protection provided by the RNS relief valves is not changed. The addition of the 1-inch RNS relief valve, RNS-PL-V020, aids in reducing chattering of the larger RNS relief valve, RNS-PL-V021, and supports continued operability and reliability of the RNS for LTOP. The changes regarding closure of the CVS makeup line containment isolation valve, CVS-PL-V091, demonstrate consistency with the intent of the change to add a smaller RNS relief valve, to limit the potential for an LTOP event by limiting mass and heat injection capabilities to the capacity of the smaller RNS relief valve, RNS-PL-V020, and reducing potential chatter of the current RNS relief valve, RNS-PL-V021. The operation and restoration of two relief valves does not adversely impact the ability to maintain Technical Specifications as the LCO requires that both RNS relief valves be operable as one of the chosen methods for LTOP. Adding the verification of the lift setting of the new RNS relief valve to the surveillance requirements does not adversely affect the surveillance as it is performed in accordance with the IST Program, which already captures the requirements for the existing RNS relief valve, RNS-PL-V021, and includes testing of the added RNS relief valve. The surveillance is therefore performed in the same manner for both RNS relief valves. Operability of the identified LTOP methods are not adversely impacted as proposed changes further support minimizing the impact of LTOP events by limiting transients and reducing RNS relief valve chatter. Other Technical Specifications are not changed or impacted by this activity.

<u>COL Appendix C (and plant-specific Tier 1) Figure 2.2.1-1, Containment System</u>

This figure is revised to add relief valve, RNS-PL-V020. The addition of the RNS relief valve reduces chattering in the current RNS relief valve, RNS-PL-V021, by lifting prior to RNS-PL-V021 during mass input transients. Additionally, the added relief valve, RNS-PL-V020, lifts during mass and heat input transients along with valve, RNS-PL-V021, if pressure exceeds the pressure setpoint for valve RNS-PL-V020. Piping configuration changes accommodate the installation of the added valve. The class break for RNS-PL-V061 is revised from nonsafety to Class 2 (N/2) to Class 2 to nonsafety (2/N) to reflect the change in piping class following the valve. This change is consistent with the class break as shown in Tier 1 Figure 2.3.6-1 and the identification of RNS-PL-V061 as an ASME Code Section III, Class 2 component in UFSAR Table 3.2-3. There are no adverse impacts to the equipment qualification or piping design requirements as RNS-PL-V061 is a safety-related valve and is connected to safety-related piping.

COL Appendix C (and plant-specific Tier 1) Table 2.3.6-1

This table is revised to add relief valve, RNS-PL-V020, as an ASME Code Section III, seismic Category I component. The classification of remotely operated valves, Class 1E qualification, and identification of safety-related display, controls for protection and safety monitoring system (PMS), and loss of motive power position are identified as non-applicable as this valve is mechanical in operation. There are no adverse impacts to the LTOP or RNS overpressure design functions as the new valve is designed and constructed in accordance with ASME Code Section III requirements, consistent with the current RNS relief valve, RNS-PL-V021, which is already identified in the table.

COL Appendix C (and plant-specific Tier 1) Table 2.3.6-2

This table is revised to add relief valve pipe line number, RNS-L090, to identify the new RNS suction line to LTOP relief valve, RNS-PL-V020. Functional capability, ASME Code applicability, and leak-before-break treatment is consistent with the existing pipe line, RNS-L040, to LTOP relief valve, RNS-PL-V021. There are no adverse impacts to the table as the pressure boundary welds in this piping meet ASME Code Section III requirements. There are no adverse impacts to the existing suction line and LTOP relief currently identified in this table.

COL Appendix C (and plant-specific Tier 1) Table 2.3.6-4

Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC) Nos. 2.3.06.09a.i and 2.3.06.09a.ii are revised to identify that inspections are conducted on both of the LTOP relief valves instead of the one current valve, RNS-PL-V021. This ITAAC is also changed to verify the rated capacities recorded on both valves' vendor code plates align with the flow required as described in the LTOP evaluations. This is acceptable as the smaller valve, RNS-PL-V020, is credited in the LTOP evaluation and required flow rates can be verified. Inspection methods and acceptance criteria are not changed by this activity as LTOP functions for the RCS during shutdown are not changed. The addition of the RNS relief valve, RNS-PL-V020, reduces chattering in the current RNS valve, RNS-PL-V021, and provides stability for LTOP events.

COL Appendix C (and plant-specific Tier 1) Figure 2.3.6-1, Normal Residual Heat Removal System

This figure is revised to add relief valve, RNS-PL-V020. The addition of the RNS relief valve reduces chattering in the existing RNS valve, RNS-PL-V021, and provides stability for LTOP events. Piping configuration changes are made to accommodate the installation of the added valve.

Tier 2

UFSAR Table 1.6-1, Material Referenced

The revision level of WCAP-15993 is changed from Revision 1 to Revision 2 and the given date of March 2003 is removed. This WCAP is revised to address the addition of RNS relief valve, RNS-PL-V020. The revision to WCAP-15993 is described below. There are no adverse impacts to the identified material that is incorporated by reference.

UFSAR Subsection 1.9.6, References

The revision level of WCAP-15993 is changed from Revision 1 to Revision 2 as this WCAP is revised to address the addition of the RNS relief valve, RNS-PL-V020. The revision to WCAP-15993 is described below. There are no adverse impacts to the references and their use in relation to licensing information. No other references are impacted.

UFSAR Table 3.2-3, AP1000 Classification of Mechanical and Fluid Systems, Components and Equipment

This table is revised to add RNS relief valve, RNS-PL-V020, as the valve is a safety-related, ASME Section III, Class 2 valve, which is classified as seismic Category I. No comments are added. The addition of the 1-inch RNS relief valve is consistent with the current RNS relief valve, RNS-PL-V021, which is already identified in this table.

UFSAR Table 3.9-12, List of ASME Class 1, 2 and 3 Active Valves

This table is revised to add RNS relief valve, RNS-PL-V020, as an ASME Class active valve. Function 2 is identified for containment isolation functionality consistent with the current RNS relief valve, RNS-PL-V021.

UFSAR Table 3.9-16, Valve Inservice Test (IST) Requirements

This table is revised to add RNS relief valve, RNS-PL-V020, to the IST program. “Relief” is identified as the type of valve. The active functions of containment isolation and safety seat leakage are listed consistent with the functions of the existing RNS relief valve, RNS-PL-V021. Category AC, which represents valves with both seat leakage requirements and self-actuated valves that actuate in response to pressure to fulfill its required function, is identified for the applicable IST Category. Required inservice testing is identified in UFSAR Subsection 3.9.5.2.2, Valve Testing. The identified testing required for the added valve is containment isolation leak testing every two years and inservice testing every 10 years per requirements for ASME Class 2 valves. Additionally, 20% of the valves from each valve group are tested every 4 years for ASME Class 2 devices. Note 9 of this table is revised to identify plural relief valves. This change does not affect the intent of the note. The IST program is not adversely impacted by the addition of RNS-PL-V020 as testing requirements are consistent with the current RNS relief valve, RNS-PL-V021.

UFSAR Table 3.11-1, Environmentally Qualified Electrical and Mechanical Equipment

This table is revised to add RNS relief valve, RNS-PL-V020, as the valve is mechanical equipment and is required to be qualified for a harsh environment. This valve is located in environmental zone 1 (containment). The function listed for the valve is "ESF" for engineered safety features as the relief valve functions to localize, control, mitigate and terminate accidents and maintain radiation exposure levels to the public below applicable limits and guidelines in accordance with the definition of engineered safety features in UFSAR Chapter 6. The operating time required following an accident is 24 hours based on post-accident operability requirements for the safety-related function of relieving pressure as necessary. The qualification program for the valve is designated by M* to represent the mechanical equipment program and a harsh environment as the valve is mechanical in operation and located in a harsh environment. Equipment qualified for a harsh environment has a qualified life of 60 years and is designed to perform under the harsh environmental conditions. The valve is designed to withstand harsh environment conditions and does not contain material that degrades in a harsh environment. The addition of this valve to UFSAR Table 3.11-1 is consistent with the current RNS relief valve, RNS-PL-V021, which is already identified in the table.

UFSAR Table 3I.6-3, List of AP1000 Safety-Related Electrical and Mechanical Equipment Not High Frequency Sensitive

This table is revised to add RNS relief valve, RNS-PL-V020, as the valve is safety-related equipment which is not sensitive to high frequencies. Comment 2 is listed for the valve to denote AP1000 safety-related seismically qualified valves in accordance with the ASME Code for structural integrity to a maximum acceleration of 6g in all three principal orthogonal axes. This comment is appropriate as this valve is designed to ASME Code Section III and is designated as seismic Category I. The addition of RNS relief valve, RNS-PL-V020, to UFSAR Table 3I.6-3 is consistent with the current RNS relief valve, RNS-PL-V021, which is already identified in the table.

UFSAR Subsection 5.2.2.1, Design Bases

This section is revised to identify plural relief valves which provide LTOP for the RCS. The valves are sized appropriately for overpressure protection during the identified credible events with a water-solid pressurizer. Additionally, the mass input transient description is revised to clarify the flow rate postulated for a mass input transient is based on the flow from one or both CVS makeup pumps instead of both pumps. This is consistent with the LTOP analysis which identifies the RNS relief valves are relied upon for overpressure protection when one or both CVS makeup pumps are operating. This change is also made in Technical Specification 3.4.14 Bases. UFSAR Subsection 5.2.2.1 is also revised to identify both of the RNS relief valves have set pressures which are established based on the lower values of the RNS design pressure and low-temperature pressure limits for the reactor vessel. The changes do not adversely impact the credible events which may require overpressure protection. The changes do not adversely affect the ability of the relief valves to maintain the pressure in the RCS.

UFSAR Subsection 5.4.7.2, System Description

This section is revised to identify the “safety valve” as “two relief valves” which are used for overpressure protection in the RNS. The use of the term “safety valves” or “safety relief valves” is not inaccurate; however, the term “relief valves” more accurately reflects the function of the current and added valves, RNS-PL-V021 and RNS-PL-V020, respectively, which are designed to relieve overpressurization in the line while minimizing valve cycling. Referring to valves RNS-PL-V021 and RNS-PL-V020 as relief valves is also consistent with discussion of these two valves elsewhere in the licensing basis. The changes do not adversely impact the system description or function as the proposed RNS relief valve supports the same function as the current RNS relief valve, but at a different relieving pressure and capacity.

UFSAR Subsection 5.4.9.1, Design Bases

This section is revised to identify the “safety valve” as “relief valves” on the suction line of the RNS. The use of the term “safety valves” or “safety relief valves” is not inaccurate; however, the term “relief valves” more accurately reflects the function of the current and added valves, RNS-PL-V021 and RNS-PL-V020, respectively, which are designed to relieve overpressurization in the line while minimizing valve cycling. Referring to valves RNS-PL-V021 and RNS-PL-V020 as relief valves is also consistent with discussion of these two valves elsewhere in the licensing basis. Additionally, UFSAR Subsection 5.4.9.1 is revised to identify that the relief valves can accommodate flow for one or both CVS makeup pumps in accordance with the expected mass input transient. The design bases for the pressure relief devices are not adversely impacted as the function of the relief devices is not changed. The conclusion of the paragraph, to identify that use of the RNS relief valves at elevated temperatures in post-accident environments is not anticipated, is not changed.

UFSAR Subsection 5.4.11, Pressurizer Relief Discharge

This section is revised to identify the “safety valve” as “relief valves” on RNS discharge into the containment sump. The use of the term “safety valves” or “safety relief valves” is not inaccurate; however, the term “relief valves” more accurately reflects the function of the current and added valves, RNS-PL-V021 and RNS-PL-V020, respectively, which are designed to relieve overpressurization in the line while minimizing valve cycling. Referring to valves RNS-PL-V021 and RNS-PL-V020 as relief valves is also consistent with discussion of these two valves elsewhere in the licensing basis. In accordance with the change, the plural relief valves are used to describe the components which provide overpressure protection. Additionally, “containment atmosphere” is changed to “containment sump” consistent with UFSAR Figure 5.4-7 to identify the location to which the RNS relief valves discharge. The changes do not adversely impact the identification of pressurizer relief discharge components or their functions.

UFSAR Table 5.4-17, Pressurizer Safety Valves – Design Parameters

The design parameters of the RNS relief valve are revised. The number of valves is changed from one to two to reflect the addition of RNS-PL-V020. The nominal relieving capacity per valve is revised to add 50 gpm for the new relief valve, RNS-PL-V020. The nominal set pressure is revised to add 470* psig for the new relief valve, RNS-PL-V020. The full-open pressure, with accumulation is revised to add 517* psig for the new relief valve, RNS-PL-V020. The changes identify the design parameters of RNS relief valve, RNS-PL-V020, and do not adversely impact the purpose of the table to provide design information for the pressurizer safety valves and the current RNS relief valve. The * refers to a note which refers to UFSAR Subsection 5.4.9.3 for further discussion on set pressure. This note is not changed by this activity.

UFSAR Figure 5.4-6, Normal Residual Heat Removal System

This figure is revised to illustrate two relief valves. The figure is also revised to indicate that the relief valves discharge to the WLS containment sump instead of containment atmosphere, consistent with UFSAR Figure 5.4-7. The current relief valve piping is reconfigured to accommodate the addition of the added relief valve. There are no adverse impacts to the figure or operation of the current relief valve and RNS as the function of the added relief valve supports the relief and overpressure protection of the RNS and RCS. The addition of RNS relief valve, RNS-PL-V020, reduces chattering in the existing RNS valve, RNS-PL-V021, and provides stability for the LTOP events.

UFSAR Figure 5.4-7, Normal Residual Heat Removal System Piping and Instrument Diagram

This figure is revised to add RNS relief valve, RNS-PL-V020. Piping for the current relief valve, RNS-PL-V021, is reconfigured to accommodate the installation of the added relief valve, RNS-PL-V020. There are no adverse impacts to the figure or operation of the existing relief valve and RNS as the function of the added relief valve supports the relief and overpressure protection of the RNS and RCS. The addition of the RNS relief valve reduces chattering in the current RNS relief valve, RNS-PL-V021, and provides stability for the LTOP events.

UFSAR Table 6.2.3-1, Containment Mechanical Penetrations and Isolation Valves

This table is revised to add RNS relief valve, RNS-PL-V020, to the containment penetrations identified for the penetration from the RCS to residual heat removal (RHR) pump suction for the RNS. The system, line, flow and closed system IRC identifications are not changed. The addition of this valve does not add a new penetration to containment; however, the new RNS relief valve acts as part of containment isolation, consistent with the function of the current RNS relief valve, RNS-PL-V021. No pipe length is identified as the added valve is located off the main RNS line in the 3-inch line from the CVS. Pipe lengths are only provided for the nominal length of pipe to the outboard containment isolation valve. Since the RNS suction relief valves are located within containment, a pipe length is not designated. This is consistent with the existing valves listed in the table. DCD Subsection 5.4.7 is identified as the location of pertinent design information consistent with the existing RNS relief valve. The signal is identified as "None" as the added relief valve, RNS-PL-V020, is mechanical in nature and does not provide a signal to the control room for indication. Closure time is identified as not applicable (N/A) as the valve does not maintain a required valve closure stroke time. The test type is identified as "C" to represent a local leak rate test consistent with the current RNS relief valve, RNS-PL-V021, for fluid systems as designated by 10 CFR 50 Appendix J. The medium of “air” is not changed as the added RNS relief valve, RNS-PL-V020, is tested in the same manner and using the same medium as the current RNS relief valve, RNS-PL-V021. The pressurization direction is identified as forward to represent high pressure on containment side, consistent with the design of the valve to relieve pressure on the containment side to provide overpressure protection. There are no adverse impacts to the function of the current RNS relief valve, RNS-PL-V021, by the changes proposed to this table. The design of containment isolation is not adversely impacted as the added RNS relief valve supports design functions as necessary.

UFSAR Table 19.59-18, AP1000 PRA-Based Insights

This table is revised to identify the addition of the new RNS relief valve, RNS-PL-V020, to support maintaining LTOP to ensure that the reactor vessel pressure and temperature limits are not exceeded during shutdown conditions. This table is revised to identify isolation of plural RNS relief valves is permitted during shutdown conditions, consistent with current probabilistic risk assessment (PRA)-based assumptions for the current RNS relief valve, RNS-PL-V021. The changes do not adversely impact PRA assumptions or PRA-based calculations as the assumption itself is not changed. Only “valve” is changed to “valves.” Assumptions are associated with COL Appendix A, LCO 3.4.14 which are revised as described above.

WCAP-15993, Evaluation of the AP1000 Conformance to Inter-System Loss-of-Coolant Accident Acceptance Criteria, Revision 1

WCAP-15993 is incorporated by reference into the licensing basis. This WCAP is revised to Revision 2 to identify the addition of the new RNS relief valve. Specifically, Section 3.1.2, Figure 3-1, and Section 3.2.2 of WCAP-15993 are revised to identify that there are two RNS relief valves. [Note – Figure 3-1 is replaced in its entirety with the most current RNS piping and instrumentation diagram.] The discussion, which identifies the function of the relief valve to provide LTOP of the RCS, is not adversely impacted as LTOP functions are not changed. Reduction of the risk to overpressurize the low-pressure portions of the RNS is not changed. Conclusions and results are not changed, which reiterate the RNS meets the acceptance criteria for inter-system loss-of-coolant accident (ISLOCA) because the system is designed to either full RCS pressure or an ultimate rupture strength pressure equal to the RCS design pressure. The addition of the second relief valve to the RNS suction piping inside of containment does not impact the ISLOCA criteria. Additionally, an editorial change is made to revise a tag number from “V11” to “V011” consistent with the other valve tag numbers identified. This activity does not adversely impact the intent of the WCAP to evaluate systems that interface with the RCS to demonstrate that the design meets the ISLOCA acceptance criteria. The activity does not change the plant response to ISLOCAs, nor does it adversely impact any systems, structures or components (SSCs) described in the WCAP.

The following licensing sections are also revised to identify the addition of the 1″ RNS relief valve, RNS-PL-V020, but do not adversely impact the identified RNS design functions, including the relief function of the current RNS relief valve, RNS-PL-V021. The changes are made for consistency only and do not adversely impact technical information or design functions. Changes are made to identify "valves" where "valve" was previously used to identify the single RNS relief valve. Verb usage is revised as necessary. Similarly, design parameters such as "set pressure" may be revised to "set pressures" to identify that each valve maintains its own set pressure. The changes do not represent a technical change that impacts the design information described. As described above, the added RNS relief valve, RNS-PL-V020, provides the same LTOP functions as the current RNS relief valve, but lifts at a lower set pressure to reduce chattering in the current relief valve, RNS-PL-V021, and support LTOP functions.

- UFSAR Subsection 1.9.4.2.3, Issue 94, Additional Low-Temperature Overpressure Protection for Light Water Reactors
- UFSAR Subsection 3.9.1.1.2.6, Cold Overpressure
- UFSAR Subsection 3.9.3.3.2, Pressure Relief Devices for Class 2 Systems and Components
- UFSAR Subsection 5.2.2, Overpressure Protection
- UFSAR Subsection 5.2.2.2, Design Evaluation
- UFSAR Subsection 5.2.2.3, Piping and Instrumentation Diagrams
- UFSAR Subsection 5.2.2.4, Equipment and Component Description
- UFSAR Subsection 5.3.6.1, Pressure-Temperature Limit Curves
- UFSAR Subsection 5.4.7.2.2, Design Features Addressing Intersystem LOCA
- UFSAR Subsection 5.4.7.6.1.1, Valve Inspection and Testing
- UFSAR Subsection 5.4.9, Reactor Coolant System Pressure Relief Devices
- UFSAR Subsection 5.4.9.2, Design Description
- UFSAR Subsection 5.4.9.3, Design Evaluation
- UFSAR Subsection 5.4.9.4, Tests and Inspections
- UFSAR Subsection 6.3.3.4.2, Loss of Normal Residual Heat Removal Cooling With The Reactor Coolant System Pressure Boundary Intact
- UFSAR Subsection 14.2.9.2.4 (g), Normal Residual Heat Removal System Testing
- UFSAR Subsection 19E.2.2.2.3, Steam Generator Cooling in Shutdown Modes
- UFSAR Subsection 19E.2.4.2.7, Normal Residual Heat Removal System Relief Valve
- UFSAR Subsection 19E.3.1.3.1, General Shutdown
- UFSAR Subsection 19E.4.6, Increase in Reactor Coolant Inventory
- UFSAR Subsection 19E.4.10.1, Low Temperature Overpressure Protection

Depending on the magnitude of the temperature mismatch between the steam generator water and the reactor coolant temperature when an RCP is started, heat input transients might require the operation of both valves RNS-PL-V020 and RNS-PL-V021 for either reactor vessel protection or RNS ASME Section III overpressure protection. Heat input transients are considered limiting when the RNS relief valves are relied upon for overpressure protection. RNS-PL-V021 operation might be required for a CVS malfunction mass injection event which is postulated above 275°F, but below 350°F, if the orifice, CVS-PY-R10, is bypassed and CVS-PL-V091 is open.

Above 275°F, but below 350°F, the RNS relief valves are required to provide ASME Section III, ND-7000 protection of RNS (the Class A and B portions of RNS do not require ASME overpressure protection by relief valves except for a relief valve cracking open due to thermal expansion of water in isolated piping sections). Above 275°F, but below 350°F, mass injection rates of up to 175 gpm are possible if it is chosen to bypass CVS-PY-R10 by opening CVS-PL-V091, yet ASME Section III protection of RNS is required because RCS and RNS are interconnected when the 175 gpm mass injection event is postulated. However, for auxiliary relief valves, the ASME Code does not require a relief valve cycling analysis. The RNS is adequately pressure-protected based upon designing the limiting Class C portions of RNS with an ultimate rupture strength of 2235 psig, which is reiterated in the licensing basis related to ISLOCA acceptance criteria.

The performance of the current RNS relief valve, RNS-PL-V021, and required LTOP functions are not adversely impacted by this change as the current valve continues to lift at the required set pressure. The addition of RNS relief valve RNS-PL-V020 reduces chattering of the current RNS relief valve thereby providing reliability and stability during mass input transients. The proposed change to add the 1-inch RNS relief valve, RNS-PL-V020, supports reduction in potential chattering and reduction in valve wear. LTOP functions for the added RNS relief valve, RNS-PL-V020, are the same as the current RNS relief valve, RNS-PL-V021, to prevent overpressurization of the RCS and protect the integrity of the RCS pressure boundary. Both RNS relief valves provide relief operation to limit an increasing pressure event. Pressure-temperature limits for the reactor vessel are not changed. Other Technical Specifications are not adversely impacted by this change.

Conclusions for potential accidents evaluated in safety analyses are not adversely impacted as overpressure events are not described and the current RNS relief valve, RNS-PL-V021, is not credited for analyzed events. RNS overpressure events described in UFSAR Subsection 6.3.3.4.2 are not adversely impacted as the addition of the second relief valve supports the design function to relieve pressure in the RNS as necessary. As described above, this section is revised to include the addition of the smaller relief valve, RNS-PL-V020. Transient conditions, including mass input and heat input are not changed and the probability of events is not increased, as the added RNS relief valve supports LTOP functions. Overpressure protection, as described in UFSAR Subsection 5.2.2, is not adversely impacted as the proposed RNS relief valve, RNS-PL-V020, supports overpressure protection at a lower capacity and lower set point than the current RNS relief valve, RNS-PL-V021. The change does not adversely impact the capability of the RNS to protect the RCS from exceeding pressure and temperature limits in accordance with 10 CFR 50, Appendix G or 110% of the design pressure of the RNS. The current RNS relief LTOP function is not adversely impacted as the valve continues to provide relief as required to maintain low pressures in the RCS. The reactor coolant pressure boundary (RCPB) is maintained by the addition of the valve and the integrity of the RCPB is not compromised. The proposed changes to the various COL Appendix C (and plant-specific Tier 1), COL Appendix A Technical Specification and UFSAR text, tables, and figures consistently identify the addition of the safety-related RNS relief valve, RNS-PL-V020, and its function to prevent overpressure conditions.

Proposed changes to add RNS relief valve RNS-PL-V020 do not involve an interface with any SSC accident initiator or initiating sequence of events related to the accidents evaluated in the UFSAR. The changes to COL Appendix C (and plant-specific Tier 1), COL Appendix A, and UFSAR design information do not adversely impact safety-related equipment or a fission product barrier. No system or equipment qualification is adversely affected by the proposed changes. The changes do not result in a new failure mode, malfunction or sequence of events that could adversely affect a radioactive material barrier or safety-related equipment. The proposed changes do not allow for a new fission product release path, result in a new fission product barrier failure mode, or create new sequence of events that would result in significant fuel cladding failures.

The proposed changes do not adversely impact any functions associated with containing, controlling, channeling, monitoring, or processing radioactive or non-radioactive materials. The types and quantities of expected plant effluents are not changed. No effluent release path is associated with these safe shutdown components. Therefore, neither radioactive nor non-radioactive material effluents are affected by this activity.

The proposed changes to the COL Appendix C (and plant-specific Tier 1) Figure 2.2.1-1 and 2.3.6-1, Tables 2.3.6-1, 2.3.6-2, and 2.3.6-4, COL Appendix A, Technical Specification 3.4.14, and UFSAR design information do not adversely impact radiologically controlled zones. Plant radiation zones, radiation controls established to satisfy 10 CFR Part 20 requirements, and expected amounts and types of radioactive materials are not affected by the proposed changes. Therefore, individual and cumulative radiation exposures are not significantly affected by this change.

Summary

The proposed changes to COL Appendix C (and plant-specific Tier 1), COL Appendix A Technical Specifications, and associated UFSAR design information to add a second smaller RNS relief valve will not adversely affect safety-related equipment or function, design function, radioactive material barrier or safety analysis.

## 4. REGULATORY EVALUATION

### 4.1 Applicable Regulatory Requirements/Criteria

10 CFR 52.98(c) requires NRC approval for any modification to, addition to, or deletion from the terms and conditions of a Combined License (COL). This activity involves a departure from COL Appendix A and Appendix C information and corresponding plant-specific Tier 1 information; therefore, this activity requires a proposed amendment to the COL. Accordingly, NRC approval is required prior to making the plant-specific changes in this license amendment request.

10 CFR 52, Appendix D, Section VIII.B.5.a allows an applicant or licensee who references this appendix to 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 the section. The proposed departures from UFSAR

Tier 2 design information involve changes to information in COL Appendix C (and corresponding plant-specific Tier 1) Figures 2.2.1-1 and 2.3.6-1, Tables 2.3.6-1, 2.3.6-2, and 2.3.6-4, and COL Appendix A, Technical Specification 3.4.14, and thus requires NRC approval for the UFSAR Tier 2 departures.

10 CFR 50, Appendix A, "General Design Criteria for Nuclear Power Plants" General Design Criterion (GDC) 14 – Reactor coolant pressure boundary. The reactor coolant pressure boundary (RCPB) shall be designed, fabricated, erected, and tested so as to have an extremely low probability of abnormal leakage, of rapidly propagating failure, and of gross rupture.

The proposed changes do not adversely impact the quality of the RCPB. The added RNS relief valve, RNS-PL-V020, supports LTOP functions. LTOP limits RCS pressure at low temperatures so that the integrity of the RCPB is not compromised by violating pressure and temperature limits. Therefore, compliance with GDC-14 is not affected.

10 CFR 50, Appendix A, GDC-16 - Containment design. Reactor containment and associated systems shall be provided to establish an essentially leak-tight barrier against the uncontrolled release of radioactivity to the environment and to assure that the containment design conditions important to safety are not exceeded for as long as postulated accident conditions require.

The proposed changes do not adversely impact the containment or containment design as the functions of containment and containment isolation are not changed. The added relief valve, RNS-PL-V020, reduces chattering of the current RNS valve and supports LTOP functions. The added relief valve, RNS-PL-V020, performs a containment isolation function consistent with the current relief valve, RNS-PL-V021. Therefore, compliance with GDC-16 is not affected.

10 CFR 50, Appendix A, GDC-30 – Quality of reactor coolant pressure boundary. Components which are part of the reactor coolant pressure boundary shall be designed, fabricated, erected, and tested to the highest quality standards practical. Means shall be provided for detecting, and to the extent practical, identifying the location of the source of reactor coolant leakage.

The proposed changes do not adversely impact the quality of the RCPB. The added RNS relief valve, RNS-PL-V020, supports LTOP functions. LTOP limits RCS pressure at low temperatures so that the integrity of the RCPB is not compromised by violating pressure and temperature limits. Therefore, compliance with GDC-30 is not affected.

10 CFR 50, Appendix A, GDC-34 – Residual heat removal. A system to remove residual heat shall be provided. The system safety function shall be to transfer fission product decay heat and other residual heat from the reactor core at a rate such that specified acceptable fuel design limits and the design conditions of the RCPB are not exceeded.

The proposed changes do not adversely impact the function of the RNS to remove decay from the core. Therefore, compliance with GDC-34 is not affected.

10 CFR 50, Appendix A, GDC-54 – Piping systems penetrating containment. Piping systems penetrating primary reactor containment shall be provided with leak detection, isolation, and containment capabilities having redundancy, reliability, and performance capabilities which reflect the importance to safety of isolating these piping systems. Such piping systems shall be designed with a capability to test periodically the operability of the isolation valves and associated apparatus and to determine if valve leakage is within acceptable limits.

The proposed changes do not adversely impact the RNS piping that penetrates containment. The RNS relief valves are inside containment and discharge to containment. Piping inside containment is changed to accommodate the installation of the added relief valve, but the installation of this valve does not impact the piping penetrating containment. There are no adverse impacts to the RNS piping within containment. Therefore, compliance with GDC-54 is not affected.

### 4.2 Precedent

No precedent is identified.

### 4.3 Significant Hazards Consideration

The requested amendment proposes to depart from approved AP1000 Design Control Document (DCD) Tier 2 information (text, tables, and figures) as incorporated into the Updated Final Safety Analysis Report (UFSAR) as plant-specific DCD Tier 2 information, and involves changes to plant-specific Tier 1 (and associated COL Appendix C) information and COL Appendix A, Technical Specifications. The requested amendment proposes changes to add a second normal residual heat removal system (RNS) suction relief valve (RNS-PL-V020) in parallel to the current RNS suction relief valve (RNS-PL-V021), with the necessary piping changes to accommodate the installation as shown in proposed changes to Tier 1 Figures 2.2.1-1 and 2.3.6-1 and Tables 2.3.6-1, 2.3.6-2, and 2.3.6-4. Changes are also proposed to COL Appendix A, Technical Specification 3.4.14 to address the additional relief valve, and additional operational restrictions required when RNS relief valves are utilized for low temperature overpressure protection (LTOP). Additionally, a change to Tier 1 Figure 2.3.6-1 is proposed to accurately depict the safety class break from containment isolation valve RNS-PL-V061 and the nonsafety downstream piping.

An evaluation to determine whether or not a significant hazards consideration is involved with the proposed amendment was completed by focusing on the three standards set forth in 10 CFR 50.92, “Issuance of amendment,” as discussed below:

#### 4.3.1 Does the proposed amendment involve a significant increase in the probability or consequences of an accident previously evaluated?

Response: No.

The proposed changes to Combined License (COL) Appendix C (and plant-specific Tier 1) Figures 2.2.1-1 and 2.3.6-1, Tables 2.3.6-1, 2.3.6-2 and 2.3.6-4, COL Appendix A, Technical Specification 3.4.14 and associated Updated Final Safety Analysis Report (UFSAR) design information to identify a new normal residual heat removal system (RNS) relief valve, RNS-PL-V020, do not adversely impact accidents previously evaluated in the safety analysis. Transients that are capable of overpressurizing the reactor coolant system (RCS) are categorized as either mass or heat input transients. The relief valves must be capable of passing flow greater than that required for the limiting low-temperature overpressure protection (LTOP) transients while maintaining RCS pressure less than the lowest pressure represented by the pressure/temperature limit curve, 110% of the design pressure of the RNS, or the acceptable RNS relief valve inlet pressure. The restrictions added to COL Appendix A, Technical Specification 3.4.14 to close chemical and volume control system (CVS) makeup line containment isolation valve, CVS-PL-V091, limit flow capacity when the RCS is aligned to the RNS to support LTOP functions and provide reliable operation of the RNS relief valves during mass and heat input transients. When CVS-PL-V091 is open, the RCS is depressurized and an RCS vent of ≥ 4.15 square inches is established. Transient conditions including mass input and heat input are not changed and probability of events is not increased as the added RNS relief valve, RNS-PL-V020, supports LTOP functions as required by Technical Specification 3.4.14. The current 3-inch RNS relief valve is sufficient to terminate identified transients; however, the added 1-inch RNS relief valve reduces chatter in the current valve during low flow scenarios.

Responses to mass and heat input transients are not changed as LTOP functions to prevent overpressurization of the RCS are not changed by this activity. The added RNS relief valve, RNS-PL-V020, is designed in accordance with the same requirements as the current RNS relief valve, RNS-PL-V021, but with a lower flow capacity and functions at a lower setpoint pressure. Overpressure protection provided by the RNS is not changed. The change does not adversely impact the capability of the RNS to protect the RCS from exceeding pressure and temperature limits in accordance with 10 CFR 50, Appendix G or 110% of the design pressure of the RNS. Changes in piping to accommodate the addition of the valve and reduce inlet piping losses do not impact the consequences or probabilities of previously evaluated accidents. The class break correction for valve RNS-PL-V061, in COL Appendix C (and plant-specific Tier 1) Figure 2.2.1-1 does not impact accidents previously evaluated.

No safety-related structure, system, component (SSC) or function is adversely affected by this change. The change does not involve an interface with any structure, system, or component (SSC) accident initiator or initiating sequence of events, and thus, the probabilities of the accidents evaluated in the plant-specific UFSAR are not affected. The proposed changes do not involve a change to the predicted radiological releases due to postulated accident conditions, thus, the consequences of the accidents evaluated in the UFSAR are not affected.

Therefore, the proposed amendment does not involve a significant increase in the probability or consequences of an accident previously evaluated.

**4.3.2 Does the proposed amendment create the possibility of a new or different kind of accident from any accident previously evaluated?**

Response: No.

Conclusions of existing analyses are not changed by the proposed change as LTOP functions provided by both the current and added RNS relief valves continue to provide the assumed protection for LTOP events. RCS pressure is maintained within limits by the use of both RNS relief valves. The closure of CVS-PL-V091 limits flow and reduces the impact of mass and heat input transients when RNS relief valves are relied upon for overpressure protection.

The proposed change to add the smaller RNS relief valve, RNS-PL-V020, does not adversely affect safety-related equipment, and does not add any new interfaces to safety-related SSCs that adversely affect safety functions. The added RNS relief valve, functions in the same manner as the current RNS relief valve, but has a lower capacity and lifts at a lower pressure. The added RNS relief valve also discharges to the liquid radwaste system (WLS) containment sump. No system or design function or equipment qualification is adversely affected by these changes as the change does not modify any SSCs that prevent safety functions from being performed by the RNS and the current relief valve. The changes do not introduce a new failure mode, malfunction or sequence of events that could adversely affect safety or safety-related equipment. Piping changes to accommodate the installation of the new valve do not create the potential for a new or different kind of accident as the piping requirements are consistent with those of the current relief valve, and subject to the same pipe rupture evaluation requirements. LTOP functions are not changed. The class break correction for valve RNS-PL-V061 does not impact accident analysis or create a new or different kind of accident as the function of the affected equipment and piping is not changed.

Therefore, the proposed amendment does not create the possibility of a new or different kind of accident from any accident previously evaluated.

**4.3.3 Does the proposed amendment involve a significant reduction in a margin of safety?**

Response: No.

The proposed changes do not affect safety-related equipment or fission product barriers. LTOP functions are not adversely impacted as both the current and added RNS relief valves continue to provide protection from overpressurization. The added RNS relief valve is designed in accordance with ASME Code Section III, Class 2, requirements consistent with the current RNS relief valve. Modified piping is constructed consistent with current design requirements for RNS piping. The addition of the valve adds safety margin in regards to transients as the new valve lifts at a lower set pressure than the current valve, causing flow rates to be lower through the RNS piping. Therefore, margin of safety is not reduced. The requested changes will not affect any design code, function, design analysis, safety analysis input or result, or design/safety margin. No safety analysis or design basis acceptance limit/criterion is challenged or exceeded by the requested changes. Transient conditions, including mass input and heat input, are not changed and margin of safety is not reduced as the added RNS relief valve supports LTOP functions in the same manner as the current RNS relief valve.

Therefore, the proposed amendment does not involve a significant reduction in a margin of safety.

Based on the above, it is concluded that the proposed amendment does not involve a significant hazards consideration under the standards set forth in 10 CFR 50.92(c), and, accordingly, a finding of “no significant hazards consideration” is justified.

### 4.4 Conclusions

In conclusion, based on the considerations discussed above, (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission’s regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public. Pursuant to 10 CFR 50.92, the requested change does not involve a Significant Hazards Consideration.

## 5. ENVIRONMENTAL CONSIDERATIONS

The requested amendment proposes to depart from approved AP1000 Design Control Document (DCD) Tier 2 information (text, tables, and figures) as incorporated into the Updated Final Safety Analysis Report (UFSAR) as plant-specific DCD Tier 2 information, and involves changes to plant-specific Tier 1 (and associated COL Appendix C) information and COL Appendix A, Technical Specifications. The requested amendment proposes changes to add a second normal residual heat removal system (RNS) suction relief valve (RNS-PL-V020) in parallel to the current RNS suction relief valve (RNS-PL-V021), with the necessary piping changes to accommodate the installation as shown in proposed changes to Tier 1 Figures 2.2.1-1 and 2.3.6-1 and Tables 2.3.6-1, 2.3.6-2, and 2.3.6-4. Changes are also proposed to COL Appendix A, Technical Specification 3.4.14 to address the additional relief valve, and additional operational restrictions required when RNS relief valves are utilized for low temperature overpressure protection (LTOP). Additionally, a change to Tier 1 Figure 2.3.6-1 is proposed to accurately depict the safety class break from containment isolation valve RNS-PL-V061 and the nonsafety downstream piping.

The details of the proposed changes are provided in Sections 2 and 3 of this license amendment request.

This review has determined that the proposed change requires an amendment to the COL. However, a review of the anticipated construction and operational effects of the requested amendment has determined that the requested amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9), in that:

*(i)* *There is no significant hazards consideration.*

As documented in Section 4.3, Significant Hazards Consideration, of this license amendment request, an evaluation was completed to determine whether or not a significant hazards consideration is involved by focusing on the three standards set forth in 10 CFR 50.92, "Issuance of amendment." The Significant Hazards Consideration determined that (1) the requested amendment does not involve a significant increase in the probability or consequences of an accident previously evaluated; (2) the requested amendment does not create the possibility of a new or different kind of accident from any accident previously evaluated; and (3) the requested amendment does not involve a significant reduction in a margin of safety. Therefore, it is concluded that the requested amendment does not involve a significant hazards consideration under the standards set forth in 10 CFR 50.92(c), and accordingly, a finding of "no significant hazards consideration" is justified.

*(ii)* *There is no significant change in the types or significant increase in the amounts of any effluents that may be released offsite.*

The proposed changes in the requested amendment revise COL Appendix C (and plant-specific Tier 1) Figures 2.2.1-1 and 2.3.6-1, Tables 2.3.6-1, 2.3.6-2, and 2.3.6-4, COL Appendix A, Technical Specification 3.4.14, and associated UFSAR design information to add a smaller RNS relief valve, RNS-PL-V020, to reduce chattering of the current RNS relief valve, RNS-PL-V021, and support LTOP functions. The changes are unrelated to any aspects of plant construction or operation that would introduce any changes to effluent types (e.g., effluents containing chemicals or biocides, sanitary system effluents, and other effluents) or affect any plant radiological or non-radiological effluent release quantities. Furthermore, these changes do not diminish the functionality of any design or operational features that are credited with controlling the release of effluents during plant operation. Therefore, it is concluded that the proposed amendment does not involve a significant change in the types or a significant increase in the amounts of any effluents that may be released offsite.

*(iii)* *There is no significant increase in individual or cumulative occupational radiation exposure.*

The proposed change to add the smaller RNS relief valve, RNS-PL-V020, does not impact radiation exposure or dose rates. Plant radiation zones, radiation controls established to satisfy 10 CFR 20 requirements, and expected amounts and types of radioactive materials are not affected by the proposed changes. Therefore, it is concluded that the proposed amendment does not involve a significant increase in individual or cumulative occupational radiation exposure.

Based on the above review of the requested amendment, it has been determined that anticipated construction and operational effects of the requested amendment do not involve (i) a significant hazards consideration, (ii) a significant change in the types or significant increase in the amounts of any effluents that may be released offsite, or (iii) a significant increase in individual or cumulative occupational radiation exposure. Accordingly, the requested amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, pursuant to 10 CFR 51.22(b), an environmental impact statement or environmental assessment of the proposed exemption is not required.

## 6. REFERENCES

None.

**Southern Nuclear Operating Company**

**ND-17-1085**

**Enclosure 2**

**Vogtle Electric Generating Plant (VEGP) Units 3 and 4**

**Exemption Request:**

**Changes to Residual Heat Removal Suction Relief Valve**

**(LAR-17-022)**

(This Enclosure consists of eight pages, including this cover page.)

## 1.0 Purpose

Southern Nuclear Operating Company (the Licensee) requests a permanent exemption from the provisions of 10 CFR 52, Appendix D, Section III.B, *Design Certification Rule for the AP1000 Design, Scope and Contents*, to allow a departure from elements of the certification information in Tier 1 of the generic AP1000 Design Control Document (DCD). The regulation, 10 CFR 52, Appendix D, Section III.B, requires an applicant or licensee referencing Appendix D to 10 CFR Part 52 to incorporate by reference and comply with the requirements of Appendix D, including certified information in DCD Tier 1. The Tier 1 information for which a plant-specific departure and exemption is being requested includes changes related the addition of a second normal residual heat removal system (RNS) suction relief valve in parallel to the current RNS suction relief valve, with the necessary piping changes, and a change to Tier 1 Figure 2.2.1-1, for penetration P19, to accurately depict the orientation of the class break of containment isolation valve RNS-PL-V061.

This request for exemption provides the technical and regulatory basis to demonstrate that 10 CFR 52.63, §52.7, and §50.12 requirements are met and applies the requirements of 10 CFR 52, Appendix D, Section VIII.A.4 to allow departures from generic Tier 1 information due to proposed changes to Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC) Table 2.3.6-4, Item 9.a)i) and 9.a)ii), and supporting information in generic Tier 1 Figure 2.2.1-1, Figure 2.3.6-1, Table 2.3.6-1, Table 2.3.6-2, and Table 2.3.6-4 for the inspections, tests, and analyses of RNS low temperature overpressure protection (LTOP) relief valves and the associated RNS piping.

Consistent with the current RNS suction relief valve, RNS-PL-V021, and piping, the new RNS suction relief valve, RNS-PL-V020, and piping are integral to supporting the RNS function of providing LTOP to the reactor coolant system (RCS) and to supporting the containment system (CNS) function of separating the containment atmosphere from the outside environment during design basis accidents. Therefore, it is appropriate to apply the same inspections, tests, analyses, and acceptance criteria to the added RNS piping and components to provide assurance that the facility has been constructed and will be operated in conformity with the applicable design criteria, codes, and standards.

The RNS hot leg suction pressure relief valves support the RNS LTOP function of limiting RCS pressure during low temperature modes of operation when a water solid pressurizer is possible by opening to relieve pressure transients in the RCS, including mass input and heat input. As required by General Design Criterion 2 of Appendix A to 10 CFR Part 50, the RNS is designed to withstand the effects of natural phenomena and normal and accident conditions without loss of capability to perform its safety functions. The RNS hot leg suction pressure relief valves are safety-related; designed to ASME Code Section III requirements; located on the Nuclear Island; and required to withstand design basis seismic and post-accident operating loads without losing the capability to perform their safety function. These pressure relief valves are not remotely operated, do not have a safety-related display, and perform an active function to transfer open and transfer closed. To provide assurance these ITAAC design commitments are met, plant-specific Tier 1 Table 2.3.6-1 is updated to include the new RNS Hot Leg Suction Pressure Relief Valve, RNS-PL-V020, and plant-specific Tier 1 Table 2.3.6-4 is revised to address LTOP relief valves (i.e., plural) that are inspected to confirm the flow rate capacities identified on the vendor code plates and tested and analyzed to verify their opening set pressures.

The new RNS Suction Line to LTOP Relief Valve RNS-PL-V020, RNS-L090, supports the capability of RNS-PL-020 to provide RNS LTOP for the RCS during low temperature modes of operation and the CNS function of separating the containment atmosphere from the outside environment during design basis accidents. To assure these capabilities, the functional capability, ASME Code applicability, and leak before break treatment is consistent with the current pipe line, RNS-L040, for the current LTOP relief valve, RNS-PL-V021. As required by General Design Criterion 4 of Appendix A to 10 CFR Part 50, the RNS suction line relief valve piping is safety-related and required to withstand normal and seismic design basis loads without losing functional capability. To provide assurance these ITAAC design commitments are met, plant-specific Tier 1 Table 2.3.6-2 is updated to include the new RNS Suction Line LTOP Relief pipe line, RNS-L090, plant-specific Tier 1 Figures 2.3.6-1 and 2.2.1-1 are revised to depict the functional arrangement of the new RNS suction line relief valve, RNS-PL-V020 and the relief valve piping, RNS-L090, and plant-specific Tier 1 Table 2.3.6-4 is revised to address LTOP relief valves (i.e., plural) that are inspected to confirm the flow rate capacities identified on the vendor code plates and tested and analyzed to verify their opening set pressures.

## 2.0 Background

The Licensee is the holder of Combined License Nos. NPF-91 and NPF-92, which authorize construction and operation of two Westinghouse Electric Company AP1000 nuclear plants, named Vogtle Electric Generating Plant (VEGP) Units 3 and 4, respectively.

As described in UFSAR Subsection 5.4.7, the safety-related functions of the RNS include isolation of the RNS lines penetrating containment, preservation of the RCS pressure boundary, and provision of a flow path for long-term post-accident makeup to the containment inventory. Following cooldown, the RNS removes heat from the core and the RCS during plant shutdown. The system is designed to limit the RCS pressure within the limits specified in 10 CFR 50, Appendix G, or 110% of the RNS design pressure. Low temperature overpressure protection is provided by a relief valve, RNS-PL-V021, in the suction line of the RNS.

LTOP limits RCS pressure at low temperatures so that the integrity of the RCS pressure boundary is not compromised by violating pressure and temperature limits. During operations at ≤ 350°F, the RNS is operated for decay heat removal by opening the RNS suction isolation valves in the piping from the RCS hot legs to the inlet of the RNS. While these valves are open, the RNS suction relief valve, RNS-PL-V021, is exposed to the RCS and able to provide LTOP for the RCS by relieving pressure transients in the RCS, including mass input and heat input transients.

Because the current RNS relief valve, RNS-PL-V021, is designed with a higher rated capacity than any LTOP event or any overpressure transient, it may chatter when flow through the valve is less than full rated flow capacity. To reduce chattering of the current 3-inch RNS relief valve, RNS-PL-V021, a second, smaller 1-inch relief valve, RNS-PL-V020, is added to the RNS suction piping. This smaller valve is added in parallel to the current LTOP relief valve, RNS-PL-V021, to provide stability for the range of LTOP events.

Additionally, the class break for valve RNS-PL-V061 on plant-specific Tier 1 Figure 2.2.1-1 is revised to accurately reflect the orientation of the change from safety to nonsafety-related piping.

## 3.0 Technical Justification of Acceptability

As described in UFSAR Subsection 5.4.7, the safety-related functions of the RNS include preservation of the RCS pressure boundary, isolation of the RNS lines penetrating containment, and provision of a flow path for long-term post-accident makeup to the containment inventory.

The RNS is designed to provide the safety-related function of low temperature overpressure protection for the reactor coolant system during refueling, startup, and shutdown operations. The system is designed to limit the RCS pressure within the limits specified in 10 CFR 50, Appendix G. LTOP limits RCS pressure at low temperatures so that the integrity of the reactor coolant pressure boundary (RCPB) is not compromised by violating pressure and temperature limits. The added RNS relief valve, RNS-PL-V020, supports the LTOP function currently provided by the current RNS relief valve, RNS-PL-V021. The changes proposed to the Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC) in Tier 1 Table 2.3.6-4 Item 9.a) do not change the associated Design Commitment to verify the overpressure protection function of the relief valve in the RNS provides LTOP for the RCS during shutdown operations.

10 CFR 50, Appendix A, General Design Criteria (GDC) 14 and 30 require that components of the RCPB be designed, fabricated, erected, and tested to the highest quality standards practical so as to have an extremely low probability of abnormal leakage or failure. The changes proposed to Tier 1 Tables 2.3.6-1 and 2.3.6-2, in concert with the unchanged ITAAC in Tier 1 Table 2.3.6-4, confirm that the new RNS pressure relief valve and associated piping, RNS-PL-V020, meet the same quality standards as the current RNS pressure relief valve and associated piping, RNS-PL-V021. The changes described herein do not change the commitments to demonstrate that the RNS piping and components are designed and constructed in accordance with the Code requirements and functional criteria specified in Tier 1 Tables 2.3.6-1 and 2.3.6-2.

10 CFR 50, Appendix A, GDC-16 requires that the reactor containment and associated systems be provided to establish an essentially leak-tight barrier against the uncontrolled release of radioactivity to the environment and to assure that the containment design conditions important to safety are not exceeded for as long as postulated accident conditions require. The proposed changes do not adversely impact the containment or containment design as the functions of containment and containment isolation are not changed. The added relief valve, RNS-PL-V020, performs a containment isolation function consistent with the current relief valve, RNS-PL-V021. As depicted in the proposed change to Tier 1 Figure 2.2.1-1, the addition of this valve does not add a new penetration to containment; however, the new RNS relief valve acts as part of containment isolation, consistent with the function of the current RNS relief valve, RNS-PL-V021. The change to add the RNS relief valve, RNS-PL-V020, reconfigure piping, and revise the class break for RNS-PL-V061, support the containment isolation functions of these components and piping, consistent with the current ITAAC requirements in Tier 1 Table 2.2.1-3.

10 CFR 50, Appendix A, GDC-34 requires that a system be provided to transfer fission product decay heat and other residual heat from the reactor core at a rate such that specified acceptable fuel design limits and the design conditions of the RCPB are not exceeded. The proposed changes to the RNS do not adversely impact the function of the RNS to remove decay from the core, as verified by Tier 1 Table 2.3.6-4, ITAAC Item 9.a).

Detailed technical justification supporting this request for exemption is provided in Section 3 of the associated License Amendment Request in Enclosure 1 of this letter.

## 4.0 Justification of Exemption

10 CFR Part 52, Appendix D, Section VIII.A.4 and 10 CFR 52.63(b)(1) govern the issuance of exemptions from elements of the certified design information for AP1000 nuclear power plants. Since SNC has identified changes to the Tier 1 information as discussed in Enclosure 1 of the accompanying License Amendment Request, an exemption from the certified design information in Tier 1 is needed.

10 CFR Part 52, Appendix D, and 10 CFR 50.12, §52.7, and §52.63 state that the NRC may grant exemptions from the requirements of the regulations provided 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, App. 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 52.63, §52.7, and §50.12 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 1 DCD to depart from the AP1000 certified (Tier 1) design information. The plant-specific DCD Tier 1 will continue to reflect the approved licensing basis for VEGP Units 3 and 4, and will maintain a consistent level of detail with that which is currently provided elsewhere in Tier 1 of the plant-specific DCD. Therefore, the affected plant-specific DCD Tier 1 ITAAC will continue to serve its required purpose.

The addition of a second RNS suction relief valve and associated piping in parallel to the current RNS suction relief valve, and the change to Tier 1 Figure 2.2.1-1, for penetration P19, to accurately depict the orientation of the class break of containment isolation valve RNS-PL-V061 do not represent any adverse impact to the design functions of the RNS, RCS, CNS or the systems, structures and components therein and will continue to protect the health and safety of the public in the same manner as the current RNS suction relief valve and associated piping. The proposed changes do not introduce any new industrial, chemical, or radiological hazards that would represent a public health or safety risk, nor do they modify or remove any design or operational controls or safeguards intended to mitigate any existing on-site hazards. Furthermore, the proposed change would not allow for a new fission product release path, result in a new fission product barrier failure mode, or create a new sequence of events that would result in fuel cladding failures. Accordingly, this change does not present an undue risk from any existing or proposed equipment or systems.

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 requested exemption from the requirements of 10 CFR 52, Appendix D, Section III.B would allow the licensee to depart from elements of the plant specific DCD Tier 1 design information. The proposed 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 is 10 CFR 52, Appendix D, Section III.B, which requires that a licensee 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. The VEGP Units 3 and 4 COLs reference the AP1000 Design Certification Rule and incorporate by reference the requirements of 10 CFR Part 52, Appendix D, including Tier 1 information. 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.

The requested exemption allows departure from Tier 1 ITAAC Table 2.3.6-4 and a supporting Tier 1 table and figures related the addition of a second normal residual heat removal system (RNS) suction relief valve in parallel to the current RNS suction relief valve, with the necessary piping changes, and a change to Tier 1 Figure 2.2.1-1 to accurately depict the orientation of the class break of a containment isolation valve in the normal residual heat removal system. The added RNS relief valve, RNS-PL-V020, supports low-temperature overpressure protection (LTOP) function currently provided by the current RNS relief valve, RNS-PL-V021. The proposed changes to the RNS maintain the design margins of the normal residual heat removal system, reactor coolant system, and containment system. The proposed changes do not adversely impact the ability of any structures, systems, or components to perform their functions or negatively impact safety. Accordingly, this exemption from the certification information will enable the Licensee 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 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 1 information and the understanding that these changes support the design functions of the RNS, RCS, and CNS, it is expected that this exemption may be requested by other AP1000 licensees and applicants. However, a review of the reduction in standardization resulting from the departure from the standard DCD determined that even if other AP1000 licensees and applicants do not request this same departure, the special circumstances will continue to outweigh any decrease in safety from the reduction in standardization because the key design functions of the structures associated with this request will continue to be maintained. Furthermore, the justification provided in the license amendment request and this exemption request and the associated mark-ups demonstrate that there is a limited change from the standard information provided in the generic AP1000 DCD, which is offset by the special circumstances identified above.

   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.

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

   The exemption revises the plant-specific DCD Tier 1 information by adding a second normal residual heat removal system (RNS) suction relief valve with the necessary piping, in parallel to the current RNS suction relief valve, to Tier 1 Figures 2.2.1-1 and 2.3.6-1 and Tier 1 Tables 2.3.6-1, 2.3.6-2, and 2.3.6-4, and changing Tier 1 Figure 2.2.1-1 to accurately depict the orientation of the class break of containment isolation valve RNS-PL-V061. These changes do not change the design or safety functions of the normal residual heat removal system, reactor coolant system, or containment system. Because these functions continue to be met, there is no reduction in the level of safety.

## 5.0 Risk Assessment

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

## 6.0 Precedent Exemptions

None

## 7.0 Environmental Consideration

The Licensee requests a departure from elements of the certified information in Tier 1 of the generic AP1000 DCD. The Licensee has determined that the proposed departure would require a permanent exemption from the requirements of 10 CFR 52, Appendix D, Section III.B, *Design Certification Rule for the AP1000 Design, Scope and Contents,* with respect to installation or use of facility components located within the restricted area, as defined in 10 CFR Part 20, or which changes an inspection or a surveillance requirement; however, the Licensee evaluation of the proposed exemption has determined that the proposed exemption meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9).

Based on the above review of the proposed exemption, the Licensee has determined that the proposed activity does not involve (i) a significant hazards consideration, (ii) a significant change in the types or significant increase in the amounts of any effluents that may be released offsite, or (iii) a significant increase in the individual or cumulative occupational radiation exposure. Accordingly, the proposed exemption meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, pursuant to 10 CFR 51.22(b), an environmental impact statement or environmental assessment of the proposed exemption is not required.

Specific details of the environmental considerations supporting this request for exemption are provided in Section 5 of the associated License Amendment Request provided in Enclosure 1 of this letter.

## 8.0 Conclusion

The proposed changes to Tier 1 are necessary to add a second normal residual heat removal system (RNS) suction relief valve and piping in parallel to the current RNS suction relief valve, and revise Tier 1 Figure 2.2.1-1, for penetration P19, to accurately depict the orientation of the class break of containment isolation valve RNS-PL-V061. The exemption request meets the requirements of 10 CFR 52.63, *Finality of design certifications*, 10 CFR 52.7, *Specific exemptions*, 10 CFR 50.12, *Specific exemptions*, and 10 CFR 52 Appendix D, *Design Certification Rule for the AP1000*. Specifically, the exemption request meets the criteria of 10 CFR 50.12(a)(1) in that the request is authorized by law, presents no undue risk to public health and safety, and is consistent with the common defense and security. Furthermore, approval of this request does not result in a significant decrease in the level of safety, satisfies the underlying purpose of the AP1000 Design Certification Rule, and does not present a significant decrease in safety as a result of a reduction in standardization.

## 9.0 References

None

**Southern Nuclear Operating Company**

**ND-17-1085**

**Enclosure 3**

**Vogtle Electric Generating Plant (VEGP) Units 3 and 4**

**Proposed Changes to Licensing Basis Documents**

**(LAR-17-022)**

**Insertions Denoted by Blue Underline and Deletions by ~~Red~~ Strikethrough**
**Omitted text is identified by three asterisks ( * * * )**

(This Enclosure consists of 32 pages, including this cover page)

3.4 REACTOR COOLANT SYSTEM (RCS)

3.4.14 Low Temperature Overpressure Protection (LTOP)

LCO 3.4.14 At least one of the following overpressure protection methods shall be OPERABLE, with the accumulators isolated:

a. ~~The~~Two Normal Residual Heat Removal System (RNS) suction relief valves ~~with lift setting within the limit specified in the PTLR~~ and Chemical and Volume Control System (CVS) makeup line containment isolation valve, CVS-PL-V091, closed; or

b. The RCS depressurized and an RCS vent of ≥ 4.15 square inches.

---

**- NOTES -**

1. No reactor coolant pump (RCP) shall be started when the RCS temperature is ≥ 350°F unless pressurizer level is < 92%.

2. No RCP shall be started with any RCS cold leg temperature ≤ 350°F unless the secondary side water temperature of each steam generator (SG) is ≤ 50°F above each of the RCS cold leg temperatures and the RCP is started at ≤ 25% of RCP speed.

3. Accumulator isolation is only required when accumulator pressure is greater than or equal to the maximum RCS pressure for the existing RCS cold leg temperature allowed by the P/T limit curves provided in the PTLR.

---

APPLICABILITY: MODE 4 when any cold leg temperature is ≤ 275°F,
MODE 5,
MODE 6 when the reactor vessel head is on.

ACTIONS

| CONDITION | REQUIRED ACTION | COMPLETION TIME |
|---|---|---|
| A. An accumulator not isolated when the accumulator pressure is greater than or equal to the maximum RCS pressure for existing cold leg temperature allowed in the PTLR. | A.1 Isolate affected accumulator. | 1 hour |

ACTIONS (continued)

| CONDITION | REQUIRED ACTION | COMPLETION TIME |
|---|---|---|
| B. ------------------------------- **- NOTE -** Not applicable when an RCS vent of ≥ 4.15 square inches is established. ------------------------------- CVS-PL-V091 not closed | B.1 Close CVS-PL-V091. | 1 hour |
| ~~B~~ C. Required Action and associated Completion Time of Condition A not met. | ~~B~~C.1 Increase RCS cold leg temperature to a level acceptable for the existing accumulator pressure allowed in the PTLR. | 12 hours |
| | OR | |
| | ~~B~~C.2 Depressurize affected accumulator to less than the maximum RCS pressure for existing cold leg temperature allowed in the PTLR. | 12 hours |
| ~~C~~ D. Required LTOP method inoperable for reasons other than Condition A, B, or ~~B~~C. | ~~C~~D.1 Restore ~~the~~two RNS suction relief valves to OPERABLE status. | 12 hours |
| | OR | |
| | ~~C~~D.2 Depressurize RCS and establish RCS vent of ≥ 4.15 square inches. | 12 hours |

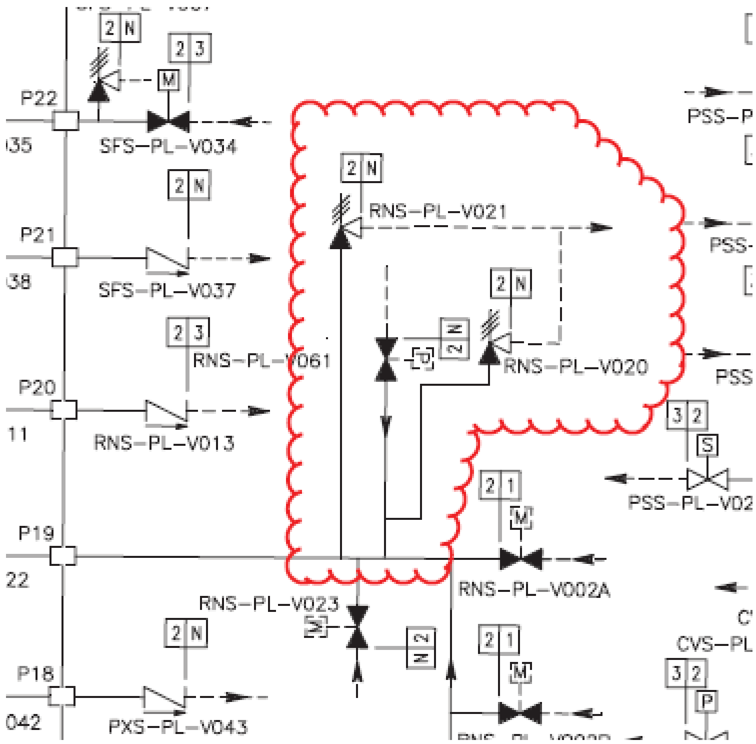
SURVEILLANCE REQUIREMENTS

| | SURVEILLANCE | FREQUENCY |
|---|---|---|
| SR 3.4.14.1 | ---------------------------------------------<br>**- NOTE -**<br>Only required to be met when accumulator pressure is greater than or equal to the maximum RCS pressure for the existing RCS cold leg temperature allowed by the P/T limit curves provided in the PTLR.<br>---------------------------------------------<br>Verify each accumulator is isolated. | 12 hours |
| SR 3.4.14.2 | ---------------------------------------------<br>**- NOTE -**<br>Only required to be met when complying with LCO 3.4.14.a.<br>---------------------------------------------<br>Verify both RNS suction isolation valves in one RNS suction flow path are open. | 12 hours |
| SR 3.4.14.3 | ---------------------------------------------<br>**- NOTE -**<br>Only required to be met when complying with LCO 3.4.14.a.<br>---------------------------------------------<br>Verify CVS makeup line containment isolation valve, CVS-PL-V091, is closed. | 12 hours |
| SR 3.4.14.~~3~~4 | ---------------------------------------------<br>**- NOTE -**<br>Only required to be met when complying with LCO 3.4.14.b.<br>---------------------------------------------<br>Verify RCS vent ≥ 4.15 square inches is open. | 12 hours for unlocked-open vent<br><br>AND<br><br>31 days for locked-open vent |

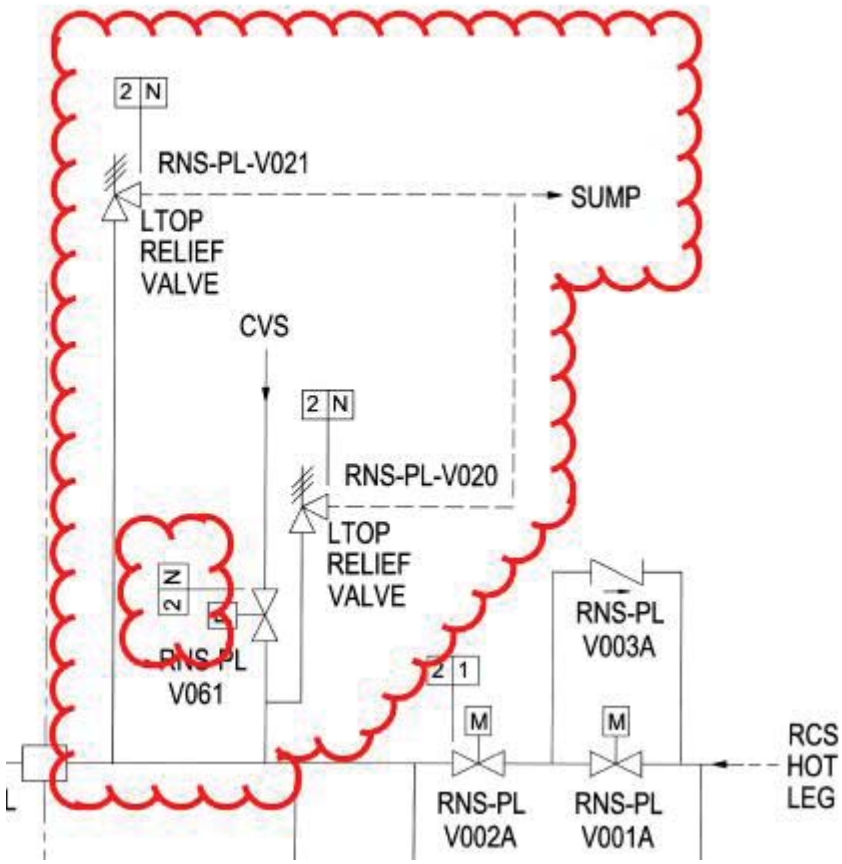
SURVEILLANCE REQUIREMENTS (continued)

| SURVEILLANCE | | FREQUENCY |
|---|---|---|
| SR 3.4.14.~~4~~5 | ----------------------------------------<br>**- NOTE -**<br>Only required to be met when complying with LCO 3.4.14.a.<br>----------------------------------------<br><br>Verify the lift setting of ~~the~~each RNS suction relief valve in accordance with the Inservice Testing Program. | In accordance with the Inservice Testing Program |

**Revise COL Appendix C (and plant-specific Tier 1) Figure 2.2.1-1, Containment System, as shown in the excerpt below, to add RNS relief valve, RNS-PL-V020, and reconfigure piping. Revise class break for RNS-PL-V061 from nonsafety-to-Class 2 (N / 2), to Class 2-to-nonsafety (2 / N).**



**Revise COL Appendix C (and plant-specific Tier 1) Figure 2.3.6-1, Normal Residual Heat Removal System, as shown in the excerpt below, to add RNS relief valve, RNS-PL-V020, and reconfigure piping.**



**Revise COL Appendix C (and plant-specific Tier 1) Table 2.3.6-1, as shown below, to add RNS relief valve, RNS-PL-V020, and designated parameters as shown on the markups.**

| Equipment Name | Tag No. | ASME Code Section III | Seismic Cat. I | Remotely Operated Valve | Class 1E/ Qual. for Harsh Envir. | Safety-Related Display | Control PMS | Active Function | Loss of Motive Power Position |
|---|---|---|---|---|---|---|---|---|---|
| * * * | | | | | | | | | |
| RNS Discharge RCS Pressure Boundary Check Valve | RNS-PL-V017B | Yes | Yes | No | -/- | No | - | Transfer Open/ Transfer Closed | - |
| RNS Hot Leg Suction Pressure Relief Valve | RNS-PL-V020 | Yes | Yes | No | -/- | No | - | Transfer Open/ Transfer Closed | - |
| RNS Hot Leg Suction Pressure Relief Valve | RNS-PL-V021 | Yes | Yes | No | -/- | No | - | Transfer Open/ Transfer Closed | - |
| * * * | | | | | | | | | |

**Revise COL Appendix C (and plant-specific Tier 1) Table 2.3.6-2, as shown below, to add the pipe line number, RNS-L090, for RNS suction line LTOP relief.**

| Line Name | Line No. | ASME Code Section III | Leak Before Break | Functional Capability Required |
|---|---|---|---|---|
| | * * * | | | |
| RNS Suction Line LTOP Relief | RNS-L040<br>RNS-L090 | Yes | No | Yes |
| | * * * | | | |

**Revise COL Appendix C (and plant-specific Tier 1) Table 2.3.6-4, ITAAC Nos. 2.3.06.09a.i and 2.3.06.09a.ii as shown in the excerpt below, to change "valve" to "valves" and specify "each" valve is identified on the report.**

| No. | ITAAC No. | Design Commitment | Inspections, Tests, Analyses | Acceptance Criteria |
|---|---|---|---|---|
| | | * * * | | |
| 372 | 2.3.06.09a.i | 9.a) The RNS provides LTOP for the RCS during shutdown operations. | i) Inspections will be conducted on the low temperature overpressure protection relief ~~valve~~ valves to confirm that the ~~capacity~~ capacities of the vendor code plate ~~rating is~~ ratings are greater than or equal to system relief requirements. | i) The rated ~~capacity~~ capacities recorded on the ~~valve~~ valves' vendor code ~~plate is~~ plates are not less than the flow required to provide low-temperature overpressure protection for the RCS, as determined by the LTOPS evaluation based on the pressure-temperature curves developed for the as-procured reactor vessel material. |
| 373 | 2.3.06.09a.ii | 9.a) The RNS provides LTOP for the RCS during shutdown operations. | ii) Testing and analysis in accordance with the ASME Code Section III will be performed to determine set pressure. | ii) A report exists and concludes that the relief ~~valve opens~~ valves open at a pressure not greater than the set ~~pressure~~ pressures required to provide low-temperature overpressure protection for the RCS, as determined by the LTOPS evaluation based on the pressure-temperature curves developed for the as-procured reactor vessel material. |
| | | * * * | | |

**Revise Updated Final Safety Analysis Report (UFSAR) Tier 2 Table 1.6-1, Material Referenced, as shown in the excerpt below, to change WCAP-15993 from "Revision 1, March 2003" to "Revision 2."**

| DCD Section Number | Westinghouse Topical Report Number | Title |
|---|---|---|
| | * * * | |
| 1.9 | WCAP-15993 | Evaluation of the AP1000 Conformance to Inter-System Loss-of-Coolant Accident Acceptance Criteria, Revision 2 ~~1, March 2003~~ |
| | * * * | |

**Revise UFSAR Tier 2 Subsection 1.9.4.2.3, New Generic Issues, Issue 94, Additional Low-Temperature Overpressure Protection for Light Water Reactors, second paragraph of the AP1000 Response, as shown below, to change "valve" to "valves" and revise verb usage.**

**Issue 94 Additional Low-Temperature Overpressure Protection for Light Water Reactors**

**AP1000 Response:**

* * *

The normal residual heat removal system is designed to provide the safety-related function of low temperature overpressure protection for the reactor coolant system during refueling, startup, and shutdown operations. The system is designed to limit the reactor coolant system pressure within the limits specified in 10 CFR 50, Appendix G. The relief valves in the normal residual heat removal system ~~is~~ are used to provide the overpressure protection. See Subsection 5.4.7 for additional information on the design of the normal residual heat removal system and the overpressure protection function.

**Revise UFSAR Tier 2 Subsection 1.9.6, References, Reference 56, as shown below, to change the reference for WCAP-15993 from "Revision 1, March 2003" to "Revision 2."**

56. WCAP-15993, "Evaluation of the AP1000 Conformance to Inter-System Loss-of-Coolant Accident Acceptance Criteria," Revision 2 ~~1, March 2003~~.

**Revise UFSAR Tier 2 Section 1.9 incorporated by reference document WCAP-15993, Rev. 1, Section 3.1.2, Design Evaluation, first paragraph under the heading, Normal Residual Heat Removal System Relief Valves, to change "valve" to "valves" and change verb usage accordingly, as shown below.**

**Normal Residual Heat Removal System Relief Valves**

The inside-containment AP1000 RNS relief ~~valve is~~ valves are connected to the RHR pump suction line inside containment. ~~This valve is~~ These valves are designed to provide low-temperature overpressure protection of the RCS as described in DCD subsection 5.2.2. ~~It is~~ They are connected to the high-pressure portion of the pump suction line, and will reduce the risk of overpressurizing the low-pressure portions of the system. In addition, the RNS discharge header contains a relief valve provided to prevent overpressure in the RNS pump discharge line. Overpressure could occur if the three check valves (V013, V015, and V017) and the motor-operated containment isolation gate valve (V011) leaked back to the low-pressure portions of the RNS. The discharge of this relief valve is routed to the WLS effluent holdup tanks.

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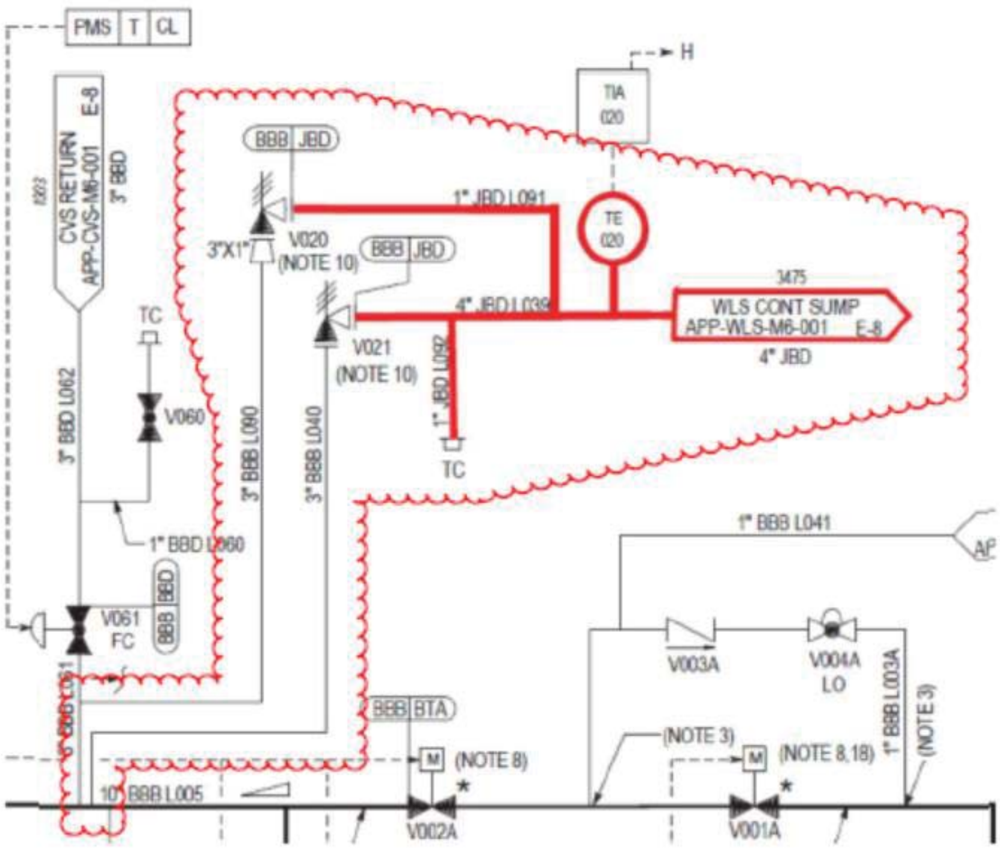
**Revise UFSAR Tier 2 Section 1.9 incorporated by reference document WCAP-15993, Rev. 1, Section 3.2.2, Design Evaluation, second paragraph, to change "valve" to "valves" and change verb usage accordingly, as shown below.**

**Design Evaluation**

During shutdown operation, with the letdown orifice bypassed, the relief valve in the CVS letdown line is required to protect the letdown line in the event of a cold overpressure transient. If the letdown isolation valves were opened and a cold overpressure transient occurred, the pressure excursion in the RCS would be limited to the set pressure of the RNS relief valves (plus accumulation pressure). Relief valve V057 is sized to provide sufficient flow for this event such that the pressure drop in the letdown line would limit the maximum WLS pressure to within 110 percent of its design pressure.

**Revise UFSAR Tier 2 Section 1.9 incorporated by reference document WCAP-15993, Rev. 1, Figure 3-1, Normal Residual Heat Removal System, by incorporating the version of this figure generated from the current revision of the design piping and instrumentation diagram, as shown in the excerpt below.**



**Revise UFSAR Tier 2 Table 3.2-3, AP1000 Classification of Mechanical and Fluid Systems, Components, and Equipment, as shown below, to add RNS relief valve, RNS-PL-V020, and designated design information as shown on the markups.**

| Tag Number | Description | AP1000 Class | Seismic Category | Principal Construction Code | Comments |
|---|---|---|---|---|---|
| | | * * * | | | |
| **Normal Residual Heat Removal System (Continued)** | | | | | |
| | | * * * | | | |
| RNS-PL-V017B | RNS Discharge RCS Pressure Boundary | A | I | ASME III-1 | |
| RNS-PL-V020 | RNS HL Suction Pressure Relief | B | I | ASME III-2 | |
| RNS-PL-V021 | RNS HL Suction Pressure Relief | B | I | ASME III-2 | |
| | | * * * | | | |

**Revise UFSAR Tier 2 Subsection 3.9.1.1.2.6, Cold Overpressure, first, third, and fourth paragraphs, as shown below, to change "valve" to "valves," change verb usage, and change "safety" to "relief."**

### 3.9.1.1.2.6 Cold Overpressure

The ~~safety valve~~ relief valves located in the residual heat removal pump suction piping provide~~s~~ the capability for additional reactor coolant system inventory letdown in order to maintain the reactor coolant system pressure consistent with the reactor vessel pressure temperature limits, as required by Appendix G of 10 CFR Part 50. Reactor coolant system cold overpressurization occurs at low temperature (below 350°F) during plant heatup or cooldown, and can occur with or without a steam bubble in the pressurizer. A cold overpressurization is especially severe when the reactor coolant system is water solid. The event is inadvertent, and can be generated by an equipment malfunction or an operator error.

* * *

Under water-solid conditions, a worst-case scenario, the mass addition causes an increase in system pressure until the relief valve set pressure, plus accumulation, is reached. The relief valves remain~~s~~ open, with the system pressure stabilizing at the set pressure plus accumulation, until the mass injection is terminated by the operator. Heat addition, also under water-solid conditions, results in a system pressure increase that eventually is terminated by the relief valves.

Once thermal equilibrium is established between the heat source and the reactor coolant system, and the volume expansion has been let down through the relief valves, system pressure stabilizes at the relief valve set pressure.

* * *

**Revise UFSAR Tier 2 Subsection 3.9.3.3.2, Pressure Relief Devices for Class 2 Systems and Components, first and third paragraphs, as shown below, to change "valve" to "valves" and change verb usage.**

### 3.9.3.3.2 Pressure Relief Devices for Class 2 Systems and Components

Pressure relieving devices for ASME Code, Section III, Class 2 systems include the safety valves and power operated relief valves on the steam line and the relief valves on the containment isolation portion of the normal residual heat removal system.

* * *

In addition to providing overpressure protection for the normal residual heat removal system, the relief valves also provide~~s~~ low temperature overpressure protection for the reactor coolant system. The location and connection for the valves on the residual heat removal system are discussed in Subsection 5.4.7.

---

**Revise UFSAR Tier 2 Table 3.9-12, List of ASME Class 1, 2, and 3 Active Valves, as shown in the excerpt below, to add RNS relief valve, RNS-PL-V020, and designated design information.**

| Valve No. | Description | Function[(a)] |
|---|---|---|
| | * * * | |
| **Normal Residual Heat Removal System** | | |
| | * * * | |
| RNS-PL-V017B | RNS Discharge Reactor Coolant System Pressure Boundary | 1, 4 |
| RNS-PL-V020 | RNS HL Suction Pressure Relief | 2 |
| RNS-PL-V021 | RNS HL Suction Pressure Relief | 2 |
| | * * * | |

**Revise UFSAR Tier 2 Table 3.9-16, Valve Inservice Test Requirements, as shown below, to add RNS relief valve, RNS-PL-V020, and designated design and inservice testing information. Revise Note 9 to identify plural relief valves.**

| Valve Tag Number | Description(1) | Valve/Actuator Type | Safety-Related Missions | Safety Functions(2) | ASME Class/ IST Category | Inservice Testing Type and Frequency | IST Notes |
|---|---|---|---|---|---|---|---|
| | | | | * * * | | | |
| RNS-PL-V017B | RNS Discharge RCS Pressure Boundary | Check | Maintain Close<br>Transfer Open<br>Transfer Close<br>Maintain Open | Active<br>RCS Pressure Boundary<br>Safety Seat Leakage | Class 1<br>Category AC | Check Exercise/Refueling Shutdown<br>Pressure Isolation Leak Test/2 Years | **24** |
| RNS-PL-V020 | RNS Hot Leg Suction Pressure Relief | Relief | Maintain Close<br>Transfer Open<br>Transfer Close | Active<br>Containment Isolation<br>Safety Seat Leakage | Class 2<br>Category AC | Containment Isolation Leak Test/2 Years<br>Class 2/3 Relief Valve Tests/10 Years and 20% in 4 Years | **27** |
| RNS-PL-V021 | RNS Hot Leg Suction Pressure Relief | Relief | Maintain Close<br>Transfer Open<br>Transfer Close | Active<br>Containment Isolation<br>Safety Seat Leakage | Class 2<br>Category AC | Containment Isolation Leak Test/2 Years<br>Class 2/3 Relief Valve Tests/10 Years and 20% in 4 Years | **27** |
| | | | | * * * | | | |

Notes:

* * *

9. This note applies to the PXS accumulator check valves (PXS-V028A/B, V029A/B). To exercise these valves, flow must be provided through these valves to the RCS. These valves are not exercised during power operations because the accumulators cannot provide flow to the RCS since they are at a lower pressure. In addition, providing flow to the RCS during power operation would cause undesirable thermal transients on the RCS. During cold shutdowns, a full flow stroke test is impractical because of the potential of adding significant water to the RCS, and lifting the RNS relief ~~valve~~ valves. There is also a risk of injecting nitrogen into the RCS. A partial stroke test is practical during longer cold shutdowns (≥48 hours in Mode 5). In this test, flow is provided from test connections, through the check valves and into the RCS. Sufficient flow is not available to provide a detectable obturator movement. Full stroke exercise testing of these valves is conducted during refueling shutdowns.

**Revise UFSAR Tier 2 Table 3.11-1, Environmentally Qualified Electrical and Mechanical Equipment, as shown below, to add RNS relief valve, RNS-PL-V020, and designated design information.**

| Description | AP1000 Tag No. | Envir. Zone (Note 2) | Function (Note 1) | Operating Time Required (Note 5) | Qualification Program (Note 6) |
|---|---|---|---|---|---|
| * * * | | | | | |
| RNS Discharge RCS Pressure Boundary | RNS-PL-V017B | **1** | **ESF** | 5 min | M * |
| RNS Hot Leg Suction Relief | RNS-PL-V020 | **1** | **ESF** | 24 hr | M * |
| RNS Hot Leg Suction Relief | RNS-PL-V021 | **1** | **ESF** | 24 hr | M * |
| * * * | | | | | |

**Revise UFSAR Tier 2 Table 3I.6-3, List Of AP1000 Safety-Related Electrical and Mechanical Equipment Not High Frequency Sensitive, as shown below, to add RNS relief valve, RNS-PL-V020, and designated design information.**

| Description | AP1000 Tag Number | Comment |
|---|---|---|
| * * * | | |
| RNS Discharge RCS Pressure Boundary | RNS-PL-V017B | **2** |
| RNS Hot Leg Suction Relief | RNS-PL-V020 | **2** |
| RNS Hot Leg Suction Relief | RNS-PL-V021 | **2** |
| * * * | | |

**Revise UFSAR Tier 2 Subsection 5.2.2, Overpressure Protection, second paragraph, as shown below, to change “a relief valve” to “relief valves” and change “valve” to “valves”.**

### 5.2.2 Overpressure Protection

* * *

Low temperature overpressure protection is provided by ~~a relief~~ relief valves in the suction line of the normal residual heat removal (RNS) system. The sizing and use of the relief ~~valve~~ valves for low temperature overpressure protection is consistent with the guidelines of Branch Technical Position RSB 5-2.

---

**Revise UFSAR Tier 2 Subsection 5.2.2.1 Design Bases, fourth, fifth, sixth, and seventh paragraphs, as shown below, to change “valve” to “valves,” change verb usage, and change “pressure” to “pressures,” and change “two makeup pumps” to “one or both makeup pumps.”**

### 5.2.2.1 Design Bases

* * *

Administrative controls and plant procedures aid in controlling reactor coolant system pressure during low-temperature operation. Normal plant operating procedures maximize the use of a steam or gas bubble in the pressurizer during periods of low pressure, low-temperature operation. For those low-temperature modes of operation when operation with a water solid pressurizer is possible, ~~a relief valve~~ relief valves in the residual heat removal system ~~provides~~ provide low-temperature overpressure protection for the reactor coolant system. The ~~valve is~~ valves are sized to prevent overpressure during the following credible events with a water-solid pressurizer:

* * *

Of those events the makeup/letdown flow mismatch is the limiting mass input condition. Inadvertent start of an inactive reactor coolant pump is the limiting heat input condition to size the relief ~~valve~~ valves. The flow rate postulated for mass input condition is based on the flow from ~~two~~ one or both makeup pumps at the set pressure of the relief ~~valve~~ valves. The heat input condition is based on a 50-degree temperature difference between the reactor coolant system and the steam generator secondary side.

The set ~~pressure~~ pressures for the normal residual heat removal system relief ~~valve is~~ valves are established based on the lower value of the normal residual heat removal system design pressure and the low-temperature pressure limit for the reactor vessel based on ASME Code, Section III, Appendix G, analyses. The pressure-temperature limits for the reactor vessel, based on expected material properties and the vessel design, are discussed in Subsection 5.3.3.

The capacity of the residual heat removal relief ~~valve~~ valves can maintain the pressure in the reactor coolant system and the residual heat removal system to a pressure less than the lesser of 110 percent of the design pressure of the normal residual heat removal system or the pressure limit from the Appendix G analyses for the limiting event.

* * *

**Revise UFSAR Tier 2 Subsection 5.2.2.2, Design Evaluation, first and third paragraphs, as shown below, to change "valve" to "valves," change verb usage, and change "pressure" to "pressures."**

### 5.2.2.2 Design Evaluation

The relief capacities of the pressurizer safety valves, steam generator safety valves, and the normal residual heat removal system relief ~~valve~~ valves are determined from the postulated overpressure transient conditions in conjunction with the action of the reactor protection system. An overpressure protection report is prepared according to Article NB-7300 of Section III of the ASME Code. WCAP-7907 (Reference 1) describes the analytical model used in the analysis of the overpressure protection system and the basis for its validity.

* * *

Subsection 5.4.9 discusses the capacities of the pressurizer safety valves and residual heat removal system relief ~~valve~~ valves used for low temperature overpressure protection. The setpoints and reactor trip signals which occur during operational overpressure transients are discussed in Subsection 5.4.5. With the current AP1000 pressure-temperature limits (Subsection 5.3.3), the set ~~pressure~~ pressures for the relief ~~valve~~ valves in the normal residual heat removal system ~~is~~ are based on a sizing analysis performed to prevent the reactor coolant system pressure from exceeding the applicable low temperature pressure limit for the reactor vessel based on ASME Code, Section III, Appendix G. The limiting mass and energy input transients are assumed for the sizing analysis.

**Revise UFSAR Tier 2 Subsection 5.2.2.3, Piping and Instrumentation Diagrams, first paragraph, as shown below, to change "valve" to "valves."**

5.2.2.3 Design Evaluation

The connection of the pressurizer safety valves to the pressurizer is incorporated into the pressurizer safety and relief valve module and is discussed in Subsection 5.4.9. The pressurizer safety and relief valve module configuration appears in the piping and instrumentation drawing for the reactor coolant system (Figure 5.1-5). The normal residual heat removal system (Subsection 5.4.7) incorporates the relief ~~valve~~ valves for low-temperature overpressure protection. The valves which isolate the normal residual heat removal system from the reactor coolant system do not have an autoclosure interlock. Figure 5.4-6 shows a simplified sketch of the normal residual heat removal system. Figure 5.4-7 shows the piping and instrumentation drawing for the residual heat removal system.

* * *

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**Revise UFSAR Tier 2 Subsection 5.2.2.4, Equipment and Component Description, second and third paragraphs, as shown below, to change "valve" to "valves," change verb usage, and change "component" to "components."**

**5.2.2.4 Equipment and Component Description**

* * *

The relief ~~valve~~ valves included in the normal residual heat removal system ~~provides~~ provide containment boundary function since ~~it is~~ they are connected to the piping between the containment isolation valves for the system. Containment isolation requirements are discussed in Subsection 6.2.3. Based on the containment boundary function, the relief ~~valve is an~~ valves are ASME Code Class 2 ~~component and is~~ components and are analyzed to the appropriate requirements.

In addition to the testing and analysis required for ASME Code requirements, the pressurizer safety valves are of a type which has been verified to operate during normal operation, anticipated transients, and postulated accident conditions. The verification program (Reference 2) was established by the Electric Power Research Institute to address the requirements of 10 CFR 50.34 (f)(2)(x). These requirements do not apply to relief valves of the size and type represented by the relief ~~valve~~ valves on the normal residual heat removal system.

* * *

**Revise UFSAR Tier 2 Subsection 5.3.6.1, Pressure-Temperature Limit Curves, as shown below, to change "valve" to "valves," change verb usage, change "pressure" to "pressures," and change "LTOP system" to "LTOP analysis."**

### 5.3.6.1 Pressure-Temperature Limit Curves

The pressure-temperature curves shown in Figures 5.3-2 and 5.3-3 are generic curves for AP1000 reactor vessel design, and they are the limiting curves based on copper and nickel material composition. Plant-specific curves will be developed based on material composition of copper and nickel. Use of plant-specific curves will be addressed during procurement and fabrication of the reactor vessel. As noted in the bases to Technical Specification 3.4.14, use of plant-specific curves requires evaluation of the LTOP ~~system~~ analysis. This includes an evaluation of the setpoint ~~pressure~~ pressures for the RNS relief ~~valve~~ valves to determine if the setpoint ~~pressure needs~~ pressures need to be changed based on the plant-specific pressure-temperature curves. The development of the plant-specific curves and evaluation of the setpoint ~~pressure~~ pressures are required prior to fuel load.

* * *

---

**Revise UFSAR Tier 2 Subsection 5.4.7.2, tenth paragraph, as shown below, to change "valve" to "valves," change verb usage, identify two valves instead of one, and remove "safety" from description of relief valves.**

### 5.4.7.2 System Description

* * *

~~One safety relief valve is~~ Two relief valves are located on the normal residual heat removal system suction header inside containment. ~~This valve provides~~ These valves provide low temperature overpressure protection of the reactor coolant system. Subsection 5.4.9 describes the sizing basis of ~~this valve~~ these valves. Another ~~safety~~ relief valve outside of containment provides protection against excess pressure for the piping and components.

* * *

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**Revise UFSAR Tier 2 Subsection 5.4.7.2.2, Design Features Addressing Intersystem LOCA, in the paragraph describing Normal Residual Heat Removal System Relief Valve, as shown below, to change "valve" to "valves" and change verb usage.**

**Normal Residual Heat Removal System Relief ~~Valve~~ Valves** - The inside containment AP1000 normal residual heat removal system relief ~~valve is~~ valves are connected to the residual heat removal pump suction line. ~~This valve is~~ These valves are designed to provide low-temperature overpressure protection of the reactor coolant system as described in Subsection 5.2.2. ~~It is~~ They are connected to the high pressure portion of the pump suction line and reduces the risk of overpressurizing the low pressure portions of the system.

**Revise UFSAR Tier 2 Subsection 5.4.7.6.1.1, Valve Inspection and Testing, second paragraph, as shown below, to add RNS relief valve, RNS-PL-V020, change "line" to "lines," change "valve" to "valves," revise verb usage, and revise grammar to identify there are two relief valves.**

#### 5.4.7.6.1.1 Valve Inspection and Testing

* * *

The low temperature overpressure protection relief ~~valve,~~ valves, RNS-V020 and RNS-V021, located on the normal residual heat removal system suction relief ~~line, is~~ lines, are bench tested with water. ~~Valve~~ Each valve's set pressure is verified to be less than or equal to the value assumed in the low temperature overpressure protection analysis. Relieving capacity of ~~the~~ each valve is certified in accordance with the ASME code, Section III, NC-7000.

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**Revise UFSAR Tier 2 Subsection 5.4.9, Reactor Coolant System Pressure Relief Devices, first paragraph, as shown below, to change "valve" to "valves" and change verb usage.**

#### 5.4.9 Reactor Coolant System Pressure Relief Devices

Safety valves connected to the pressurizer provide overpressure protection for the reactor coolant system during power operation. The relief ~~valve~~ valves on the suction line of the normal residual heat removal system (RNS) ~~provides~~ provide low temperature overpressure protection consistent with the guidelines of NRC Branch Technical Position RSB 5-2. The following discusses the requirements for the valves. Sizing of the safety and relief valves is discussed in Subsection 5.2.2.

* * *

---

**Revise UFSAR Tier 2 Subsection 5.4.9.1 Design Bases, first and second paragraphs, as shown below, to change "valve" to "valves," change "safety" to "relief" valve, and change "both" to "one or both" to describe makeup pump flow.**

#### 5.4.9.1 Design Bases

The combined capacity of the pressurizer safety valves can accommodate the maximum pressurizer surge resulting from complete loss of load. The ~~safety valve~~ relief valves on the suction line of the normal residual heat removal system can accommodate the flow from one or both makeup pumps with no letdown and a water-solid reactor coolant system during low-temperature modes. Table 5.4-17 gives design parameters for the pressurizer safety valves and the residual heat removal system relief ~~valve~~ valves.

Use of the pressurizer safety valves and the normal residual heat removal relief ~~valve~~ valves at elevated temperatures in post-accident environments is not anticipated.

**Revise UFSAR Tier 2 Subsection 5.4.9.2 Design Description, first, third, and fourth paragraphs, as shown below, to change “valve” to “valves,” change verb usage, and identify where leakage is directed.**

### 5.4.9.2 Design Description

The pressurizer safety valves and the normal residual heat removal system relief ~~valve~~ valves are spring loaded, self-actuated by direct fluid pressure, and have backpressure compensation features. These valves are designed to reclose and prevent further flow of fluid after normal conditions have been restored. The pressurizer safety valves are of the totally enclosed pop type. The normal residual heat removal relief ~~valve is~~ valves are designed for water relief.

* * *

The relief ~~valve~~ valves in the normal residual heat removal system ~~is~~ are located between the suction line of the pump and the valve that isolates the residual heat removal system from the reactor coolant system. The discharge from ~~that valve~~ the valves is directed to the containment ~~atmosphere~~ sump. Subsection 5.4.7 discusses the residual heat removal system. Figure 5.4-6 shows a simplified sketch of the normal residual heat removal system.

In accordance with the requirements of 10 CFR 50.34(f)(2)(xi), positive position indication is provided for the pressurizer safety valves and the normal residual heat removal system relief ~~valve~~ valves, which provide overpressure protection for the reactor coolant pressure boundary.

* * *

**Revise UFSAR Tier 2 Subsection 5.4.9.3, Design Evaluation, first and fourth paragraphs, as shown below, to change "valve" to "valves," change verb usage, and change "pressure" to "pressures."**

### 5.4.9.3 Design Evaluation

The pressurizer safety valves prevent reactor coolant system pressure from exceeding 110 percent of system design pressure, in compliance with the ASME Code, Section III. The relief ~~valve~~ valves on the suction line of the normal residual heat removal system ~~protects~~ protect that system from exceeding 110 percent of the design pressure of the system and from exceeding the pressure-temperature limits determined from ASME Code, Appendix G, analyses.

* * *

The relief ~~valve~~ valves on the normal residual heat removal system ~~has~~ have an accumulation of 10 percent of the set pressure. The set ~~pressure is~~ pressures are the lower of the pressure based on the design pressure of the residual heat removal system and the pressure based on the reactor vessel low temperature pressure limit. The pressure limit determined based on the design pressure includes the effect of the pressure rise across the pump. The set ~~pressure~~ pressures in Table 5.4-17 ~~is~~ are based on the reactor vessel low temperature pressure limit. The lowest permissible set pressure is based on the required net positive suction head for the reactor coolant pump.

---

**Revise UFSAR Tier 2 Subsection 5.4.9.4 Tests and Inspections, second paragraph, as shown below, to change "valve" to "valves," change verb usage, and change grammar to identify there are two relief devices, each with a set pressure less than RCS design pressure.**

### 5.4.9.4 Tests and Inspections

* * *

Safety valves similar to those connected to the pressurizer have been tested within the Electric Power Research Institute (EPRI) safety and relief valve test program. Capacity data for the specific AP1000 safety valve size has been correlated with the EPRI test data to demonstrate that the valve is adequate for steam flow and water flow, even though water flow is not anticipated through the pressurizer safety valves. The completion of this program addresses the requirements of 10 CFR 50.34(f)(2)(x) as related to reactor coolant system relief and safety valve testing. The normal residual heat removal system relief ~~valve is~~ valves are designed for water relief and ~~is~~ are not ~~a~~ reactor coolant system pressure relief devices since ~~it~~ each valve has a set pressure less than reactor coolant system design pressure. Therefore, the valves selected for the normal residual heat removal system relief ~~valve is~~ valves are independent from the Electric Power Research Institute safety and relief valve test program.

* * *

**Revise UFSAR Tier 2 Subsection 5.4.11 Pressurizer Relief Discharge, fifth paragraph, as shown below, to change "safety valve" to "relief valves," change "atmosphere" to "sump," and change verb usage.**

### 5.4.11 Pressurizer Relief Discharge

* * *

The ~~safety valve~~ relief valves on the normal residual heat removal system, which ~~provides~~ provide low temperature overpressure protection, ~~discharges~~ discharge into the containment ~~atmosphere~~ sump. See Subsection 5.4.7 for a discussion of the connections to and location of the ~~safety valve~~ relief valves in the normal residual heat removal system.

* * *

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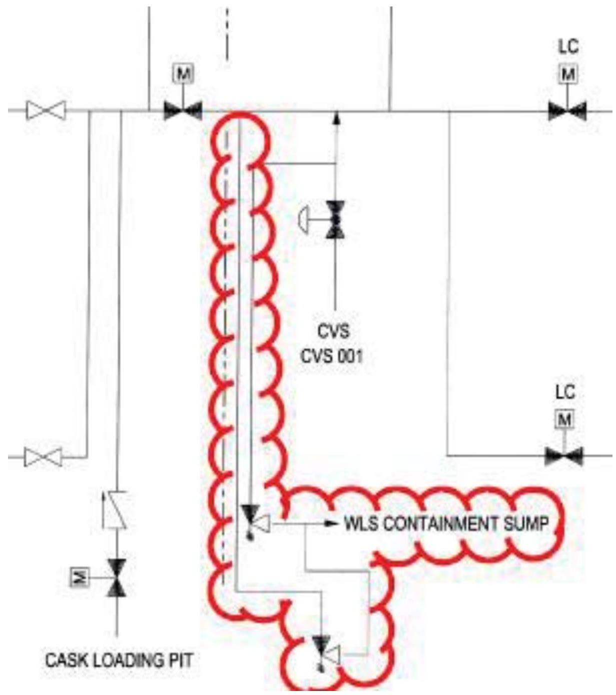
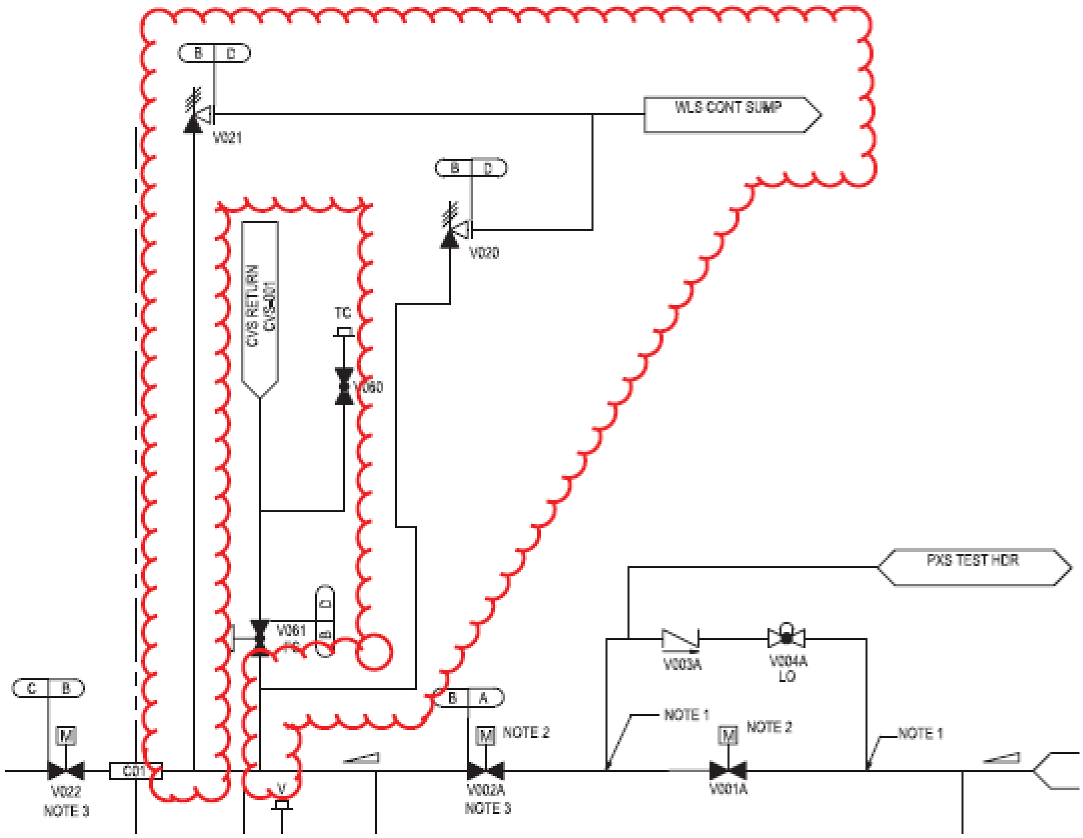
**Revise UFSAR Tier 2 Table 5.4-17 Pressurizer Safety Valves – Design Parameters, as shown below, to incorporate design parameters for RNS-PL-V020.**

| * * * | |
|---|---|
| **Residual Heat Removal Relief Valve - Design Parameters** | |
| Number | ~~1~~ 2 |
| Nominal relieving capacity per valve, ASME flowrate (gpm) | 850/50 |
| Nominal set pressure (psig) | 500*/470* |
| Full-open pressure, with accumulation (psig) | 550*/517* |
| Design temperature (°F) | 400 |
| * * * | |

**Revise UFSAR Tier 2 Figure 5.4-6, Normal Residual Heat Removal System, as shown in the excerpt below, to add second RNS relief valve that discharges to the containment atmosphere.**



**Revise UFSAR Tier 2 Figure 5.4-7 Simplified Normal Residual Heat Removal System Piping and Instrument Diagram, as shown in the excerpt below, to add RNS relief valve, RNS-PL-V020, and reconfigure piping.**



**Revise UFSAR Tier 2 Table 6.2.3-1 Containment Mechanical Penetrations and Isolation Valves, as shown in the excerpt below, to add RNS-PL-V020 and associated table parameters.**

| | Containment Penetration | | | Isolation Device | | | | | | Test | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **System** | **Line** | **Flow** | **Closed Sys IRC** | **Valve/Hatch Identification** | **Pipe Length** | **DCD Subsection** | **Position N-S-A** | **Signal** | **Closure Times** | **Type[1] & Note** | **Medium** | **Direction** |
| * * * | | | | | | | | | | | | |
| RNS | RCS to RHR pump | Out | No | RNS-PL-V002A/B | - | 5.4.7 | C-O-C | HR, S | std. | C | Air | Forward |
| | | | | RNS-PL-V023 | - | 5.4.7 | C-O-C | HR, S | std. | C | | Forward |
| | | | | RNS-PL-V022 | 42 | 5.4.7 | C-O-C | HR, S | std. | C,4 | | Forward |
| | | | | RNS-PL-V020 | - | 5.4.7 | C-C-C | None | N/A | C | | Forward |
| | | | | RNS-PL-V021 | - | 5.4.7 | C-C-C | None | N/A | C | | Forward |
| | | | | RNS-PL-V061 | - | 5.4.7 | C-O-C | T | std. | C | | Forward |
| | | | | PXS-PL-V208A | - | 6.3 | C-C-C | None | N/A | C | | Forward |
| | RHR pump to RCS | In | No | RNS-PL-V011 | 25 | 5.4.7 | C-O-C | HR, S | Std. | C,4 | Air | Forward |
| | | | | RNS-PL-V012 | - | | C-C-C (11) | None | N/A | | | |
| | | | | RNS-PL-V013 | | | C-O-C | None | N/A | | | |
| * * * | | | | | | | | | | | | |

**Revise UFSAR Tier 2 Subsection 6.3.3.4.2, Loss of Normal Residual Heat Removal Cooling With The Reactor Coolant System Pressure Boundary Intact, fourth paragraph, as shown below, to change "the normal residual heat removal system relief valve" to "one or both of the normal residual heat removal system relief valves," change "core make tanks" to "core makeup tanks," and make grammatical and editorial changes accordingly.**

### 6.3.3.4.2 Loss of Normal Residual Heat Removal Cooling With The Reactor Coolant System Pressure Boundary Intact

* * *

The normal residual heat removal system is operated once the reactor coolant system temperature is too low to support sufficient steam production for decay heat removal. With a loss of shutdown cooling, the reactor coolant system temperature does not increase sufficiently to initiate steam generator steaming and to reduce steam generator level. This is because the steam generators are normally filled, with a nitrogen purge established, during shutdown conditions. The loss of cooling would result in the heat up of the reactor coolant system and a pressure increase resulting in one or both of the normal residual heat removal system relief ~~valve~~ valves opening. This loss of fluid would result in a decrease in the pressurizer level; ~~which~~ a low pressurizer level signal automatically actuates the core makeup tanks and the passive residual heat removal heat exchanger. The passive residual heat removal heat exchanger could also be manually actuated.

* * *

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**Revise UFSAR Tier 2 Subsection 14.2.9.2.4, Normal Residual Heat Removal System Testing, bullet "g" under the heading "General Test Acceptance Criteria and Methods," as shown below, to change "valve" to "valves" and change grammar accordingly.**

### 14.2.9.2.4 Normal Residual Heat Removal System Testing

**General Test Acceptance Criteria and Methods**

* * *

g) Operation of the normal residual heat removal system relief ~~valve which provides~~ valves which provide low temperature overpressure protection for the reactor coolant system is verified by the performance of baseline in-service testing, as specified in Subsection 3.9.6. The acceptance criteria are based on the valve performance criteria specified in Subsection 5.4.9.

* * *

**Revise UFSAR Tier 2 Table 19.59-18, AP1000 PRA-Based Insights, Item 82, as shown in the excerpt below, to change "valve" to "valves."**

| Insight | Disposition |
|---|---|
| * * * | * * * |
| 82. It is important to maintain the low-temperature overpressure protection provided by the RNS relief ~~valve~~ valves to ensure that the reactor vessel pressure and temperature limits are not exceeded during shutdown conditions. Isolation of the RNS and its relief ~~valve~~ valves is permitted during shutdown conditions in case the hot legs empty due to a loss of RCS inventory; if the RNS is isolated, an alternate vent path would be opened, such as the ADS Stage 1, 2, and 3 valves. | 16.1 (LCO Basis 3.4.14) |
| * * * | |

**Revise UFSAR Tier 2 Subsection 19E.2.2.2.3, Steam Generator Cooling in Shutdown Modes, first paragraph, as shown below, to change "valve" to "valves" and change "setpoint" to "setpoints."**

### 19E.2.2.2.3 Steam Generator Cooling in Shutdown Modes

The secondary side of the steam generators can be recirculated during shutdown by circulating their contents through the blowdown system to promote heat transfer from the steam generators to the primary system. This feature reduces the challenges to low-temperature overpressure events. During RCS water-solid operation, heat input from the steam generators is capable of challenging the low-temperature relief ~~valve~~ valves. The Technical Specifications prevent the operators from starting an RCP with the steam generator secondary side temperature more than 50°F higher than the primary side, with the pressurizer water-solid. With the RCS water-solid, the heat input that could occur would cause the system to be pressurized to the ~~setpoint~~ setpoints of the low-temperature overpressure relief ~~valve~~ valves in the RNS.

* * *

**Revise UFSAR Tier 2 Subsection 19E.2.4.2.7, Normal Residual Heat Removal System Relief Valve, as shown below, to change "valve" to "valves" and change verb usage.**

### 19E.2.4.2.7 Normal Residual Heat Removal System Relief Valve

The inside containment RNS relief ~~valve is~~ valves are connected to the residual heat removal pump suction line. ~~This valve is~~ These valves are designed to provide low-temperature, overpressure protection of the RCS as described in Subsection 5.2.2. The ~~valve,~~ valves, connected to the high-pressure portion of the pump suction line, ~~reduces~~ reduce the risk of overpressurizing the low-pressure portions of the system.

---

**Revise UFSAR Tier 2 Subsection 19E.3.1.3.1, General Shutdown, third bullet, as shown below, to change "setpoint" to "setpoints."**

### 19E.3.1.3.1 General Shutdown

Precautions and limitations for general shutdown are as follows:

* * *

- When the RNS is in operation, the reactor coolant temperature should not exceed 350°F. The reactor coolant pressure should be limited to avoid approaching the RNS relief valve ~~setpoint~~ setpoints.

* * *

**Revise UFSAR Tier 2 Subsection 19E.4.6, Increase in Reactor Coolant Inventory, fifth paragraph, as shown below, to change "valve" to "valves."**

### 19E.4.6 Increase in Reactor Coolant Inventory

* * *

Isolation of CVS on high-2 pressurizer level is available in Modes 1 through 4 until the plant is operating on RNS. There are applications where the RCS may be filled water-solid when the RNS is in operation. In Modes 4, 5, and 6 when the RNS is in operation, low-temperature overpressure protection (LTOP) of the RCS pressure boundary is provided by the RNS relief ~~valve~~ valves. A discussion of this is provided in Subsection 19E.4.10.1 of this appendix.

---

**Revise UFSAR Tier 2 Subsection 19E.4.10.1, Low Temperature Overpressure Protection, as shown below, to change "valve" to "valves" and change verb usage.**

### 19E.4.10.1 Low Temperature Overpressure Protection

For the AP1000, the normal residual heat removal system (RNS) suction relief ~~valve is~~ valves are located immediately downstream of the RCS suction isolation valves. ~~This relief valve protects~~ These relief valves protect the RNS from overpressurization and ~~provides~~ provide low temperature overpressure protection (LTOP) for the RCS components when the RNS is aligned to the RCS to provide decay heat removal during plant shutdown and startup operations. The RNS relief ~~valve is~~ valves are sized to provide LTOP by limiting the RCS and RNS pressure to less than the 10 CFR 50 Appendix G (Reference 13) steady-state pressure limit. Subsection 5.2.2 provides a discussion of the AP1000 low temperature overpressure protection design bases.

**Southern Nuclear Operating Company**

**ND-17-1085**

**Enclosure 4**

**Vogtle Electric Generating Plant (VEGP) Units 3 and 4**

**Conforming Technical Specification Bases Changes**

**(For Information Only)**

**(LAR-17 -022)**

**Insertions Denoted by Blue Underline and Deletions by ~~Red~~ Strikethrough**
**Omitted text is identified by three asterisks ( * * * )**

(This Enclosure consists of 11 pages, including this cover page.)

B 3.4 REACTOR COOLANT SYSTEM (RCS)

B 3.4.14 Low Temperature Overpressure Protection (LTOP)

BASES

BACKGROUND

LTOP limits RCS pressure at low temperatures so that the integrity of the reactor coolant pressure boundary (RCPB) is not compromised by violating the pressure and temperature (P/T) limits of 10 CFR 50, Appendix G (Ref. 1). The reactor vessel is the limiting RCPB component for demonstrating such protection. The PTLR provides the limits which set the maximum allowable setpoints for the Normal Residual Heat Removal System (RNS) suction relief valves, RNS-PL-V020 (1 inch) and RNS-PL-V021 (3 inch). LCO 3.4.3 provides the maximum RCS pressure for the existing RCS cold leg temperature during cooldown, shutdown, and heatup to meet the Reference 1 requirements during the LTOP MODES.

The reactor vessel material is less tough at low temperatures than at normal operating temperature. As the vessel neutron exposure accumulates, the material toughness decreases and becomes less resistant to pressure stress at low temperatures (Ref. 2). RCS pressure, therefore, is maintained low at low temperatures and is increased only as temperature is increased.

The potential for vessel overpressurization is most acute when the RCS is water solid, occurring only while shutdown; a pressure fluctuation can occur more quickly than an operator can react to relieve the condition. Exceeding the RCS P/T limits by a significant amount could cause brittle cracking of the reactor vessel. LCO 3.4.3, “RCS Pressure and Temperature (P/T) Limits,” requires administrative control of RCS pressure and temperature during heatup and cooldown to prevent exceeding the PTLR limits.

This LCO provides RCS overpressure protection by having a maximum coolant input capability and having adequate pressure relief capacity. Limiting coolant input capability requires isolating the accumulators and closing CVS makeup line containment isolation valve, CVS-PL-V091. The pressure relief capacity requires the RNS suction relief valves or a depressurized RCS and an RCS vent of sufficient size. The RNS suction relief valves or the open RCS vent is the overpressure protection device that acts to terminate an increasing pressure event.

RNS Suction Relief Valve Requirements

During the LTOP MODES, the RNS system is operated for decay heat removal. Therefore, the RNS suction isolation valves are open in the

BASES

BACKGROUND (continued)

piping from the RCS hot legs to the inlet of the RNS system. While these valves are open, the RNS suction relief valves are ~~is~~ exposed to the RCS and able to relieve pressure transients in the RCS.

The RNS suction relief valves are ~~is a~~ spring loaded, water relief valves with a pressure tolerance and an accumulation limit established by Section III of the American Society of Mechanical Engineers (ASME) Code (Ref. 3) for Class 2 relief valves.

The RNS suction isolation valves must be open to make the RNS suction relief valves OPERABLE for RCS overpressure mitigation.

RCS Vent Requirements

Once the RCS is depressurized, a vent exposed to the containment atmosphere will maintain the RCS at containment ambient pressure in an RCS overpressure transient, if the relieving requirements of the transient do not exceed the capabilities of the vent. Thus, the vent path must be capable of relieving the flow resulting from the limiting LTOP mass or heat input transient, and maintaining pressure below the P/T limits. The required vent capacity may be provided by one or more vent paths.

For an RCS vent to meet the flow capacity requirement, it may require removing one or more pressurizer safety valves or manually opening one or more Automatic Depressurization System (ADS) valves. The vent path(s) must be above the level of reactor coolant, so as not to drain the RCS when open.

---

APPLICABLE SAFETY ANALYSES

Safety analyses (Ref. 4) demonstrate that the reactor vessel is adequately protected against exceeding the Reference 1 P/T limits. In MODES 1, 2, and 3, and in MODE 4 with the RCS temperature above 275°F, the pressurizer safety valves will prevent RCS pressure from exceeding the Reference 1 limits. When the RNS is aligned and open to the RCS, overpressure protection is provided by the RNS suction relief valves, or a depressurized RCS and a sufficiently sized open RCS vent.

The actual temperature at which the pressure in the P/T limit curve falls below the suction relief setpoint increases as the reactor vessel material toughness decreases due to neutron embrittlement. Each time the PTLR curves are revised, LTOP must be re-evaluated to ensure its functional requirements can still be met using the RNS suction relief valves, or the depressurized and vented RCS condition.

BASES

APPLICABLE SAFETY ANALYSES (continued)

The PTLR contains the acceptance limits that define the LTOP requirements. Any change to the RCS must be evaluated against the Reference 4 analyses to determine the impact of the change on the LTOP acceptance limits.

Transients that are capable of overpressurizing the RCS are categorized as either mass or heat input transients. The events listed below were used in the analysis to size the RNS suction relief valves. Therefore, any events with a mass or heat input greater than the listed events cannot be accommodated and must be prevented.

Mass Input

a. Makeup water flow rate to the RCS assuming one or both CVS makeup pumps are in operation and letdown is isolated.

Heat Input

a. Restart of one reactor coolant pump (RCP) with water in the steam generator secondary side 50°F hotter than the primary side water, and the RCS water solid.

RNS Suction Relief Valve Performance

Since each of the RNS suction relief valves do ~~does~~ not have a variable P/T lift setpoint, the analysis must show that with chosen setpoint, the relief valves will pass flow greater than that required for the limiting LTOP transient while maintaining RCS pressure less than the lowest of either the P/T limit curve, 110% of the design pressure of the normal residual heat removal system, or the acceptable RNS relief valve inlet pressure. ~~The current analysis shows that up to a temperature of 70°F, the mass input transient is limiting, and above this temperature the heat input transient is limiting.~~

When the RCS is aligned to the RNS with RNS suction relief valves OPERABLE, Chemical and Volume Control System (CVS) valve, CVS-PL-V091, is closed to limit the flow rate to the capacity of the smaller RNS suction relief valve by directing flow to CVS flow-restricting orifice, CVS-PY-R10. During a mass input transient, the smaller RNS suction relief valve will lift at its lift setting and the larger RNS suction relief valve will remain closed. If the pressure exceeds the capacity of the smaller RNS suction relief valve, the larger RNS suction relief valve will open.

APPLICABLE SAFETY ANALYSES (continued)

During a heat input transient, the larger RNS suction relief valve is relied upon for overpressure protection and the smaller RNS suction relief valve opens to provide reliability and reduce potential chattering in the larger valve. The heat input transient is limiting when the RNS suction relief valves are relied upon for overpressure protection.

To prevent the possibility of a heat input transient, and thereby limit the required flow rate of the RNS suction relief valves, administrative requirements in the LCO note have been imposed for starting an RCP.

RCS Vent Performance

With the RCS depressurized, a vent size of 4.15 square inches is capable of mitigating a limiting overpressure transient. The area of the vent is equivalent to the area of the inlet pipe to the larger RNS suction relief valve so the capacity of the vent is greater than the flow possible with either the mass or heat input transient, while maintaining the RCS pressure less than the lower of either the maximum pressure on the P/T limit curve or 110% percent of the design pressure of the normal residual heat removal system. When an RCS vent of ≥ 4.15 square inches is established, CVS-PL-V091 may be opened.

The required vent area may be obtained by opening one ADS Stage 2, 3, or 4 flow path.

The RCS vent size will be reevaluated for compliance each time the P/T limit curves are revised based on the results of the vessel material surveillance.

The RCS vent is passive and is not subject to active failure.

LTOP satisfies Criterion 2 of 10 CFR 50.36(c)(2)(ii).

LCO

This LCO requires that LTOP is OPERABLE. LTOP is OPERABLE when the maximum coolant input and minimum pressure relief capabilities are OPERABLE. Violation of this LCO could lead to the loss of low temperature overpressure mitigation and violation of the Reference 1 limits as a result of an operational transient.

To limit the coolant input capability, the LCO requires all accumulator discharge isolation valves closed and immobilized, when accumulator pressure is greater than or equal to the maximum RCS pressure for the existing RCS temperature allowed in the PTLR.

LCO (continued)

The elements of the LCO that provide low temperature overpressure mitigation through pressure relief are one of the following:

a. ~~One~~Two OPERABLE RNS suction relief valves.

   An RNS suction relief valve is OPERABLE for LTOP when both RNS suction isolation valves in one flow path are open, its setpoint is set within the ~~PTLR (Reference 6)~~ Inservice Testing Program limits, and testing has proven its ability to open at this setpoint. Additionally, CVS-PL-V091 is closed to limit the flow rate to within the relieving capacity of the smaller RNS suction relief valve when the RNS suction relief valves are OPERABLE; or

b. A depressurized RCS and an RCS vent path is open with an area of ≥ 4.15 square inches.

Each of these methods of overpressure prevention is capable of mitigating the limiting LTOP transient.

Note 1 prohibits startup of an RCP when the RCS temperature is ≥ 350°F unless pressurizer level is < 92%. This restraint is to prevent a low temperature overpressure event due to a thermal transient when an RCP is started.

Note 2 requires that the secondary side water temperature of each SG be ≤ 50°F above each of the RCS cold leg temperatures before the start of an RCP with any RCS cold leg temperature ≤ 350°F, and the RCP must be started at ≤ 25% of RCP speed. This restraint is to prevent a low temperature overpressure event due to a thermal transient when an RCP is started. This limitation also helps to ensure that the RNS system pressure remains below both the piping design pressure and the acceptable RNS relief valve inlet pressure.

Note 3 provides that accumulator isolation is only required when the accumulator pressure is more than or at the maximum RCS pressure for the existing temperature, as allowed by the P/T limit curves. This Note permits the accumulator discharge isolation valve Surveillance to be performed only under these pressure and temperature conditions.

APPLICABILITY

This LCO is applicable in MODE 4 when any cold leg temperature is below 275°F, MODE 5, and in MODE 6 when the reactor vessel head is on. The pressurizer safety valves provide overpressure protection that meets the Reference 1 P/T limits above 275°F. In MODE 6 with the reactor vessel head off an overpressurization cannot occur.

APPLICABILITY (continued)

LCO 3.4.3 provides the operational P/T limits for all MODES. LCO 3.4.6, “Pressurizer Safety Valves,” requires the OPERABILITY of the pressurizer safety valves that provide overpressure protection during MODES 1, 2, and 3, and MODE 4 with the RNS isolated or RCS temperature ≥ 275°F.

Low temperature overpressure prevention is most critical during shutdown when the RCS is water solid, and a mass or heat input transient can cause a very rapid increase in RCS pressure with little or no time for operator action to mitigate the event.

ACTIONS

A.1~~, B.1, and B.2~~

An unisolated accumulator requires isolation within 1 hour. This is only required when the accumulator pressure is at or more than the maximum RCS pressure for the existing temperature allowed by the P/T limit curves.

The Completion Time is based on operating experience that this activity can be accomplished in this time period and on engineering evaluations indicating that an event requiring LTOP is not likely in the allowed time.

B.1

CVS makeup line containment isolation valve, CVS-PL-V091, requires closure within 1 hour. Condition B is modified by a Note stating that the Action is only applicable when an RCS vent of ≥ 4.15 square inches is not established.

The Completion Time is based on operating experience that this activity can be accomplished in this time period and on engineering evaluations indicating that an event requiring LTOP is not likely in the allowed time.

C.1 and C.2

If isolation is needed and cannot be accomplished in 1 hour, Required Action ~~B~~C.1 and Required Action ~~B~~C.2 provide two options, either of which must be performed in the next 12 hours. By increasing the RCS temperature to > 275°F, the accumulator pressure cannot exceed the

ACTIONS (continued)

LTOP limits if the accumulators are fully injected. Depressurizing the accumulators below the LTOP limit from the PTLR also gives this protection.

The Completion Times are based on operating experience that these activities can be accomplished in these time periods and on engineering evaluations indicating that an event requiring LTOP is not likely in the allowed times.

~~C~~D.1 and ~~C~~D.2

If the RNS suction relief valves are ~~is~~ inoperable and the RCS is not depressurized, there is a potential to overpressurize the RCS and exceed the limits allowed in LCO 3.4.3. The suction relief valves are ~~is~~ considered inoperable if the RNS isolation valves have isolated the RNS from the RCS in such a way that the suction relief valves cannot perform their ~~its~~ intended safety function, or if the valves themselves ~~itself~~ will not operate to perform their ~~its~~ intended safety function. If the RCS is depressurized but the RCS vent path does not provide a flow area sufficient to mitigate any of the design low temperature overpressure events and the RNS suction relief valves are ~~is~~ inoperable, there is a potential to overpressurize the RCS and exceed the limits allowed in LCO 3.4.3. The RCS vent path is considered inoperable if the area of the vent is not equivalent to the area of the inlet pipe to the larger RNS suction relief valve.

Under these conditions, Required Action ~~C~~D.1 or ~~C~~D.2 provide two options, either of which must be accomplished in 12 hours. If the RNS suction relief valves cannot be restored to OPERABLE status, the RCS must be depressurized and vented with a RCS vent which provides a flow area sufficient to mitigate any of the design low temperature overpressure events.

The 12 hour Completion Time represents a reasonable time to repair the relief valves, open the RNS isolation valves or otherwise restore the LTOP to OPERABLE status, or depressurize and vent the RCS, without imposing a lengthy period when the LTOP is not able to mitigate a low temperature overpressure event.

SURVEILLANCE REQUIREMENTS

SR 3.4.14.1

To minimize the potential for a low temperature overpressure event by limiting the mass input capability, the accumulator discharge isolation valves are verified closed and locked out. The Frequency of 12 hours is sufficient considering other indications and alarms available to the operator in the main control room to verify the required status of the equipment.

SR 3.4.14.1 is modified by a Note stating that accumulator isolation is only required when the accumulator pressure is more than or at the maximum RCS pressure for the existing temperature, as allowed by the P/T limit curves. This Note requires the accumulator discharge isolation valve Surveillance to be met only under these pressure and temperature conditions.

SR 3.4.14.2

The RNS suction relief valves shall be demonstrated OPERABLE by verifying two RNS suction isolation valves in one flow path are open. This Surveillance is only performed if the RNS suction relief valves are ~~is~~ being used to satisfy this LCO.

The RNS suction isolation valves are verified to be opened every 12 hours. The Frequency is considered adequate in view of other administrative controls such as valve status indications available to the operator in the control room that verify the RNS suction isolation valves remain open. This Surveillance is required to be met if the RNS suction relief valves are ~~is~~ being used to satisfy the pressure relief requirements of LCO 3.4.14.a.

SR 3.4.14.3

To minimize the potential for a low temperature overpressure event when the RNS suction relief valves are OPERABLE, the flow from the CVS is limited to the capacity of the smaller RNS suction relief valve. The CVS makeup line containment isolation valve, CVS-PL-V091, is closed to limit CVS mass and heat injection flow to the CVS flow-restricting orifice, CVS-PY-R10. The Frequency of 12 hours is sufficient considering other indications and alarms available to the operator in the main control room to verify the required status of the equipment. This Surveillance is required to be met if the RNS suction relief valves are being used to satisfy the pressure relief requirements of LCO 3.4.14.a.

BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.4.14.~~3~~4

The RCS vent of ≥ 4.15 square inches is verified open either:

a. Once every 12 hours for a valve that is not locked (valves that are sealed or secured in the open position are considered "locked" in this context) or

b. Once every 31 days for other vent path(s) (e.g., a vent valve that is locked, sealed, or secured in position or a removed pressurizer safety valve or open manway also fits this category).

This Surveillance is modified by a Note that states it is only required to be met if the vent is being used to satisfy the pressure relief requirements of the LCO 3.4.14.b.

SR 3.4.14.~~4~~5

The RNS suction relief valves shall be demonstrated OPERABLE by verifying that two RNS suction isolation valves in one flow path are open and by testing them ~~it~~ in accordance with the Inservice Testing Program. (Refer to SR 3.4.14.2 for the RNS suction isolation valve Surveillance.) This Surveillance is only required to be performed if the RNS suction relief valves are ~~is~~ being used to meet this LCO. The ASME OM Code (Ref. 5) test per Inservice Testing Program verifies OPERABILITY by proving proper relief valve mechanical motion and by measuring and, if required, adjusting the lift setpoint. This Surveillance is required to be met if the RNS suction relief valves are ~~is~~ being used to satisfy the pressure relief requirements of LCO 3.4.14.a.

REFERENCES

1. Title 10, Code of Federal Regulations, Part 50, Appendix G, "Fracture Toughness Requirements."

2. Generic Letter 88-11, "NRC Position on Radiation Embrittlement of Reactor Vessel Materials and Its Impact on Plant Operation."

3. ASME Boiler and Pressure Vessel Code, Section III.

4. FSAR Section 5.2.2, "Overpressure Protection."

5. ASME OM Code, "Code for Operation and Maintenance of Nuclear Power Plants."

BASES

REFERENCES (continued)

6. APP-RXS-Z0R-001, Revision 2, “AP1000 Generic Pressure Temperature Limits Report,” F. C. Gift, September 2008.

**Southern Nuclear Operating Company**

**ND-17-1085**

**Enclosure 5**

**Vogtle Electric Generating Plant (VEGP) Units 3 and 4**

**WCAP-15993**

**Evaluation of the AP1000 Conformance to Inter-System Loss-of-Coolant Accident Acceptance Criteria**

**Revision 2**

**(LAR-17-022)**

(Enclosure 5 consists of 32 pages, plus this cover page.)

WCAP-15993
Revision 2

June 2017

# Evaluation of the AP1000 Conformance to Inter-System Loss-of-Coolant Accident Acceptance Criteria

**WCAP-15993**
**Revision 2**

# Evaluation of the AP1000 Conformance to Inter-System Loss-of-Coolant Accident Acceptance Criteria

**A. L. Stanish**

**June 2017**

**AP1000 Document: APP-GW-GLR-002, Revision 2**

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# 1 INTRODUCTION

## 1.1 BACKGROUND

In conducting studies directed at finding vulnerabilities of pressurized water reactor (PWR) plants to inter-system loss-of-coolant accidents (ISLOCAs), the Nuclear Regulatory Commission (NRC) staff concluded that the core damage frequency caused by ISLOCAs could be substantially greater than previous Probabilistic Risk Assessment (PRA) estimates.[(1)] In NRC Information Notice 92-36 (Reference 1), the NRC staff indicated that these PRAs have typically been limited to modeling ISLOCA sequences that include only the catastrophic failures of check valves that isolate the Reactor Coolant System (RCS) from low-pressure systems. Also, the PRAs included little consideration of human errors leading to an ISLOCA and the effects of the accident-caused harsh environment or flooding on plant equipment and recovery activities.

The results of these NRC studies have suggested that ISLOCA precursors most likely would be initiated by human errors or because of procedural deficiencies. This may be attributed to the general lack of awareness of the possibility or consequences of an ISLOCA.

The NRC has developed a position on design requirements necessary to minimize the potential for ISLOCAs. The staff position is addressed in numerous NRC documents, including References 1 through 7. Westinghouse has evaluated the AP1000 design and concludes that it complies with the stated NRC position.

## 1.2 OBJECTIVE

The purpose of this report is to perform a systematic evaluation of the systems that interface with the RCS and to demonstrate that the design of the systems meets the ISLOCA acceptance criteria, which are described in section 2.2 of this report.

## 1.3 SCOPE

The scope of this evaluation is applicable to the AP1000 systems and subsystems that interface directly or indirectly with the RCS and are susceptible to ISLOCA challenges.

1. AP1000 PRA results show that ISLOCAs provide only a minor contribution to core damage frequency. In current calculations, this contribution accounts for approximately 5.0E-11 per reactor year, which is less than one-tenth of one percent of the overall AP1000 core damage frequency at-power, calculated to be approximately 2.4E-7 per reactor year.

# 2 DESIGN REQUIREMENTS AND APPROACH

## 2.1 ISLOCA DEFINITION

An ISLOCA is defined in NRC Information Notice 92-36 (Reference 1) as a class of events in which a break occurs outside containment in a system connected to the RCS, causing a loss of primary system inventory outside containment. This is interpreted as a beyond-design-basis event for systems connected directly or indirectly to the RCS. The pressurization pathway can be established by an inadvertent opening of a valve or valves, a failure of containment isolation, or the postulation that valves are fully open (for example, check valves). This interpretation is believed to address all sources that may challenge low-pressure systems. Based on this definition of an ISLOCA, an evaluation was performed to assess the ability of the AP1000 design to withstand an overpressure event.

## 2.2 ISLOCA ACCEPTANCE CRITERIA

The design of systems that interface with the RCS is evaluated against acceptance criteria consistent with the following NRC guidance provided in SECY-90-016 (Reference 5).

- All systems and subsystems connected to the RCS are to be designed to withstand the full RCS pressure to the extent practicable.

- Systems that are not designed to full RCS pressure should include:

  - the capability for leak-testing of the pressure isolation valves

  - valve position indication that is available in the control room when isolation valve operators are deenergized, and

  - a high-pressure alarm to warn control room operators when rising reactor coolant pressure approaches the design pressure of attached low-pressure systems and both isolation valves are not closed.

- Systems not designed in the above methods should include other proper design features to prevent ISLOCAs to the extent practicable.

## 2.3 ISLOCA EVALUATION PROCESS

The systematic evaluation performed for this study of ISLOCA challenges and the subsequent determination of appropriate design responses can be summarized in the following steps:

1. The AP1000 RCS piping and instrumentation diagram (P&ID) was reviewed to identify systems or subsystems that directly interface with the RCS. The P&IDs of these primary interfacing systems were also reviewed to identify secondary interfacing systems or subsystems that directly interface with the primary interfacing systems.

2. The design pressure of each of the primary and secondary interfacing systems was identified and categorized as follows:

   A – Design pressure ≥ RCS Design Pressure
   B – Ultimate Rupture Strength (URS) ≥ RCS Design Pressure
   C – Low-Pressure System

3. Any system or subsystem that interfaces with a primary interfacing system categorized as A or B above was then itself evaluated as a primary interfacing system for the following reason: If a primary interfacing system is designed for full RCS pressure, then it can be considered (for this study) an extension of the reactor coolant pressure boundary (RCPB), and therefore, any system interfacing with it should be subjected to the ISLOCA evaluation criteria.

   Systems interfacing with a category C system were not evaluated as primary interfacing systems because it was assumed that the justification and design response for the category C system would also protect any system connected to that system.

   For each interfacing system or subsystem categorized as B or C above, justification for ISLOCA compliance is identified and categorized as follows:

   (1) All parts of system or subsystem are located inside the containment.

   (2) System or subsystem is designed to a URS at least equal to the full RCS pressure.

   (3) System or subsystem includes the following design features:

      – the capability for leak-testing of the pressure isolation valves

      – valve position indication that is available in the control room when isolation valve operators are deenergized, and

      – a high-pressure alarm to warn control room operators when rising reactor coolant pressure approaches the design pressure of attached low-pressure systems and both isolation valves are not closed.

   (4) System or subsystem includes other design features specific to them that prevent an ISLOCA to the extent practicable. These design features are discussed in section 3 of this report.

4. A design evaluation is performed for all category B and C primary and secondary interfacing systems with compliance justification other than (1). Each interface in the pressurization pathways was analyzed relative to the ISLOCA acceptance criteria.

Tables 2-1 through 2-11 summarize the results of the evaluation process described above. The first system in each table is the primary interfacing system. The remaining systems in each table are the secondary interfacing systems that interface with that primary system. Section 3 of this report contains design evaluations for the category B or C systems identified with justifications that do not include justification (1) (system is located entirely inside containment).

**Table 2-1 Normal Residual Heat Removal System**

| Interfacing System | Design Pressure[1] | Justification[2] | | | | Design Evaluation (Section) |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | |
| Normal Residual Heat Removal System (RNS)<br>Pump seal | A/B<br>C | | X | X | | 3.1 |
| Passive Core Cooling System (PXS)<br>test header | A | X | X | | | |
| Chemical and Volume Control System (CVS)<br>purification return line | A | X | X | | | |
| PXS direct vessel injection line | A | X | X | | | |
| In-containment refueling water storage tank (IRWST)<br>sparger | C | X | | | | |
| CVS purification line | A | X | X | | | |

1. See subsection 2.3.2 for an explanation of design pressure codes.
2. See subsection 2.3.3 for an explanation of justification codes.

**Table 2-2 Chemical and Volume Control System Purification Loop**

| Interfacing System | Design Pressure | Justification | | | | Design Evaluation (Section) |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | |
| CVS purification loop | A | X | | | | |
| RNS discharge and return headers | A | X | | | | |
| Solid Radwaste System (WSS) | C | | | | X | 3.5 |
| Containment sump | C | X | | | | |
| Demineralized Water Transfer and Storage System (DWS) | C | X | | | X | 3.6 |
| Primary Sampling System (PSS) | A | | X | | | 3.4 |
| CVS makeup line<br>Makeup pump suction line | A<br>C | | X | | <br>X | 3.3 |
| Hydrogen addition line | A | | X | | | |
| RCS pressurizer spray | A | X | | | | |

**Table 2-3 Chemical and Volume Control System Letdown Line**

| Interfacing System | Design Pressure | Justification | | | | Design Evaluation (Section) |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | |
| CVS letdown line | C | | | X | X | 3.2 |
| Liquid Radwaste System (WLS) degasifier | C | | | X | X | 3.2 |
| WLS effluent holdup tank | C | | | X | X | 3.2 |

**Table 2-4 Chemical and Volume Control System Makeup Pump Discharge Line**

| Interfacing System | Design Pressure | Justification | | | | Design Evaluation (Section) |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | |
| CVS makeup pump discharge line | A | | X | | | |
| PXS test header | A | X | X | | | |
| Spent fuel pool | C | | | | X | 3 |

**Table 2-5 Chemical and Volume Control System Makeup Pump Suction Line**

| Interfacing System | Design Pressure | Justification | | | | Design Evaluation (Section) |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | |
| CVS makeup pump suction line | C | | | | X | 3.3 |
| Spent fuel pool | C | | | | X | 3 |
| Waste holdup tank | C | | | | X | 3.3 |
| Demineralized water storage tank | C | | | | X | 3.3 |

**Table 2-6 Chemical and Volume Control System Hydrogen Injection Line**

| Interfacing System | Design Pressure | Justification | | | | Design Evaluation (Section) |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | |
| CVS hydrogen injection line | A | | X | | | |

| Table 2-7 Primary Sampling System | | | | | | |
|---|---|---|---|---|---|---|
| **Interfacing System** | **Design Pressure** | **Justification** | | | | **Design Evaluation (Section)** |
| | | **1** | **2** | **3** | **4** | |
| PSS | A | | X | | | 3.4 |
| Grab sample panel | C | | | | X | |
| DWS | C | X | | | X | 3.6 |
| PXS accumulators | C | X | | | | |
| PXS core makeup tanks (CMTs) | A | X | X | | | |
| CVS demineralizers | A | X | X | | | |
| WLS degasifier | C | | | | X | 3.4 |

| Table 2-8 Passive Core Cooling System Core Makeup Tanks | | | | | | |
|---|---|---|---|---|---|---|
| **Interfacing System** | **Design Pressure** | **Justification** | | | | **Design Evaluation (Section)** |
| | | **1** | **2** | **3** | **4** | |
| PXS CMTs | A | X | X | | | |
| Reactor coolant drain tank (RCDT) | C | X | | | | |
| PSS | A | | X | | | |
| CVS makeup line | A | | X | | | |

| Table 2-9 Passive Core Cooling System Direct Vessel Injection Line | | | | | | |
|---|---|---|---|---|---|---|
| **Interfacing System** | **Design Pressure** | **Justification** | | | | **Design Evaluation (Section)** |
| | | **1** | **2** | **3** | **4** | |
| PXS direct vessel injection line | A | X | | | | |
| IRWST | C | X | | | | |
| PXS accumulators | C | X | | | | |

| Table 2-10 Passive Residual Heat Removal Heat Exchangers | | | | | | |
|---|---|---|---|---|---|---|
| **Interfacing System** | **Design Pressure** | **Justification** | | | | **Design Evaluation (Section)** |
| | | **1** | **2** | **3** | **4** | |
| Passive residual heat removal (RHR) heat exchangers | A | X | X | | | |

**Table 2-11 Passive Core Cooling System Test Header**

| Interfacing System | Design Pressure | Justification | | | | Design Evaluation (Section) |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | |
| PXS test header | A | X | X | | | |
| CVS makeup line | A | | X | | | |
| PXS accumulators | C | X | | | | |
| RNS suction and discharge RCPB valves | A | X | X | | | |
| WLS RCDT | C | X | | | | |
| PXS CMTs | A | X | | | | |
| IRWST | C | X | | | | |

# 3 DESIGN EVALUATIONS

This section presents evaluations of the systems and subsystems identified in section 2.3 as requiring evaluation with regard to ISLOCA criteria. These systems or subsystems are connected directly to the RCS, or connect to high-pressure systems that connect directly to the RCS during some mode of operation, such that they must be evaluated for susceptibility to an ISLOCA. Based on the results of the evaluation process described in section 2.3, the following systems were selected for a detailed design evaluation:

- Normal Residual Heat Removal System (RNS)
- CVS letdown line to the WLS
- CVS makeup pump suction line
- Primary Sampling System (PSS)
- Solid Radwaste System (WSS)
- Demineralized Water Transfer and Storage System (DWS)

This section provides a detailed evaluation of each of these systems and subsystems. Each subsection is structured as follows:

- Description of Primary System Interface – A brief overview of the interfacing system under evaluation, the potential ISLOCA pathway, and operating conditions and failures necessary to create the ISLOCA pathway.

- Design Evaluation – An evaluation of the design against the ISLOCA criteria, and a description of any additional design features that address the ISLOCA issue.

- Justification of Design – A summary of the adequacy of the AP1000 system or subsystem design with respect to potential ISLOCA challenges.

In addition to describing systems under evaluation, these sections describe portions of systems designed to full RCS pressure, designed to a URS equal to full RCS pressure, or designed for low pressures. A system or portion of a system designed to full RCS pressure will have a design pressure of at least 2485 psig. A system or portion of a system designed to an URS equal to full RCS pressure will have a design pressure of at least 900 psig. A low-pressure system will have a design pressure less than 900 psig. These sections also describe piping lines from point A to point B. When this term is used, it can be assumed that all piping, valves, fittings, components, and instrument lines located in a "line" from point A to point B are designed to the pressure of the "line," unless otherwise specified.

SECY-90-016 (Reference 5) provides practical guidance in upgrading systems to URS design pressure. As discussed in Reference 10, it is impractical to design the large, low-design-pressure tanks and tank structures that are vented to the atmosphere to URS design pressure. Tanks included in this category are as follows:

- Spent fuel pool and fuel transfer canal
- CVS boric acid tank
- Demineralized water storage tank

- WLS effluent holdup and monitor tanks
- WLS waste holdup and monitor tanks

Table 3-1 provides the approximate sizes of these tanks to show the impracticality of increasing their design pressure. Increasing the design pressure of these tanks to the URS value would result in an unnecessary dollar cost burden. In addition, the tanks that contain radioactive waste are typically designed with features such as sloped bottoms to reduce crud deposition. Such features cannot be used in tanks designed to high pressure. Tanks such as the spent fuel pool and fuel transfer canal have no top cover and are open to the auxiliary building so that their pressure cannot be increased above the static head for which they are designed.

As discussed in the following evaluations, interfacing systems or subsystems that connect directly to an atmospheric tank are excluded from further ISLOCA consideration. This is limited to the piping connected directly to the atmospheric tank, up to the first isolation valve other than a locked-open, manual isolation valve. Designing these portions of the system to a higher pressure would provide no practical benefit. Designing these systems to full RCS pressure would offer no reduction in RCS inventory lost in the event that these lines were aligned to the RCS at full RCS pressure.

Other justifications for designing interfacing systems to less than full RCS pressure are provided on a case-by-case basis.

**Table 3-1 AP1000 Low-Pressure Tanks Not Designed to URS Design Pressure**

| Tanks | Volume (gallon) |
|---|---|
| Spent fuel pit | 190,000 |
| Fuel transfer canal | 61,000 |
| CVS boric acid tank | 70,000 |
| Demineralized water storage tank | 150,000 |
| WLS effluent holdup tank | 28,000 |
| WLS waste holdup tank | 15,000 |
| WLS waste monitor tank | 15,000 |

## 3.1 NORMAL RESIDUAL HEAT REMOVAL SYSTEM

### 3.1.1 Description of Primary System Interface

The RNS is the nonsafety-related system that provides shutdown cooling for the RCS. During normal shutdown operations, the RCS is cooled and depressurized to the RNS cut-in temperature and pressure using the steam generators as a heat sink, and using pressurizer spray to reduce RCS pressure. Once RCS pressure and temperature have been reduced to the conditions for RNS initiation, the RNS suction line isolation valves are opened, and the RNS pumps are started to provide shutdown cooling. Cooldown to refueling conditions continues with the RNS operating in this mode of shutdown cooling. Design Control Document (DCD) subsection 5.4.7 provides a complete description of the various functions and operations associated with the RNS. Figure 3-1 is the RNS P&ID modified to clearly indicate all high-pressure/low-pressure interfaces.

The RNS takes suction from an RCS hot leg and discharges to the reactor vessel direct vessel injection (DVI) lines. The lines represent the two potential paths of overpressurization for the RNS. As shown in Figure 3-1, the RNS suction line contains three normally closed isolation valves in series, with a design pressure equal to RCS design pressure. This represents the first potential pressurization pathway. The RNS inner and outer suction line isolation valves (V001A and B, and V002A and B) are RCPB valves. These valves have power removed at the valve motor control centers and are interlocked so that they cannot be opened unless RCS pressure is reduced to a pressure within the design pressure of the RNS (450 psig). The third normally closed isolation valve (V022) is designed to full RCS pressure and is a containment isolation valve. Overpressurization would occur only if either all three motor-operated gate isolation valves leaked excessively, or if the valves were inadvertently opened with the RCS pressure above the design pressure of the low-pressure portions of the RNS.

The second potential overpressurization pathway for the RNS is via the discharge branch lines, which each connect to a DVI line. Each RNS branch line contains two normally closed check valves that are RCPB valves, and as such, are designed to the RCS design pressure. The branch lines then connect to a common header that penetrates containment. The common header contains two containment isolation valves, a check valve inside containment (V013), and a motor-operated gate valve outside containment (V011). All the valves and piping up to and including the motor-operated gate valve are designed to full RCS pressure. Overpressurization would occur only if three check valves and the motor-operated gate isolation valve (in series) all leaked excessively.

### 3.1.2 Design Evaluation

The RNS suction line from the RCS hot leg to the outside-containment isolation valve (V022) is designed to full RCS pressure. Likewise, the RNS discharge lines from the DVI line back to the outside-containment isolation valve (V011) is designed to full RCS pressure. The portions of the RNS between these isolation valves are designed to a URS equal to the design pressure of the RCS, with the exception of the RNS pump shaft seal. The following is a summary of the specific design features incorporated in the AP1000 RNS design to address the ISLOCA issue.

**Quality Assurance/Seismic Protection**

The portions of the RNS located outside containment (that serve no active safety functions) are classified as AP1000 Equipment Class C so that the design, manufacture, installation, and inspection of this pressure boundary is controlled by the following industry and regulatory safety-related quality assurance requirements: 10CFR21; 10CFR50, Appendix B; Regulatory Guide 1.26 Quality Group C; and American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section III, Class 3. In addition, this pressure boundary is classified as Seismic Category I so that it is protected from failure following a safe shutdown earthquake.

**Increased Design Pressure**

The portions of the RNS from the RCS to the containment isolation valves outside containment are designed to the operating pressure of the RCS. The portions of the system downstream of the suction line containment isolation valve and upstream of the discharge line containment isolation valve are designed with a URS not less than RCS operating pressure. Specifically, the piping is designed as Schedule 80S, and the flanges, valves, and fittings are specified to be greater than or equal to ANS class 900. Although the design pressure of the system has been increased to 900 psig, the maximum operating pressure has remained consistent with previous designs, and therefore, the actual margin between the maximum operating pressure and the design pressure of the RNS is increased by a factor of 3 (from 150 to 450 psig).

**Reactor Coolant System Isolation Valve**

The AP1000 RNS contains an isolation valve in the pump suction line from the RCS. This motor-operated containment isolation valve is designed to the RCS pressure. It provides an additional barrier between the RCS and lower-pressure portions of the RNS.

**Normal Residual Heat Removal System Relief Valves**

The inside-containment AP1000 RNS relief valves are connected to the RHR pump suction line inside containment. These valves are designed to provide low-temperature overpressure protection of the RCS as described in DCD subsection 5.2.2. They are connected to the high-pressure portion of the pump suction line, and will reduce the risk of overpressurizing the low-pressure portions of the system. In addition, the RNS discharge header contains a relief valve provided to prevent overpressure in the RNS pump discharge line. Overpressure could occur if the three check valves (V013, V015, and V017) and the motor-operated containment isolation gate valve (V011) leaked back to the low-pressure portions of the RNS. The discharge of this relief valve is routed to the WLS effluent holdup tanks.

**Features Preventing Inadvertent Opening of Isolation Valves**

An interlock is provided for the normally closed, motor-operated RNS inner and outer suction isolation valves (RNS-V001A and B, and V002A and B). The interlock prevents the suction valves for the RNS from being opened by operator action unless the RCS pressure is less than a preset pressure and the following valves are in a closed position:

- IRWST suction isolation valve (RNS-V023)
- IRWST discharge isolation valve (RNS-V024)

Alarms are also provided in the main control room and on the remote shutdown workstation to alert the operator if RCS pressure exceeds the RNS design pressure after the valves are opened.

**Reactor Coolant System Pressure Indication and High Alarm**

The AP1000 RNS contains an instrumentation channel that indicates pressure in each RHR pump suction line. A high-pressure alarm is provided in the main control room to alert the operator to a condition of rising RCS pressure, which could eventually exceed the design pressure of the RNS.

The only portion of the RNS not designed to full RCS pressure, or to a URS pressure equal to the RCS design pressure, is the RNS pump shaft seal. The RNS pumps contain a shaft seal that has a design pressure of 900 psig. In addition, the pump is fitted with a disaster bushing that limits seal leakage in the event of a catastrophic failure of the pump seal to within the capabilities of the normal makeup system. The seal leakoff line is routed to a floor drain that is routed to the auxiliary building sump.

### 3.1.3 Justification of Design

This section provides justification for the adequacy of the RNS design with regard to ISLOCA criteria. Justification for the portions of the RNS other than the RNS pump mechanical seal is provided in subsection 3.1.3.1. Subsection 3.1.3.2 contains the justification for the design of the RNS pump shaft seal.

#### 3.1.3.1 Design Justification for Normal Residual Heat Removal System

The design of the RNS meets the acceptance criteria for ISLOCA because the system is designed to either full RCS pressure or to a URS pressure equal to the RCS design pressure. In addition, design features are provided that exceed the ISLOCA criteria. The design features of the RNS contribute to the low core damage frequency attributed to ISLOCA calculated in the AP1000 PRA.

#### 3.1.3.2 Design Justification for Normal Residual Heat Removal Pump Mechanical Seal

The RNS pumps contain a mechanical seal that permits proper operation of the RNS pump while limiting shaft leakage. The RNS pump shaft seal has a design pressure of 900 psig, and a maximum operating pressure of ~565 psig, with an expected operating range from 450 to 0 psig.

A fundamental problem with designing an RNS pump seal that can withstand full RCS pressure is that any type of seal that can withstand full RCS pressure will likely have abnormally fast wear of the seal faces during normal plant operation at low seal pressures. This increased wear at normal plant operating conditions could prevent the seal from maintaining the pressure boundary if ever exposed to the full RCS pressure. High-pressure seals would also require more frequent maintenance during normal operation. Therefore, a seal can be designed for normal-low pressure operation or for full-RCS-pressure conditions, but it is impractical to design a seal that would maintain the RCS pressure boundary with no leakage, and also operate satisfactorily at low-pressure conditions.

The AP1000 RNS pump mechanical seal is designed to minimize the amount of leakage if exposed to full RCS pressure. NUREG/CR-5603 (Reference 9) documented an evaluation of the pumps at the Davis Besse Nuclear Power Station under potential ISLOCA conditions. This study concluded the following for the Davis Besse Decay Heat Removal (DHR) System pumps.

Based on extensive discussions with the seal manufacturer, it was found that the rotating seal would maintain its structural integrity to pressures in excess of 2500 psi. The mechanical seals are designed to withstand a pressure of 1200 to 1250 psi without leaking. At greater pressures, the rotating face begins to distort creating a rotation at the contact surface. At 2500 psi, the rotation is three times the maximum allowable value. Thus, it is recommended that the potential for leakage through the pump seals be characterized assuming a nominal leak rate of 100 to 200 mg/sec together with an uncertainty variability of about 0.20.

The Davis Besse DHR pumps use a mechanical seal of a similar design as the AP1000 RNS pumps. Furthermore, the design pressure of the AP1000 mechanical seal is 900 psig as opposed to 450 psig for the Davis Besse DHR pumps. Since the design pressure of the AP1000 RNS mechanical seal is higher than that of the DHR pump in NUREG/CR-5603 (Reference 9), the expected leakage for the AP1000 RNS pump is less than that of the Davis Besse DHR pumps. Seal manufacturers contacted would not claim as low a leakage as specified in the reference study; they claimed their seals would meet the requirement that leakage at full RCS pressure be limited to within the capabilities of the normal makeup system.

The AP1000 RNS pump also has a disaster bushing that limits the leakage from the pump to within the capabilities of the normal makeup system in case of a catastrophic mechanical seal failure. The combination of a highly reliable single-seal design, in conjunction with a sturdy disaster bushing, maximizes the reliability of the seal during normal RNS operation and minimizes maintenance and associated radiation exposure. Furthermore, this design approach minimizes RNS pump leakage in the event of catastrophic mechanical seal failure. Leakage can be controlled so that only a small portion of the water that leaks past the primary seal faces escapes to the pump cubicle and most leakage is piped to a controlled drain. This is more favorable than a seal specially designed for full RCS pressure at the expense of normal-condition reliability.

## 3.2 CHEMICAL AND VOLUME CONTROL SYSTEM LETDOWN LINE TO LIQUID RADWASTE SYSTEM

### 3.2.1 Description of Primary System Interface

The CVS is the nonsafety-related system that provides for purification and makeup flow for the RCS. Unlike current PWRs that use continuous charging and letdown flow to maintain RCS chemistry and inventory control, the AP1000 uses a high-pressure purification loop totally within containment that uses reactor coolant pump (RCP) head to provide the motive force to drive purification flow. This eliminates the need for continuous charging and letdown, and therefore, letdown operations (that is, letdown of the RCS to the WLS) are limited to off-normal situations. DCD subsection 9.3.6 provides a complete description of the various functions and operations associated with the CVS. Figure 3-2 is the CVS P&ID modified to clearly indicate all high-pressure/low-pressure interfaces.

As shown in Figure 3-2, the CVS letdown line connects to the high-pressure CVS purification loop inside containment. Immediately downstream of this connection is the high-pressure, multi-stage letdown orifice, which reduces pressure in the letdown line from RCS operating pressure to below the design pressure of the low-pressure portion of the letdown line. The letdown line also contains a locked-closed bypass line around the letdown orifice. This line contains a locked-closed manual isolation valve (V043), which is opened only at shutdown when the RCS is depressurized. The letdown orifice must be bypassed when the RCS is depressurized to ensure sufficient letdown flow when required.

Downstream of the letdown orifice are two normally closed, fail-closed containment isolation valves (V045 and V047). The portions of the letdown line, from the purification loop up to and including the second containment isolation valve, are designed to full RCS pressure. The WLS portion of the letdown line contains a three-way valve that normally routes the letdown flow to the WLS degasifier package, and can be aligned to route the letdown flow to the WLS effluent holdup tanks. The discharge of the degasifier package is also routed to the WLS effluent holdup tanks.

A potential ISLOCA overpressurization pathway could exist from the RCS through the CVS purification loop, and through the CVS letdown line to the low-pressure WLS.

### 3.2.2 Design Evaluation

During power operation, the WLS is protected from overpressurization by the letdown orifice. The orifice design limits WLS pressure during letdown operation. In addition, a relief valve is provided in the low-pressure portion of the CVS letdown line in case a valve in the letdown line is inadvertently mispositioned and consequently causes an overpressurization of a low-pressure line. As seen in Figure 3-2, relief valve V057 is provided to limit the pressure in the WLS if manual isolation valve V048 were inadvertently closed, and the letdown isolation valves were opened. Discharge from relief valve V057 is routed directly to the WLS waste holdup tank.

During shutdown operation, with the letdown orifice bypassed, the relief valve in the CVS letdown line is required to protect the letdown line in the event of a cold overpressure transient. If the letdown isolation valves were opened and a cold overpressure transient occurred, the pressure excursion in the RCS would be limited to the set pressure of the RNS relief valves (plus accumulation pressure). Relief valve V057 is sized to provide sufficient flow for this event such that the pressure drop in the letdown line would limit the maximum WLS pressure to within 110 percent of its design pressure.

Because of the passive features in the CVS letdown line (that is, the letdown orifice and relief valve V057), inadvertent pressurization of the low-pressure portion of the letdown line is avoided. However, other events, such as excessive letdown operation or valve mispositioning that causes relief valve V057 to open and discharge to the WLS effluent holdup tanks, could cause a depletion in reactor coolant inventory. For any event that results in the depletion in the pressurizer water level (including excessive letdown or a letdown line ISLOCA), the letdown line isolation valves receive separate automatic signals to close. The letdown line isolation valves receive a control-grade automatic signal to close on normal low pressurizer level (~40 to 55 percent based on power level). This signal will terminate any letdown line ISLOCA or other excessive letdown event. Furthermore, the letdown isolation valves and the purification loop isolation valves (V001 and V002) also receive a safety-related signal to close on an abnormally low pressurizer level (~25 percent). Finally, the letdown line isolation valves and the purification loop isolation valves also close on a safeguards actuation signal, which would occur as a result of a LOCA that continued until the low-pressure safeguards actuation setpoint was reached. These four safety-related valves isolate the letdown line and would terminate any letdown line ISLOCA before it became a challenge to core cooling.

### 3.2.3 Justification of Design

The CVS letdown line meets ISLOCA criteria for low-pressure systems. The letdown isolation valves are containment isolation valves, and as such, have the capability for leak-testing, and are provided with valve position indication in the control room at all times. Furthermore, the WLS degasifier column contains a high-pressure alarm (via pressure switch PS-014), which would warn the control room operators that the WLS pressure was approaching the design pressure and that rising reactor coolant pressure could result in an ISLOCA. Also, the multiple safety-related isolation valves, which close automatically on low pressurizer level and on a safeguards actuation signal, protect against a letdown line ISLOCA, which could cause a loss of core cooling.

The flow rate from any excessive letdown or letdown line ISLOCA event would be within the capabilities of the normal makeup system. If the makeup pumps operate such that RCS inventory and pressure remain within the RCS operating limits (that is, pressurizer level >25 percent, RCS pressure >1800 psig), then it is assumed that the operator would identify the break and determine the actions to terminate the leak within 30 minutes. The radioactive releases from such an event are within the design basis analysis contained in DCD subsection 15.6.2.

It is not practicable to design the low-pressure portions of the letdown line to a higher design pressure. The letdown line is routed to either the degasifier package or the effluent holdup tanks. As discussed in section 3, it is not practicable to design the WLS effluent holdup tanks to a higher design pressure. It is also not practicable to design the WLS degasifier package to a higher design pressure. This degasifier package includes a degasifier column and a degasifier separator, four low-pressure pumps, and a low-pressure heat exchanger. A significant cost and development effort would be required to redesign this equipment to withstand full RCS design pressure. In addition, the degasifier package discharges directly to the WLS effluent holdup tanks, and therefore, designing the degasifier package to high pressure, if practicable, would provide no benefit. This is because the system interfaces directly with large, low-pressure tanks for which higher design pressures are impractical.

## 3.3 CHEMICAL AND VOLUME CONTROL SYSTEM MAKEUP PUMP SUCTION LINE

### 3.3.1 Description of Primary System Interface

The AP1000 CVS makeup pumps operate intermittently to make up for RCS leakage. The pumps start automatically when the pressurizer level reaches the bottom of the normal level band, and stop when the level reaches the top of the band. The makeup pumps take suction from either the boric acid tank, the demineralized water storage tank, or both, and inject makeup into the CVS purification loop return stream. DCD subsection 9.3.6 provides a complete description of the various functions and operations associated with the CVS. Figure 3-3 is the CVS P&ID modified to clearly indicate all high-pressure/low-pressure interfaces.

As shown in Figures 3-2 and 3-3, the CVS makeup line from the makeup pump discharge to the RCS, has a design pressure greater than or equal to the RCS design pressure. Pressurization is postulated from the RCS through the purification loop, through the makeup line connection to the purification loop, back through the makeup line and makeup pumps, and to the low-pressure makeup pump suction line. This pressurization pathway exists only if the makeup pumps are not operating. If the makeup pumps are operating, the system hydraulic phenomena prevent pressurization of the suction piping. It should be noted that two normally closed check valves in the makeup line isolate the pump suction line from the high-pressure purification loop. In addition, each makeup pump suction line contains a relief valve that protects the low-pressure piping in the event that leakage through the check valves causes the suction piping to become overpressurized.

The makeup pumps can take suction from either the boric acid tank (BAT), the demineralized water storage tank, the waste holdup tanks, or the spent fuel pool. Each suction line contains a check valve to prevent flow between water storage tanks. In addition, the spent fuel pool and waste holdup tank suction lines contain a normally closed manual valve.

### 3.3.2 Design Evaluation

As discussed in section 3, the tanks that the CVS can take suction from are all large, low-pressure tanks for which high-pressure designs are impractical. As such, these tanks and the piping up to the first manual isolation valve, are excluded from ISLOCA consideration. As shown in Figure 3-3, each makeup pump suction line contains a check valve and at least one manual isolation valve. To prevent overpressurization of the makeup pump suction line, relief valves V158A and B are provided in case the check valves (V064, and V160A and B) in the makeup pump discharge line leak when the pumps are not running. These relief valves prevent an ISLOCA in the makeup pump suction piping.

In the event that makeup line check valve failure causes the relief valves to open, the relief valves would discharge to the WLS effluent holdup tanks. This would eventually lead to a low normal pressurizer level signal, causing the makeup pumps to start, and effectively terminating the ISLOCA. If the nonsafety-related makeup pumps failed to start, safety-related isolation of the makeup line would be achieved by isolation of the purification loop isolation valves (V001 and V002), the makeup line containment isolation valves (V090 and V091), and the RCS boundary check valves in the makeup line (V081 and V082). These safety-related valves isolate the makeup line and would terminate any makeup suction line ISLOCA before it became a challenge to core cooling.

### 3.3.3 Justification of Design

The CVS suction line piping meets ISLOCA criteria for low-pressure systems. The makeup line isolation valves are containment isolation valves, and as such, have the capability for leak-testing, and are provided with valve position indication in the control room at all times. In the event of an ISLOCA, the makeup pumps would be operated (either manually or automatically on low pressurizer level), and the mechanism for overpressurizing the suction piping would not exist. If the makeup pumps did not start, and the mechanism was still available to overpressurize the suction piping, the containment isolation valves would automatically terminate the ISLOCA. These valves are closed on a safeguards actuation signal coincident with low pressurizer level. In addition, the RCS pressure boundary valves in the purification loop are also closed on a safeguards actuation signal. These multiple, safety-related isolation valves prevent an ISLOCA in the makeup pump suction line that could result in a loss of core cooling.

It is not practicable to design the low-pressure portions of the makeup pump suction line to a higher design pressure. The suction line contains relief valves that protect the low-pressure portions of the piping from overpressure in events such as leaking check valves in the discharge line or thermal expansion in case of a loss of miniflow cooling. A loss of miniflow cooling could occur if component cooling water to the miniflow heat exchanger was lost. If the design pressure of the piping were increased to the URS pressure, the relief valves would still be necessary to protect against leaking check valves or thermal expansion. An increase in the valve set pressure (to correspond to the higher design pressure) would significantly impact design pressure of the pump discharge line for cases of a loss of miniflow heat exchanger cooling. And while designing the suction piping to full RCS pressure would address the case of leaking check valves in the discharge piping, it would not solve the thermal expansion issue.

Another consideration is that the makeup pump suction lines each contain a check valve that separates the suction piping from a large atmospheric tank. The suction line check valves are designed to open on low differential pressure, and industry experience has shown that low-differential-pressure check valves have a high tendency to leak. Therefore, assuming that the two discharge line (high-differential-pressure) check valves (in series) leak, it should also be assumed that the suction piping check valves would also tend to leak. Therefore, designing the suction pipe to a higher pressure will only increase the likelihood that the RCS leak extends on to one of the atmospheric tanks.

With the AP1000 design, the relief valves provide overpressure protection and direct any leakage from the discharge line check valves to the WLS effluent holdup tanks, a satisfactory arrangement, as opposed to leaking into the clean tanks from which the makeup pumps normally take suction. The WLS effluent holdup tank is designed to handle radioactive fluids, and its level is monitored by remote instrumentation (see section 4 regarding detection of ISLOCAs). Therefore, low-pressure suction piping with appropriately sized relief valves is a preferable arrangement to higher-design-pressure suction piping.

Adding an interlock to isolate the makeup line on indication of high makeup pump suction pressure was considered but not incorporated. The added complication of potentially isolating the makeup line on spurious signals, combined with the low probability of a makeup pump suction line ISLOCA, make this interlock undesirable.

## 3.4 PRIMARY SAMPLING SYSTEM

### 3.4.1 Description of Primary System Interface

The PSS collects representative samples of fluids from the RCS and associated auxiliary system process streams, and the containment atmosphere for analysis by the plant operating staff. Since fluids are collected outside the containment, the PSS is the system that connects directly to the RCS and carries reactor coolant outside containment. DCD subsection 9.3.3 provides a complete description of the various functions and operations associated with the PSS. Figure 3-4 is the PSS P&ID modified to clearly indicate all high-pressure/low-pressure interfaces. As shown, almost the entire PSS is designed to withstand full RCS pressure.

The following portions of the PSS are designed to lower pressure than the full RCS pressure in the PSS:

- Eductor water storage tank (EWST)
- Demineralized water supply line

The PSS connects to the RCS at several locations, including the pressurizer liquid space and each hot leg. Each connection contains a flow-restricting orifice that limits the flow from the RCS in the event of a break of a sample line. These orifices also reduce the pressure in the sampling lines during sampling operations. During the sampling of the RCS, the operator opens the appropriate sample line isolation valve (for example, V003 for RCS pressurizer liquid sample) and opens the two remotely operated containment isolation valves (V010A or B, and V011). The sample passes through a sample cooler, and it is collected in the appropriate sample bottle. When a sufficient volume of coolant has been purged, the operator closes the isolation valves downstream and upstream of the appropriate sample chamber, and then closes the remotely operated valves.

### 3.4.2 Design Evaluation and Justification

It is not practicable to design the low pressure portions of the PSS to a higher design pressure. These portions of the PSS are at atmospheric pressure and connect to the low-pressure demineralized water system (DWS). Designing the low-pressure EWST to high pressure, to meet ISLOCA criteria, would then require the DWS to be designed for high pressure. As discussed in section 3.6, this is not practicable.

During sampling operations, flow limiting orifices plus the small diameter of the PSS lines limit flow to approximately 0.5 gpm, and the PSS lines are never pressurized above the design pressure of the low-pressure portions of the PSS. The PSS high pressure/low pressure interface occurs within the grab sample panel, which is a standard panel with design features to prevent backflow and overpressurization of the low pressure portions of the system. Even in the unlikely event that overpressurization would occur, leakage flow from the RCS would be well within the makeup capability of the normally operating makeup system. At any time, the operator would be able to isolate the leak by closing the PSS containment isolation valves.

For this event, assuming operation of the normal makeup system, the operator would identify the break, and/or the radiation monitors and alarms in the auxiliary building, and take actions to terminate the leak within 30 minutes. The radioactive releases resulting from such a beyond-design-basis event are within the design basis analysis contained in DCD subsection 15.6.2. For this event, assuming the normal makeup system is not available, the PSS containment isolation valves would automatically close on the safeguards actuation signal resulting from the loss of coolant and terminate the event.

## 3.5 SOLID RADWASTE SYSTEM

### 3.5.1 Description of Primary System Interface

The solid radwaste system (WSS) provides the storage facilities for both wet and dry solid wastes prior to and subsequent to processing and packaging. As shown in Figure 3-2, the WSS connects to the high-pressure CVS demineralizers to facilitate transfer of the spent resin from the CVS demineralizers to the spent resin storage tanks. The spent resin header connects to each of the three high pressure CVS demineralizers with an individual, normally closed isolation valve in each line. The spent resin header then penetrates containment with two normally closed, locked-closed, containment isolation valves (V040 and V041). A manual valve, placed downstream of the second containment isolation valve, isolates the downstream piping to facilitate containment isolation leak-testing. Figure 3-2 shows the high-pressure/low-pressure interface across this valve (V039).

### 3.5.2 Design Evaluation and Justification

It is not practical or necessary to design the WSS to a higher design pressure. The system contains many low-pressure components, such as spent resin tanks and resin transfer and resin mixing pumps. The WSS spent resin line meets the ISLOCA criteria for low-pressure systems by providing locked-closed isolation valves and administrative procedures to protect the low-pressure portion of the system.

The WSS spent resin line is normally isolated by the locked-closed manual containment isolation valves. These containment isolation valves are administratively controlled and are leak-tested in accordance with the AP1000 In-Service Testing (IST) Plan DCD subsection 3.9.6. The CVS demineralizers are inside containment and normally circulate reactor coolant at RCS operating pressure. As such, resin transfer operations cannot be performed at normal power operations. These operations are conducted during refueling operations, when the RCS is fully depressurized. Therefore, since this spent resin line can be opened only when the RCS is depressurized, and the high-pressure valves in the spent resin line that isolates the low-pressure portion of the system are administratively locked closed and regularly leak-tested, the WSS spent resin lines are not required to be designed to a higher design pressure.

## 3.6 DEMINERALIZED WATER TRANSFER AND STORAGE SYSTEM

### 3.6.1 Description of Primary System Interface

The DWS is a low-pressure water transfer system consisting of tanks, pumps, piping, valves, and associated instrumentation and controls. It interfaces with the high-pressure CVS purification loop as shown in Figure 3-2.

The DWS supply header inside containment connects to the CVS demineralizers. During shutdown operations, demineralized water is used to sluice resin to the WSS as discussed in section 3.5. To perform these operations, the operator must open manual valves in the CVS. As discussed in section 3.5, these operations can be performed only at shutdown when the RCS is fully depressurized. A potential pressurization pathway could exist if the operators failed to reclose manual valves in the CVS (such as V022A or B) before returning to power operation. In this case, the DWS would be protected from overpressurization by a single check valve (CVS-V026). If check valve V026 subsequently leaked or failed to close, the DWS header inside containment would become overpressurized.

### 3.6.2 Design Evaluation

The overpressurization pathways for the DWS initiate inside containment. Therefore, an overpressurization of this system would most likely result in the rupture of the DWS header inside containment. This would not result in an ISLOCA, as discussed in section 2 of this report. Any resulting loss of coolant would be maintained inside containment. Isolation of the CVS purification loop would terminate the event.

A relief valve has been added to the DWS header inside containment to preclude the possibility of overpressurizing the DWS for these events. This relief valve, shown in Figure 3-5, discharges to the containment.

### 3.6.3 Justification of Design

The DWS meets the ISLOCA criteria for low-pressure systems because an overpressurization of the system from the high-pressure RCS does not result in a loss of coolant outside containment. The DWS inside-containment supply header interfaces with a potentially high-pressure system containing reactor coolant. Overpressurization can only occur if there are multiple failures and misalignments of isolation valves and check valves in the high-pressure systems. For those events, the relief valve in the DWS supply header prevents an ISLOCA.

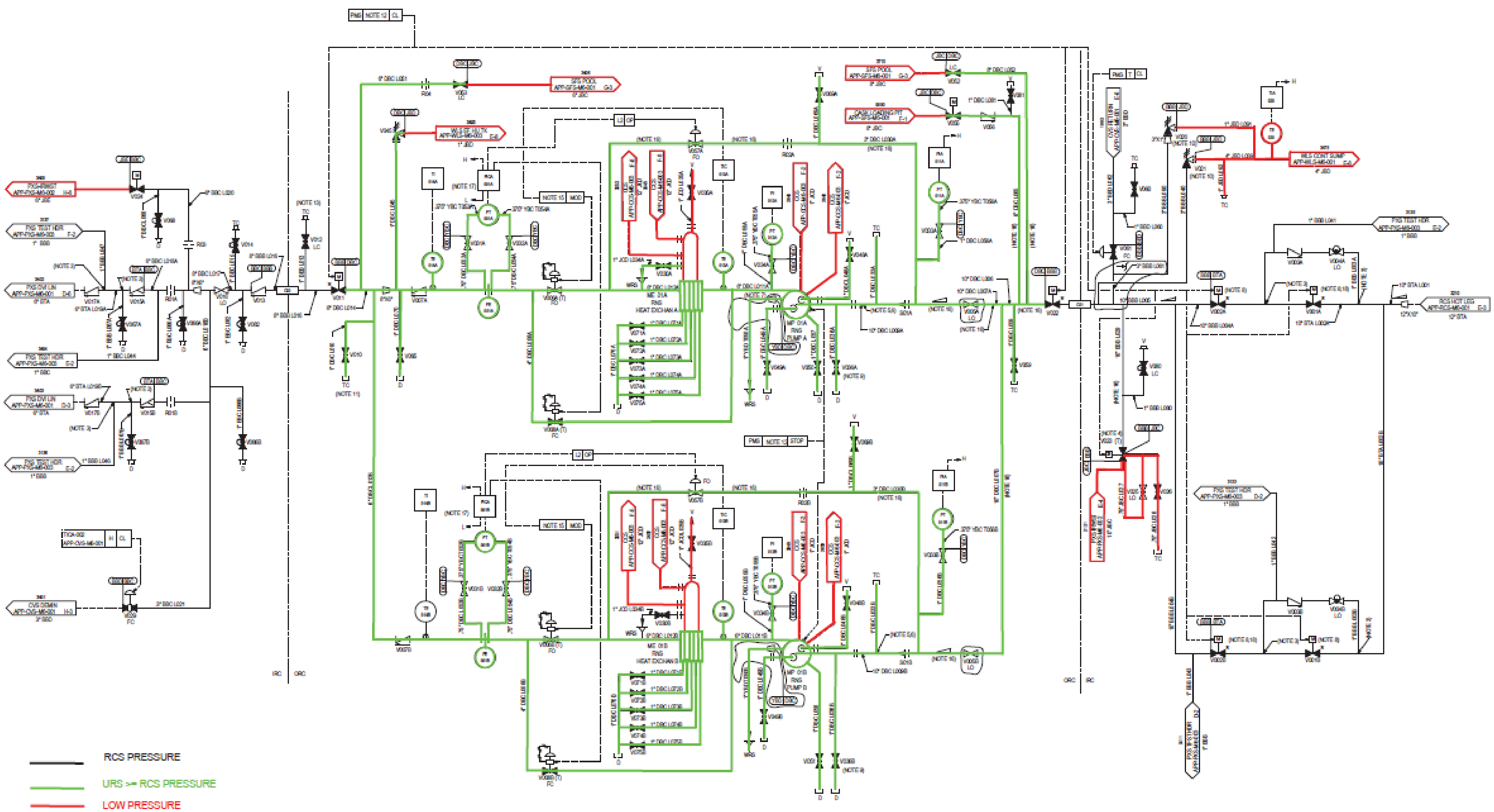


**Figure 3-1**
**Normal Residual Heat Removal System**

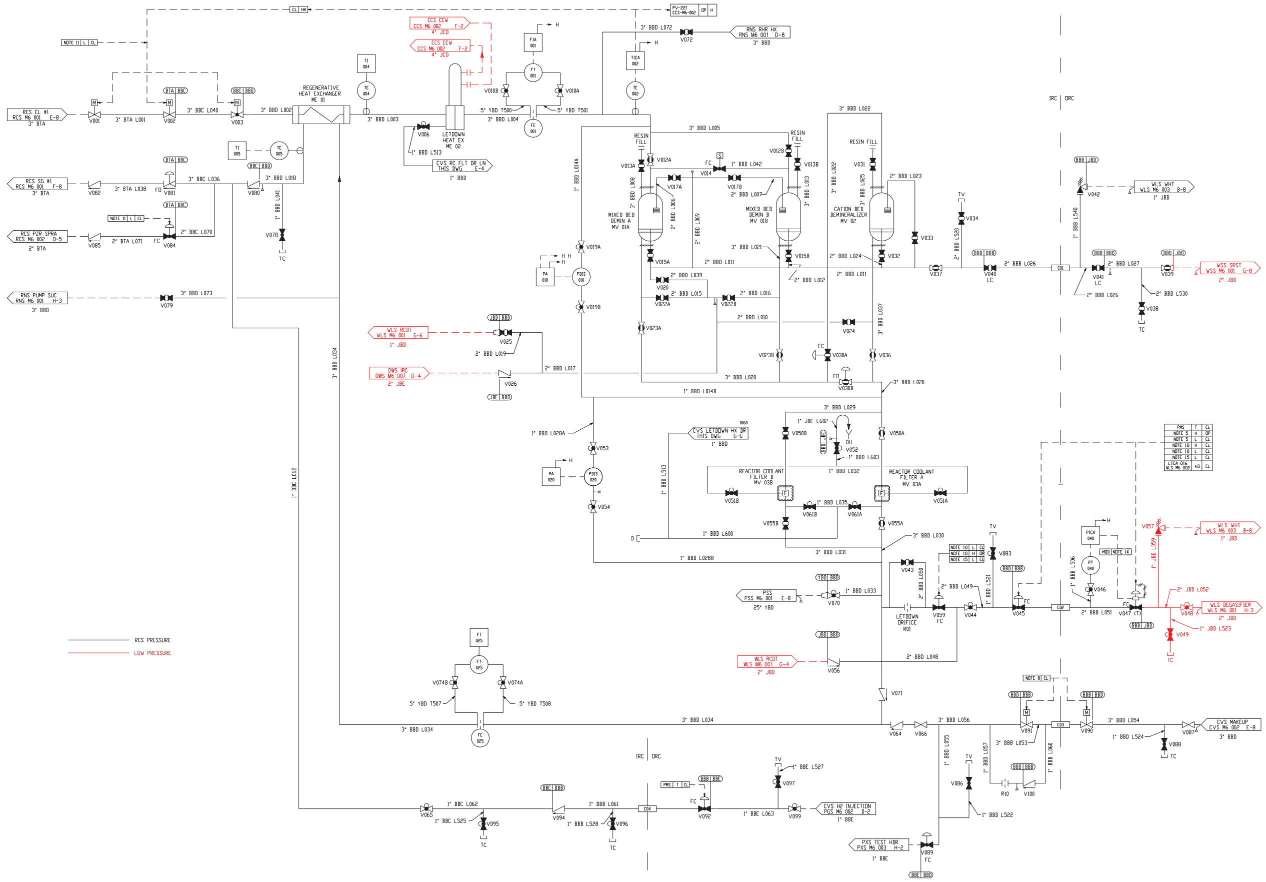


**Figure 3-2**
**Chemical and Volume Control System**
**Purification Loop**

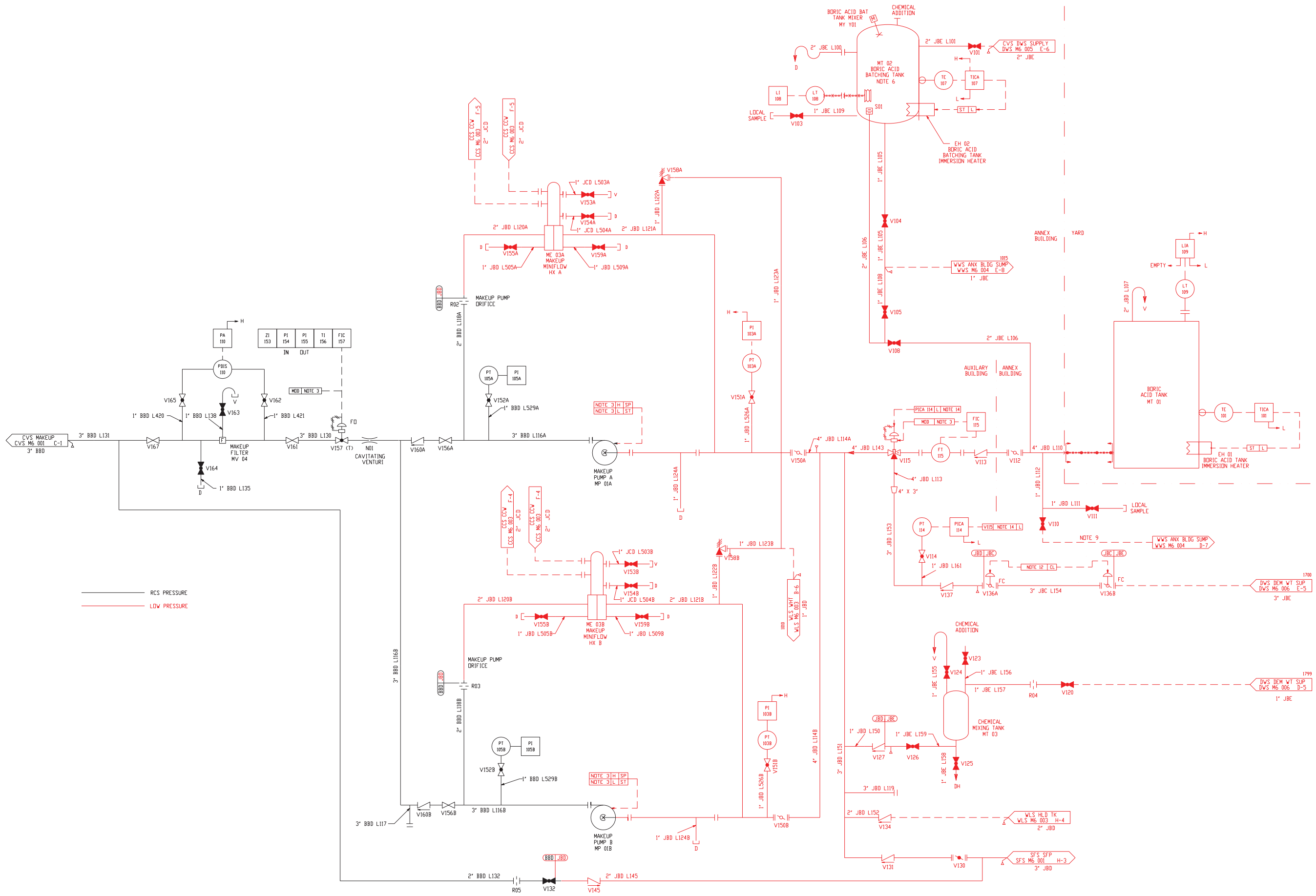

**Figure 3-3**
**Chemical and Volume Control System**
**Makeup Pumps**

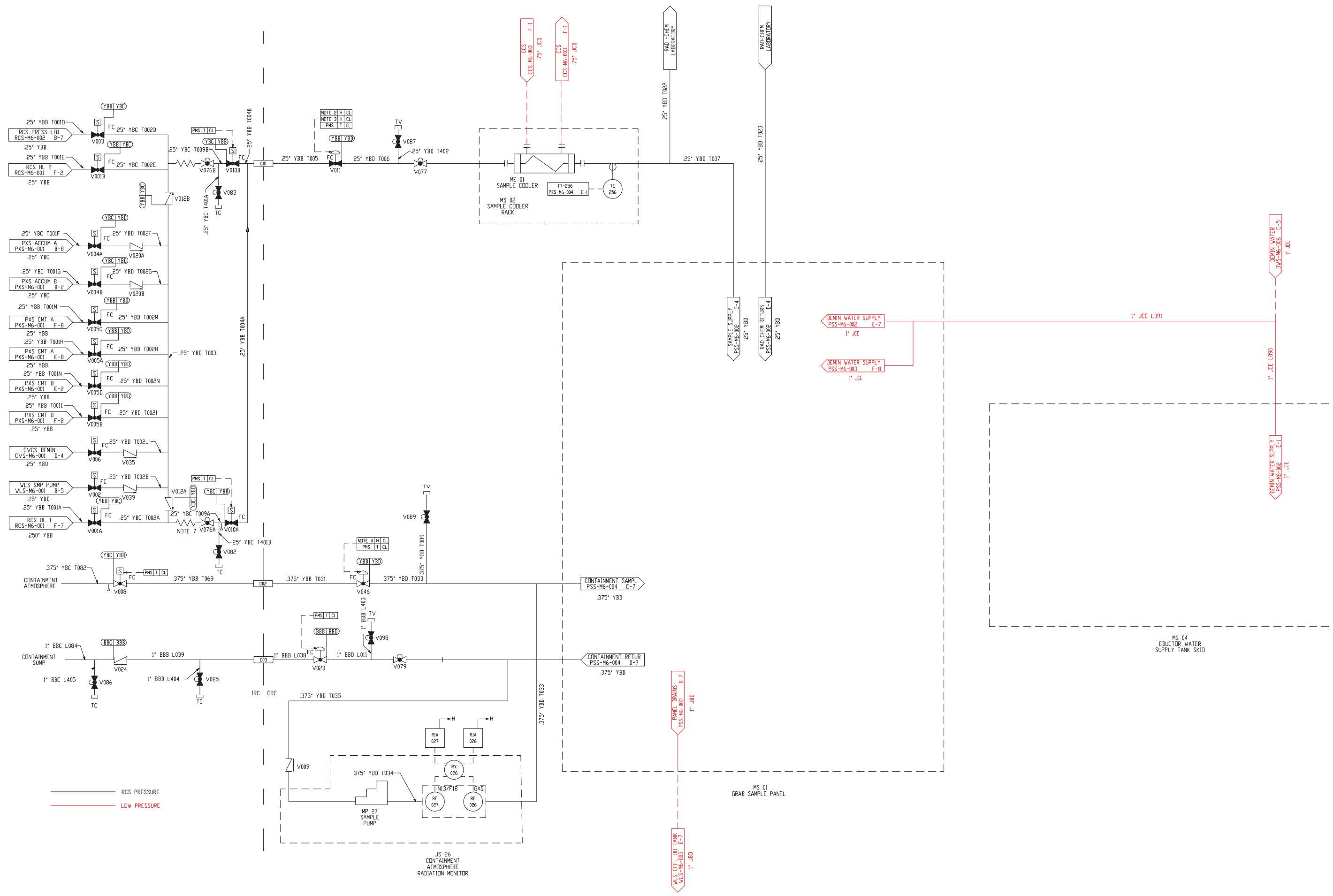


**Figure 3-4**
**Primary Sampling System**

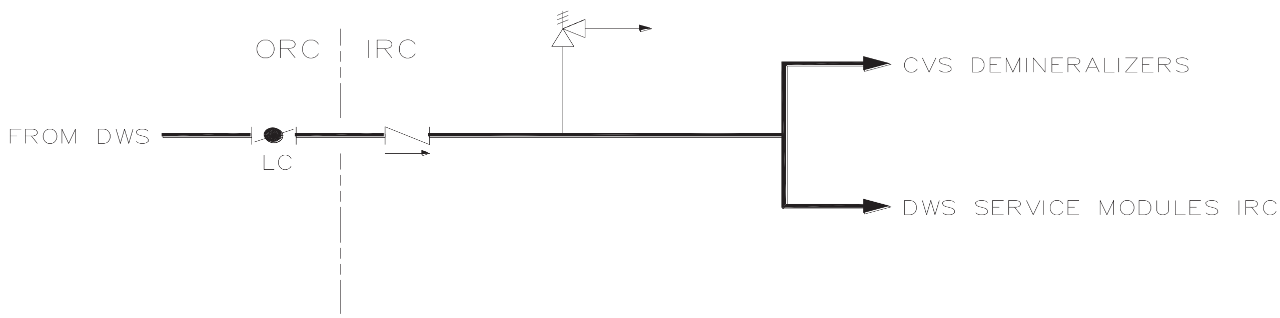


**Figure 3-5 Demineralized Water System Supply Header Inside Containment**

# 4 CONCLUSIONS

The AP1000 has incorporated various design features to address ISLOCA challenges. These design features have resulted in the low AP1000 core damage frequency for ISLOCA compared with that of current plants. These design features are primarily associated with the RNS and are discussed in detail in section 3 of this report as well as DCD subsection 5.4.7. This report was prepared to document the comprehensive systematic evaluation of the AP1000 design for conformance to the ISLOCA acceptance criteria in the various referenced NRC documents. As a result of this study, additional design features have been incorporated in the AP1000 design and are documented in the AP1000 DCD. The following table provides a summary of AP1000 design features incorporated to meet the ISLOCA acceptance criteria.

**Table 4-1 Summary of AP1000 ISLOCA Design Features**

| System/Subsystem | Major Design Features | Figure Number |
|---|---|---|
| RNS | • Increased design pressure of the RNS outside containment to a URS equal to full RCS pressure | 3-1 |
| Letdown line | • High-pressure purification loop inside containment to eliminate high-energy letdown outside containment<br>• Letdown orifice to limit leakage from a letdown line ISLOCA<br>• Automatic isolation of letdown on safeguards actuation<br>• Relief valve added to prevent overpressurization of letdown line | 3-2 |
| Makeup pump suction | • Relief valves added to minimize the consequences of pump suction overpressurization<br>• High-pressure alarm in pump suction line to alert the operator to overpressurization | 3-3 |
| PSS | • Most of PSS designed to full RCS pressure<br>• Flow-restricting orifices to limit scope of ISLOCA<br>• Automatic isolation of PSS on a safeguards actuation signal | 3-4 |
| DWS | • Relief valve added to prevent overpressurization of DWS inside containment<br>• Automatic isolation of DWS lines outside containment on safeguards actuation | 3-5 |

# 5 REFERENCES


1. NRC Information Notice 92-36, "Intersystem LOCA Outside Containment," May 7, 1992.

2. NRC Information Notice 92-36, Supplement 1, "Intersystem LOCA Outside Containment," February 22, 1994.

3. NRC Letter, "Preliminary Evaluation of the Resolution of the Intersystem Loss-of-Coolant-Accident (ISLOCA) Issue for the Advanced Boiling Water Reactor (ABWR) - Design Pressure for Low Pressure Systems," Docket Number 52-001.

4. NUREG/CR-5102, "Interfacing System LOCA: Pressurized Water Reactors," February 1989.

5. SECY-90-016, "Evolutionary Light Water Reactor (LWR) Certification Issues and Their Relationship to Current Regulatory Requirement," January 12, 1990.

6. NUREG-0933, "A Status Report on Unresolved Safety Issues," U.S. Nuclear Regulatory Commission, April 1989.

7. SECY-93-087, "Policy, Technical, and Licensing Issues Pertaining to Evolutionary and Advanced Light-Water Reactor Designs," April 2, 1993.

8. NRC Letter, "Clarification of Issues for Evolutionary Advanced Light Water Reactors (ALWR)," to E. E. Kintner (ALWR Steering Committee), May 6, 1991.

9. NUREG/CR-5603, "Pressure-Dependent Fragilities for Piping Components," October 1990.

10. Letter, "Submittal Supporting Accelerated ABWR Schedule-ISLOCA, Issue #42 (GE ABWR SSAR Appendix 3M)," General Electric Company, San Jose, California, July 9, 1993.

11. WCAP-14425, "Evaluation of the AP600 Conformance to Inter-System Loss-of-Coolant Accident Acceptance Criteria," Westinghouse, July 1995.