

FINAL MODEL SAFETY EVALUATION
BY THE OFFICE OF NUCLEAR REACTOR REGULATION TO ADD
TECHNICAL SPECIFICATIONS TASK FORCE TRAVELER
TSTF-567, REVISION 1
“ADD CONTAINMENT SUMP TS TO ADDRESS GSI-191 ISSUES”
ARIZONA PUBLIC SERVICE COMPANY
PALO VERDE NUCLEAR GENERATING STATIONS UNITS 1, 2, AND 3
DOCKET NOS. 50-528, 50-529, AND 50-530

1.0 INTRODUCTION

By application dated February 22, 2022, (Agencywide Documents Access and Management System (ADAMS) Accession No. ML22053A233), Arizona Public Service Company (the licensee) submitted a license amendment request (LAR) for Palo Verde Nuclear Generation Station (PVNGS), units 1, 2, and 3.

The amendment would revise Technical Specification (TS) 3.5.3, “ECCS [Emergency Core Cooling System] - Operating,” and TS 3.5.4, “ECCS – Shutdown.” The proposed changes would also add a new TS, “Containment Sump,” to Section 3.6, “Containment Systems.” The proposed changes are based on Technical Specifications Task Force (TSTF) Traveler TSTF-567, Revision 1, “Add Containment Sump TS to Address GSI [Generic Safety Issue]-191 Issues,” dated August 2, 2017 (ADAMS Accession No. ML17214A813). The U.S. Nuclear Regulatory Commission (NRC or the Commission) issued a final safety evaluation (SE) approving TSTF-567, Revision 1, on July 3, 2018, (ADAMS Accession No. ML18116A606).

The licensee has proposed several variations from the TS changes described in TSTF-567. The variations are described in Section 2.2.4 of this SE and evaluated in Section 3.4.

2.0 REGULATORY EVALUATION

2.1 SYSTEM DESCRIPTION AND TS CHANGES

Technical Specifications include limiting conditions for operation (LCOs), which are the lowest functional capability or performance levels of equipment required for safe operation of the facility. Specified with each stated condition of the LCO are required action(s) and completion time(s) (CTs) to meet TS requirements.

2.1.1 TS 3.5.3, “ECCS - Operating”

The function of the ECCS is to provide core cooling and negative reactivity to ensure the reactor core is protected after any of the following accidents:

- a. Loss-of-coolant accident (LOCA), coolant leakage greater than the capability of the normal charging system,

- b. Rod ejection accident,
- c. Loss of secondary coolant accident, including uncontrolled steam release or loss of feedwater, and
- d. Steam generator tube rupture.

Technical Specification 3.5.3 is applicable in Modes 1, 2, and 3 and requires that two independent ECCS trains be operable to ensure that sufficient ECCS flow is available, assuming a single failure affecting either train.

Technical Specification 3.5.3 helps ensure the following acceptance criteria for ECCS, established by Title 10 of the *Code of Federal Regulations* (10 CFR) 50.46, will be met following a LOCA:

- a. Maximum fuel element cladding temperature is ≤ 2200 degrees Fahrenheit ($^{\circ}\text{F}$),
- b. Maximum cladding oxidation is ≤ 0.17 times the total cladding thickness before oxidation,
- c. Maximum hydrogen generation from a zirconium water reaction is ≤ 0.01 times the hypothetical amount generated if all of the metal in the cladding cylinders surrounding the fuel, excluding the cladding surrounding the plenum volume, were to react,
- d. Core is maintained in a coolable geometry, and
- e. Adequate long-term core cooling capability is maintained.

Technical Specification 3.5.3 also limits the potential for a post-trip return to power following a main steam line break event and ensures that containment temperature limits are met.

2.1.2 TS 3.5.4, "ECCS - Shutdown"

Technical Specification 3.5.4 is applicable in Mode 4 and requires one of the two independent (and redundant) ECCS trains to be operable to ensure that sufficient ECCS flow is available to the core following a design-basis accident.

2.2 PROPOSED CHANGES TO THE TECHNICAL SPECIFICATIONS

The proposed changes would revise TS 3.5.3, "ECCS - Operating", and TS 3.5.4, "ECCS – Shutdown." The proposed changes would also add a new TS, "Containment Sump" to Section 3.6, "Containment Systems." The proposed changes are described below.

2.2.1 Proposed Changes to TS 3.5.3, "ECCS - Operating"

Technical Specification 3.5.3 currently contains Surveillance Requirement (SR) 3.5.3.8, which requires the following at a frequency of "In accordance with the Surveillance Frequency Control Program":

Verify, by visual inspection, each ECCS train containment sump suction inlet is not restricted by debris and the suction inlet strainers show no evidence of structural distress or abnormal corrosion.

The licensee proposed to modify and move SR 3.5.3.8 from TS 3.5.3 and include it in the new containment sump TS.

This change is evaluated in Section 3.1 of this SE.

2.2.2 Proposed Changes to TS 3.5.4, "ECCS - Shutdown"

Technical Specification 3.5.4 currently contains SR 3.5.4.1 which refers to applicable SRs under TS 3.5.3. One of those referenced SRs is SR 3.5.3.8, as described in Section 2.2.1 of this SE.

Because the licensee proposed to modify and move SR 3.5.3.8 from TS 3.5.3 and include it in the new containment sump TS, the licensee also proposed to delete the reference to SR 3.5.3.8 in SR 3.5.4.1.

This change is evaluated in Section 3.2 of this SE.

2.2.3 Proposed Addition of a New Containment Sump TS

The licensee proposed to add TS 3.6.7 requiring the containment sumps to be operable during Modes 1, 2, 3, and 4. Condition A specifies that if the containment sump is inoperable due to containment accident generated and transported debris exceeding the analyzed limits, then the licensee is required to: (1) initiate action to mitigate the containment accident generate and transported debris immediately, (2) perform SR 3.4.14.1 once per 24 hours, and (3) restore the containment sump to OPERABLE status within 90 days (Required Actions A.1, A.2, and A.3, respectively).. Surveillance Requirement 3.4.14.1 requires verification that the reactor coolant system (RCS) operational leakage is within limits by performance of an RCS water inventory balance.

Condition B specifies that if the containment sumps are inoperable for reasons other than Condition A, then the licensee is required to restore the containment sumps to operable status within 72 hours (Required Action B.1). Required Action B.1 is modified by two notes which directs entering the applicable conditions and required actions of LCO 3.5.3, "ECCS - Operating," and LCO 3.5.4, "ECCS - Shutdown," for ECCS trains made inoperable by the containment sump and entering the applicable conditions and required actions of LCO 3.6.6, "Containment Spray Systems," for containment spray system (CSS) trains made inoperable by the containment sump.

Condition C specifies that if required actions and associated CTs under Condition A and B are not met, then the licensee is required to be in Mode 3 in 6 hours and Mode 5 in 36 hours (Required Actions C.1 and C.2, respectively).

The licensee proposed to modify and move SR 3.5.3.8 currently located in TS 3.5.3. The new SR 3.6.7.1 requires the licensee to verify, by visual inspection, the containment sump does not show structural damage, abnormal corrosion, or debris blockage every "In accordance with the Surveillance Frequency Control Program."

PVNGS's containment sump design includes more than one containment sump. PVNGS has two containment sumps, one per train of ECCS/CSS. The two containment sumps are required to ensure a source of borated water to support ECCS and CSS OPERABILITY. PVNGS's containment sumps consist of the containment drainage flow paths, the containment sump strainers, the pump suction vortex breaker, and the inlet to the ECCS and CSS piping. The sumps are considered part of a single support system because containment accident generated and transported debris issues that would render one sump inoperable would render all of the sumps inoperable. The new containment sump TS proposed is applicable to plants that have more than one containment sump.

The licensee also proposed a conforming change to the TS Table of Contents to reflect the addition of the new containment sump TS.

This change is evaluated in Section 3.3 of this SE.

2.2.4 Variations from TSTF-567, Revision 1

Palo Verde Nuclear Generation Station TSs utilize different numbering and titles than the Standard Technical Specifications on which TSTF-567 was based. Specifically, the plant-specific TS for ECCS – Operating, is TS 3.5.3, whereas in TSTF-567, ECCS – Operating, is TS 3.5.2. This affects the numbering of the related sump inspection SR, which in PVNGS's TSs is 3.5.3.8, and in TSTF-567 is 3.5.2.10. In addition, PVNGS's numbering for ECCS – Shutdown, is TS 3.5.4, while in TSTF-567 it is TS 3.5.3. Also, the TS numbering for the new TS added by TSTF-567, Containment Sump, is TS 3.6.13. For PVNGS the new TS is numbered 3.6.7. Lastly, the SR numbering for the Reactor Coolant System (RCS) water inventory balance surveillance is different. For PVNGS, the SR is 3.4.14.1, while TSTF-567 used the numbering 3.4.13.1. In addition, the PVNGS TS 3.6.6 is named Containment Spray System (CSS), whereas in TSTF-567 TS 3.6.6 is named Containment Spray and Cooling System (CSS). These differences are editorial and do not affect the applicability of TSTF-567 to the proposed LAR.

PVNGS's TSs contain a SFCP. Therefore, the Frequency for SR 3.6.7.1 is "In accordance with the Surveillance Frequency Control Program."

2.3 APPLICABLE REGULATORY REQUIREMENTS AND GUIDANCE

2.3.1 Technical Specification Requirements

Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.36(a)(1) requires each applicant for a license authorizing operation of a utilization facility to include in the application proposed TSs. That regulation also states, in part, that "[a] summary statement of the bases or reasons for such specifications, other than those covering administrative controls, shall also be included in the application, but shall not become part of the technical specifications."

The regulation at 10 CFR 50.36(b) requires:

Each license authorizing operation of a ... utilization facility ... will include technical specifications. The technical specifications will be derived from the analyses and evaluation included in the safety analysis report, and amendments thereto, submitted pursuant to [10 CFR] 50.34 ["Contents of applications; technical information"]. The Commission may include such additional technical specifications as the Commission finds appropriate.

The categories of items required to be in the TSs are provided in 10 CFR 50.36(c). As required by 10 CFR 50.36(c)(2)(i), the TSs will include LCOs, which are the lowest functional capability or performance levels of equipment required for safe operation of the facility. The regulation at 10 CFR 50.36(c)(2)(i) requires that when an LCO of a nuclear reactor is not met, the licensee shall shut down the reactor or follow any remedial action permitted by the TSs until the condition can be met.

The regulation at 10 CFR 50.36(c)(3) requires TSs to include SRs, which are requirements relating to test, calibration, or inspection to assure that the necessary quality of systems and components is maintained, that facility operation will be within safety limits, and that the LCOs will be met.

The regulation at 10 CFR 50.36(c)(5) requires TSs to include administrative controls, which "are the provisions relating to organization and management, procedures, recordkeeping, review and audit, and reporting necessary to assure operation of the facility in a safe manner."

2.3.2 Guidance

The guidance that the NRC staff considered in its review of this LAR included the following:

- NUREG-0800, Revision 3, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR [Light-Water Reactor] Edition," Chapter 16.0, "Technical Specifications," dated March 2010 (ADAMS Accession No. ML100351425), provides guidance on review of TSs.
- U.S. Nuclear Regulatory Commission, "Standard Technical Specifications, Combustion Engineering Plants," NUREG-1432, Volume 1, "Specifications," and Volume 2, "Bases," Revision 4.0, dated April 2012 (ADAMS Accession Nos. ML12102A165 and ML12102A169).

3.0 **TECHNICAL EVALUATION**

3.1 PROPOSED CHANGES TO TS 3.5.3, "ECCS - OPERATING"

The licensee proposed to modify and move SR 3.5.3.8 from TS 3.5.3 to the new containment sump TS. Therefore, the licensee proposed deletion of SR 3.5.3.8.

The new SR 3.6.7.1 does not limit the visual inspection to the suction inlet, vortex breaker and screens as currently required by the TSs, but instead requires inspection of the entire containment sump system. The containment sump system consists of the containment

drainage flow paths, any design features upstream of the containment sump that are credited in the containment debris analysis, the containment sump strainers (or screens), the pump suction vortex breaker, and the inlet to the ECCS and CSS piping.

The NRC staff concludes the proposed change is acceptable since the existing requirements are either unchanged or expanded and continue to ensure the containment sump is unrestricted (i.e., unobstructed) and stays in proper operating condition. The proposed change meets the requirements of 10 CFR 50.36(c)(3) because it provides an SR to assure the necessary quality of systems and components are maintained, that facility operation will be within safety limits, and that the LCOs will be met.

3.2 PROPOSED CHANGES TO TS 3.5.4, "ECCS - SHUTDOWN"

The licensee proposed to delete the reference to SR 3.5.3.8 in SR 3.5.4.1.

The NRC staff concludes the proposed change is acceptable since SR 3.5.3.8 was modified and moved to the new containment sump TS. The existing SR on the containment sump is augmented (by requiring inspection of additional sump components) and moved to the new specification, and a duplicative requirement to perform the SR in TS 3.5.4 is removed. The new specification retains or expands the existing requirements on the containment sump and the actions to be taken when the containment sump is inoperable with the exception of adding new actions to be taken when the containment sump is inoperable due to containment accident generated and transported debris exceeding the analyzed limits. The new action provides time to evaluate and correct the condition instead of requiring an immediate plant shutdown. The proposed change meets the requirements of 10 CFR 50.36(c)(3) because it provides SRs to assure the necessary quality of systems and components are maintained, that facility operation will be within safety limits, and that the LCOs will be met.

3.3 PROPOSED ADDITION OF CONTAINMENT SUMP TS

3.3.1 Evaluation of the New TS

The licensee proposed to add a new TS to address operability requirements of the containment sump. The numbering for this new TS is TS 3.6.7.

The containment sump supports the post-accident operation of the ECCS and CSS. However, only the current ECCS TSs contain SRs related to the containment sump and the TS do not specify required actions that specifically address an inoperable containment sump. If the containment sump were found to be inoperable, as an ECCS and CSS support system, those respective LCOs would not be met. In order to address concerns related to containment sump operability due to debris accumulation described in GSI-191, "Assessment of Debris Accumulation on Pressurized-Water Reactor Sump Performance," the licensee proposed to add a new specification to address containment sump inoperability and create a condition for when the sump is inoperable due to analyzed containment accident generated and transported debris.

Based on the below evaluation, the NRC staff determined that proposed TS satisfies the requirements of 10 CFR 50.36(c)(2)(i) because the LCO specifies the lowest functional capability or performance levels of equipment required for safe operation of the facility. There is reasonable assurance that the required actions to be taken when the LCO is not met can be conducted without endangering the health and safety of the public.

3.3.2 Evaluation of the Applicability

The new TS requires the containment sump to be operable during Modes 1, 2, 3, and 4. The ECCS and CSS TS currently in TS are applicable during Modes 1, 2, 3, and 4.

The NRC staff finds the proposed applicability is acceptable because the applicability is consistent with the applicability of the ECCS and CSS TS, the containment sump supported systems.

3.3.3 Evaluation of Condition A

The licensee has analyzed the susceptibility of the ECCS and CSS to the adverse effects of post-accident debris blockage and operation with debris-laden fluids. The licensee has established limits on the allowable quantities of containment accident generated debris that could be transported to the containment sump based on its current plant configuration. In the current TSs, if unanalyzed debris sources are discovered inside containment, if errors are discovered in debris-related analyses, or if a previously unevaluated phenomenon that can affect containment sump performance is discovered, the containment sump, and the supported ECCS and CSS, may be inoperable and the TSs would require a plant shutdown with no time provided to evaluate the condition.

In order to address this situation and to provide sufficient time to evaluate the condition, the licensee proposed Condition A, which is applicable when the containment sump is inoperable due to containment accident generated and transported debris exceeding the analyzed limits. Under Condition A, the operability of the containment sump with respect to debris is based on a quantity of debris evaluated and determined to be acceptable by the licensee. Conditions not evaluated under Condition A (containment accident generated and transported debris) and that affect the quantity of analyzed debris will be evaluated using a deterministic process.

Under Condition A, Required Action A.1 mandates immediate action to be initiated to mitigate the condition. The licensee's proposed TS Bases for Required Action A.1 provided the following examples of mitigating actions:

- Removing the debris source from containment or preventing the debris from being transported to the containment sump;
- Evaluating the debris source against the assumptions in the analysis;
- Deferring maintenance that would affect availability of the affected systems and other LOCA mitigating equipment;
- Deferring maintenance that would affect availability of primary defense-in-depth systems, such as containment coolers;
- Briefing operators on LOCA debris management actions; or
- Applying an alternative method to establish new limits.

The NRC staff finds the proposed Required Action A.1 and its CT are acceptable because they place urgency on the initiation of the appropriate actions that could mitigate or reduce the impact of the identified conditions.

Concurrently, Required Action A.2 mandates SR 3.4.14.1, the RCS water inventory balance, to be performed at an increased frequency of once per 24 hours. An unexpected increase in RCS leakage could be indicative of an increased potential for an RCS pipe break, which could result in debris being generated and transported to the containment sump.

The NRC staff finds the proposed Required Action A.2 and its CT are acceptable because the more frequent monitoring allows operators to act in a timely fashion to minimize the potential for an RCS pipe break while the containment sump is inoperable.

In addition, Required Action A.3 requires the inoperable containment sump to be restored to operable status in 90 days.

The NRC staff finds the proposed Required Action A.3 and its CT are acceptable because they provide a reasonable amount of time to diagnose, plan and possibly reduce the severity of, or mitigate the unanalyzed debris condition and prevent a loss of ECCS and CSS safety function. In addition, 90 days is adequate given the conservatism in the containment debris analysis and the proposed compensatory actions required to be implemented immediately by Required Action A.1. Also, as discussed later in this SE section, the new SR will require visual inspection of the containment sump system (including the containment drainage flow paths, any design features upstream of the containment sump that are credited in the containment debris analysis, the containment sump strainers, the pump suction vortex breaker, and the inlet to the ECCS and CSS piping for evidence of structural degradation, potential for debris bypass, and presence of corrosion or debris blockage) to ensure no loose debris is present and there is no evidence of structural distress or abnormal corrosion.

For Condition A, a plant with multiple sumps is treated equivalently to a plant with a single sump, because multiple sumps are considered to be part of a single support system.

3.3.4 Evaluation of Condition B

Condition B specifies the required actions for when the containment sump is inoperable for reasons other than containment accident generated and transported debris exceeding the analyzed limits.

Required Action B.1 requires restoring the containment sump to operable status and is modified by two notes. These two notes direct entry into the conditions and required actions for the supported systems (ECCS and CSS) upon entering Required Action B.1. Since Required Action B.1 directs entry to the corresponding ECCS and CSS TS, these notes retain the existing TS actions for ECCS or CSS trains made inoperable by an inoperable containment sump for reasons other than containment accident generated and transported debris exceeding the analyzed limits.

The proposed CT for Required Action B.1 is 72 hours. This CT is consistent with the CT for a single inoperable ECCS train or CSS train so that the ECCS and CSS TS Actions control the licensee's response.

The NRC staff finds the proposed change is acceptable since it continues to provide remedial actions for when the containment sump is inoperable for reasons other than Condition A and ensures safe operation of the plant. In addition, the proposed CT is acceptable since it provides a reasonable time for repairs, and there is a low probability of an accident occurring during this period that would require the use of the containment sump.

3.3.5 Evaluation of Condition C

If operators are unable to restore the affected containment sump to operable status under Condition A or B, Required Action C.1 requires the unit to be in Mode 3 in 6 hours followed by Mode 5 in 36 hours, as required by Required Action C.2.

The NRC staff finds this proposed condition and its required actions are acceptable because the condition is consistent with the STS and the required action requires the operators to place the unit in a condition in which the LCO no longer applies. In addition, the proposed CTs allow a reasonable amount of time to decrease from full power conditions to the required plant conditions in an orderly manner and without challenging plant systems.

3.3.6 Evaluation of the New SR

The licensee proposed a new SR in the new containment sump TS. This SR was originally located in TS 3.5.3 and referred to in TS 3.5.4. The numbering for this new SR is SR 3.6.7.1. The frequency of the new SR is "In accordance with the Surveillance Frequency Control Program."

The proposed SR requires verification, by visual inspection, that the containment sump does not show structural damage, abnormal corrosion, or debris blockage.

The new SR is stated in generic terms and expands the scope of the required visual inspection to include the entire containment sump system. The entire containment sump system consists of the containment drainage flow paths, the containment sump strainers (or screens), the pump suction vortex breaker, and the inlet to the ECCS and CSS piping.

The NRC staff finds the proposed new SR is acceptable since it expands the scope of inspection of the original SR. In addition, the proposed frequency is acceptable since it is the same as that currently required by the TSs. Therefore, the NRC staff finds that, as required by 10 CFR 50.36(c)(3), the necessary quality of systems will be maintained in accordance with the associated LCOs.

3.3.7 Evaluation of Changes to Table of Contents

The licensee also proposed a conforming change to the Table of Contents to include the new containment sump TS. This conforming change is acceptable since it is an editorial change to support the inclusion of the new containment sump TS.

3.3.8 Evaluation of Changes to the TS Bases

The licensee submitted TS Bases changes (that corresponded to the proposed TS changes) to provide the reasons for the proposed TSs. The licensee stated that the TS bases changes are consistent with the bases changes in the model application.

3.3.9 Conclusion Regarding Proposed Containment Sump TS

The new containment sump TS retains and expands the existing TS requirements with the exception of the addition of Condition A. Condition A provides a condition for an inoperable containment sump due to containment accident generated and transported debris exceeding the analyzed limits.

The NRC staff reviewed the proposed changes against the regulations and concludes that the changes continue to meet the requirements of 10 CFR 50.36(c)(2)(i) and 50.36(c)(3) for the reasons discussed above, and thus provide reasonable assurance that adoption of these TSs will have the requisite requirements and controls to operate safely. Therefore, the NRC staff concludes that the proposed TS changes are acceptable.

3.4 VARIATIONS

All variations are editorial and do not affect the applicability of TSTF-567 to the proposed LAR.

3.5 TECHNICAL EVALUATION CONCLUSION

The NRC staff determined that the proposed TS changes meet the standards for TS in 10 CFR 50.36 and are acceptable. As required by 10 CFR 50.36(c)(2), the LCOs specify the lowest functional capability or performance levels of equipment required for safe operation of the facility. The proposed changes to the SR assure that the necessary quality of systems and components is maintained, that facility operation will be within safety limits, and that the LCOs will be met, and satisfy 10 CFR 50.36(c)(3).

4.0 STATE CONSULTATION

{This section is to be prepared by the plant project manager.}

In accordance with the Commission's regulations, the **[Name of State]** State official was notified of the proposed issuance of the amendment(s) on **[date]**. The State official had **[no]** comments. **[If comments were provided, they should be addressed here.]**

5.0 ENVIRONMENTAL CONSIDERATION

{This section is to be prepared by the plant project manager in accordance with current procedures.}

6.0 CONCLUSION

{This section is to be prepared by the plant project manager.}

The Commission has concluded, based on the considerations discussed above, that: (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) there is reasonable assurance that such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendment(s) will not be inimical to the common defense and security or to the health and safety of the public.

7.0 REFERENCES

{Optional section to be prepared by the PM and primary reviewers. If document is publicly available, the ADAMS Accession No. should be listed.}

{NOTE: These are the principal contributors for the model SE of the traveler. Replace these names with those who prepared the plant-specific SE.}

Principal Contributors: G. Lentchner, NRR/DSS
S. Smith, NRR/DSS

Date: