Pre-Submittal Meeting: Alloy 600 Management Program Plan

August 31, 2023

PaloVerde™ GENERATING STATION

Agenda

- License Renewal Commitment
- Program Overview
  - Past Mitigation
  - Alloy 600 Locations
  - Inspection Program
  - Repair Techniques
- Submittal Timeline

License Renewal Commitment
UFSAR Table 19.5-1

Commitment 23, Item A, states:

Reactor Coolant System Nickel Alloy Pressure Boundary Components

"Implement applicable (1) NRC Orders, Bulletins and Generic Letters associated with nickel alloys and (2) staff-accepted industry guidelines, (3) participate in the industry initiatives, such as owners group programs and the EPRI Materials Reliability Program, for managing aging effects associated with nickel alloys, (4) upon completion of these programs, but not less than 24 months before entering the period of extended operation, **APS will submit an inspection plan for reactor coolant system nickel alloy pressure boundary components to the NRC for review and approval**"

Program Overview

- Maintain plant safety
- Minimize the impact of primary water stress corrosion cracking (PWSCC) on plant availability
- Develop and execute short- and long-term strategies for Alloy 600 management

Past Mitigation

- Palo Verde has proactively replaced the Alloy 600 pressurizer and hot leg instrument nozzles in each Unit.
- In addition, pressurizer heater sleeves (36 per Unit) have been replaced or repaired.
- Weld overlays have been implemented for the more susceptible Dissimilar Metal (DM) welds.
- The reactor vessel closure heads have been replaced in each Unit.

Alloy 600 Locations

Component	Number Per Unit
Reactor Pressure Vessel	Bottom Mounted Instrument Nozzles (61 In-core Instrumentation Penetrations in Units 1 and 2. 60 In-core Instrument Penetrations in Unit 3), Flange Leak off line
Pressurizers	4 DM welds (PZR Safeties) 1 DM weld (PZR Spray) 1DM weld (PZR Surge) 7 replacement instrumentation nozzles*
RCS Piping	12 CL nozzles, 8 RCP instrument nozzles in Units 1 and 2 (7 in Unit 3 after RCP 2A repair with 690), DM weld (PRZ Surge), 2 DM welds Shutdown Cooling 27 HL instrumentation nozzles *
Steam Generators	Tubesheet cladding, Nozzle Dams Retention Rings Cladding 4 CL instrumentation nozzles*

∗ Some replacement nozzles were welded using In-82 weld

Inspection Program

Reactor Pressure Vessel (RPV)

- *Upper Head Penetrations*
  - Penetrations replaced and contain Alloy 690
  - RPV head bare metal visual inspection every third refueling outage or 5 calendar years (whichever is less)
- *Bottom Mounted Instrumentation Nozzles*
  - Alloy 600 nozzles are inspected every other outage
  - Cleaning process developed to enable bare metal visual exam

Inspection Program

Pressurizer

- Steam space nozzles replaced with Alloy 690 (all 3 units)
- Lower shell and lower head water space nozzles replaced with Alloy 690
- Replacement nozzles welded with In-82 and subject to visual examination each refueling outage
- Heater sleeves mitigated with Alloy 690 and In-52 weld

Reactor Coolant System (RCS) Dissimilar Metal Butt-Welds

- Current inspection requirements are implemented from ASME Section XI Code Case N-770-5 (large bore = 6 Cycles, small bore = 4 Cycles)

Inspection Program

RCS Piping Instrument Nozzles

- Hot leg RCS piping instrument nozzles replaced with Alloy 690 and some welded with In-82
- Hot leg nozzles examined every outage
- Bare metal examinations of cold leg nozzles performed once per interval per Code Case N-722-1

Steam Generators

- Inspections performed under the Steam Generator Management Plan (SGMP)

Repair Techniques

Half-Nozzle Repair

- Original nozzle cut off outside piping or vessel
- Outer portion of nozzle machined out
- Inner portion of nozzle abandoned in place
- New Alloy 690 half nozzle installed and welded to piping or vessel outside diameter
- New weld meets ASME Code Section III & XI Requirements

Repair Techniques

Full-Nozzle Replacement

- Pressurizer steam space nozzles repaired using a full-nozzle replacement with an internal J-weld (like-for-like replacement)
- Pressurizer water space nozzles attached with a temper bead pad weld
- Full-nozzle replacements for RCS piping instrument in Unit 2 with an external attachment directly on outside surface of pipe

Mechanical Nozzle Seal Assembly (MNSA)

- Provides external seal for Alloy 600 instrument nozzles
- One MNSA installed on the 2B Cold Leg temperature indicator in Unit 1

Submittal Timeline

- Unit 1 period of extended operation (PEO) - June 1, 2025
- Submittal is recognized as being made after the 24-month criterion for Unit 1, but before the 24-month criterion for Unit 2 (PEO - April 24, 2026), and Unit 3 (PEO - November 25, 2027)
- Unit 1 submittal delay entered into the PVNGS corrective action program
- Target submittal - September 2023

Questions