

NRC Informational Call

Potential Relief Request:
Reactor Vessel Head Nozzle #74 Examination
Catawba Nuclear Station Unit 2

April 15, 2021



Agenda

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Objectives and Scope

- ▶ Objectives:

- ▶ Present Duke's potential need for relief for deferral of completion of the leak path assessment of CRDM Nozzle #74 at Catawba Unit 2 for one nominal 18-month cycle, in the event undue hardship is encountered with obstruction removal efforts

- ▶ Scope:

- ▶ Proposed alternative only applies to a fraction of the leak path assessment portion of the Item B4.20 examination per Note (6) of Table 1 of ASME Code Case N-729-6 for a single head penetration

Inspection History

Catawba Unit 2 RVCH

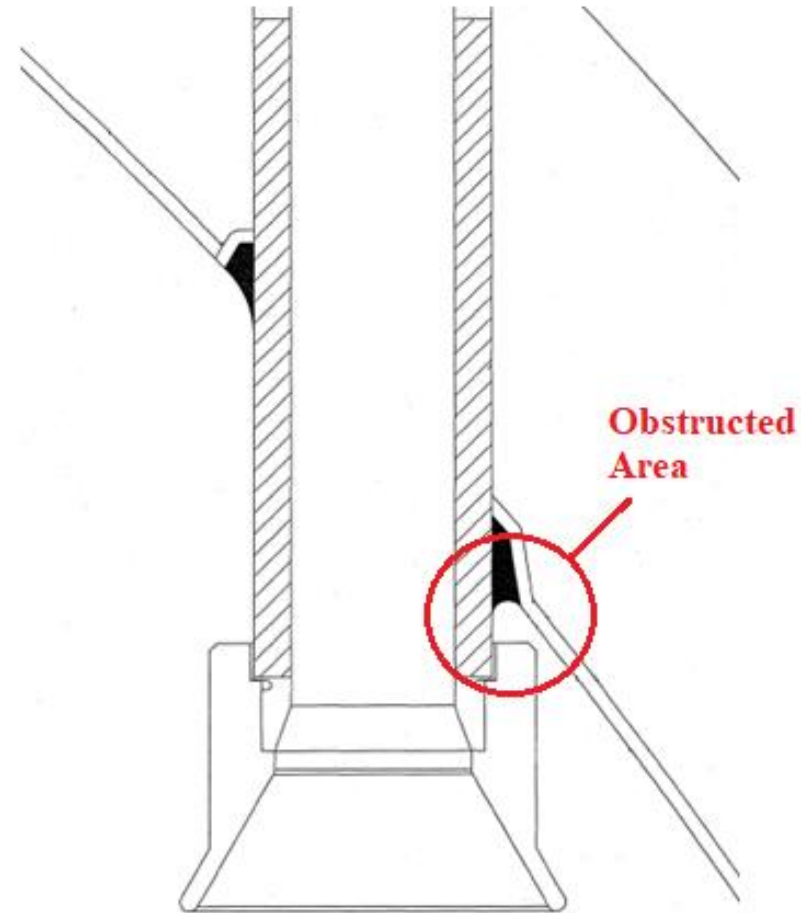
- ▶ Reactor Vessel Closure Head (RVCH) is original and fabricated by CE with Alloy 600 nozzle material supplied by Huntington attached to the inside of the head with Alloy 82/182 J-groove welds
- ▶ Previous volumetric examinations and leak path assessments of all penetrations performed using UT in 2007 and 2013 with no detected PWSCC indications
- ▶ Volumetric examinations and leak path assessments completed on all other penetrations during the current outage with no PWSCC detected. Leak path assessment of nozzle #74 is unresolved.
- ▶ Bare metal visual examinations performed of the head in 2018 (C2R22), 2019 (C2R23), and 2021 (C2R24) with no detections of head penetration leakage
- ▶ To date there have been no reports of PWSCC affecting U.S. heads fabricated by CE or fabricated with Alloy 600 nozzle material supplied by Huntington and operating at reactor cold leg temperature (T_{cold})

Current Inspection Requirements

- ▶ The Catawba Unit 2 head operates at reactor cold leg temperature ($T_{\text{cold}} = 557^{\circ}\text{F}$), and PWSCC has not been detected
- ▶ Hence, per 10 CFR 50.55a(g)(6)(ii)(D) and ASME Code Case N-729-6, Item B4.20 volumetric or surface examinations of all penetrations are required prior to RIY = 2.25 or 8 years, whichever is sooner
- ▶ Per Note (6) of Table 1 of ASME Code Case N-729-6, the volumetric or surface examination of each penetration must include a volumetric and/or surface leak path assessment examination

Nozzle #74 Description

- ▶ The nozzle at penetration #74 is one of five core exit thermocouple (CET) locations on the outer periphery of the RVCH
- ▶ The CET nozzles have a threaded guide funnel attached with two anti-rotation dowel pins installed which are plug welded in place



RVCH Examinations this RFO

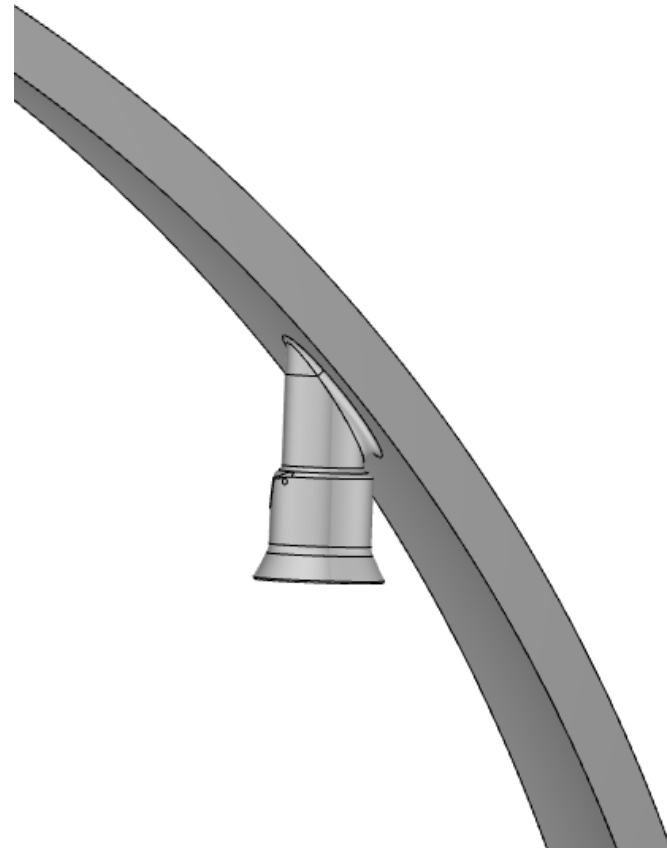
Nozzle #74

- ▶ UT examination of the Alloy 600 nozzle tube was successfully completed with no indications of PWSCC detected
- ▶ A change in back-wall reflectivity between the penetration OD and RVCH in penetration number 74 was discovered during the volumetric leak path assessment (UTLP).
 - ▶ There is an area of reduction in amplitude of the backwall region contained within the interference fit region located above the high-hill side of the J-groove weld profile.
 - ▶ EPRI review indicated the UTLP pattern does not exhibit variations similar to that of industry OE.
- ▶ A bare metal visual in accordance with Item No. B4.10 of ASME Code Case N-729-6 was performed with no relevant visual indications.
- ▶ Supplemental OD j-groove weld ECT was performed on approximately 89% (320° of 360° circumferentially) of the wetted surface of the weld, and no planar flaws or surface breaking indications were detected within the examined region.
- ▶ Until the remaining 11% (40° of 360° circumferentially) of the j-groove weld can be examined by surface methods, the examination is incomplete and the leak path assessment is unresolved.

Leak Path Assessment Obstruction

Nozzle #74

- ▶ Interference from the funnel welded to the end of the penetration nozzle (which functions as a thermocouple column) prevented completion of the ECT surface examination over 11% of the weld area
- ▶ NDE of the j-groove weld surface requires funnel removal to obtain full coverage



Nozzle #74 Funnel Removal Attempts

- ▶ Catawba contracted an outside vendor with relevant experience to work with Duke Energy maintenance personnel on removal of the plug-welded funnel
- ▶ A manual grinding evolution was performed to remove the plug welds on the dowel pins
- ▶ Attempts to remove the dowel pin and free the funnel were made using available tooling and additional tooling purchased emergently
- ▶ Dowel pins were not able to be extracted from funnel through multiple attempts, thus funnel removal was prevented
- ▶ Approximately 4.8 REM dose has been accrued to date on the funnel removal activities

Proposed Alternative

- ▶ One-time alternative will be requested in accordance with 10 CFR 50.55a(z)(2) – Hardship without a commensurate increase in quality and safety
- ▶ At the next refueling outage in Fall 2022 (C2R25):
 - ▶ The obstruction will be removed and the remaining portion of the weld surface will be examined
 - ▶ Bare metal visual will be performed
- ▶ The routine online leakage detection capability provides additional assurance and defense in depth until the time of the next refueling outage and beyond

Technical Basis for Relief Request

- ▶ The two main safety concerns addressed by the B4.20 volumetric or surface examination are:
 - ▶ 1) Nozzle ejection
 - ▶ The nozzle ejection is a concern if circumferential cracking occurs above the weld within the nozzle tube material
 - ▶ UT inspection revealed no cracking in the tube material, thus nozzle ejection is not a concern
 - ▶ 2) Boric acid corrosion of the low-alloy steel head
 - ▶ Concern is wastage of low-alloy steel material due to nozzle leakage
 - ▶ Visual examinations are highly effective in detecting any leakage caused by PWSCC before any discernible material loss is produced via boric acid corrosion of carbon or low-alloy steel pressure boundary components
 - ▶ Bare metal visual performed during current outage validated no visual indication of nozzle leakage, so discernible material loss due to boric acid corrosion over the next operating cycle is not a concern

Technical Basis for Relief Request

- ▶ During the current outage, 89% of the wetted surface of the weld was examined and no planar flaws or surface breaking indications were detected
- ▶ The susceptibility of the examined area of the weld is representative of the unexamined portion
- ▶ To date there have been no reports of PWSCC on RVCHs of equivalent fabrication material and operating temperature

Timeline for Submittal

- ▶ C2R24 outage is ongoing, with plans being made for funnel removal and completion of leak path assessment for nozzle #74
- ▶ In the event emergent funnel removal is not feasible, or it is determined it cannot be performed without undue risk to plant personnel or critical plant equipment, Duke Energy may request verbal approval for relief per 10 CFR 50.55a(z)(2)