



Pre-Submittal Meeting ANO-1 LAR Related to RCS Primary Activity and Primary-to-Secondary Leak Rate

April 8, 2021



Agenda

- Introductions
- Purpose
- Background
- Methodology and Inputs
 - Dose Models
 - Source Term
- Preliminary Results
 - Proposed Technical Specification Values
 - Preliminary Dose Results
- Conclusions
- CLOSED SESSION
 - Thermal Hydraulic Model
 - Determination of Flashing Fraction

Purpose

Discuss the proposed changes to the ANO-1 Technical Specifications (TS) for RCS activity and Primary-to-Secondary leakage.

- These changes are the result of a proposed revision to the steam generator flashing fraction due to the identification of a non-conservative TSs in 2018.
- Describe how the proposed flashing fraction was determined and the subsequent impacts to applicable technical specifications.

Background

- Current Technical Specification (TS) Values
 - TS 3.4.12 Dose Equivalent Iodine
 $< 60 \mu\text{Ci/gm}$
 - TS 3.4.12 RCS I-131 Primary Activity
 $< 1.0 \mu\text{Ci/gm}$
 - TS 3.4.13 RCS Primary-to-Secondary Leak Rate
150 gallons per day
 - Based on the use of Alternate Source Term
(10 CFR 50.67)
 - Approved in October 2009

Background (continued)

- October 2018, it was identified that the off-site dose consequences for the ANO-1 Steam Generator Tube Rupture (SGTR) event were non-conservative.
 - Failed to consider post-trip High Pressure Injection (HPI) flows during event.
 - Maintains Reactor Coolant System (RCS) pressure at a higher level, leading to a higher primary-to-secondary leak rate.
 - Extends timing to isolate the ruptured SG
 - Potential higher release

Background (continued)

- While working to resolve the issue, it was identified that a potentially non-conservative value was used for the “flashing fraction”.
 - “Flashing fraction” is the fraction of the RCS leakage that vaporizes when it enters the secondary, rather than entering the SG liquid.
 - Same flashing fraction was used in the Main Steam Line Break (MSLB) and Rod Ejection events dose analyses.
 - ANO-1 took compensatory measures to limit the RCS Primary Activity and Primary-to-Secondary leak rate to bring the potential dose consequences under the acceptance criteria in accordance with current NRC guidance based on using a flashing fraction of 100%.

Methodologies and Inputs

- Dose Analyses performed with RADTRAD
 - Maintained the previous release points
 - Maintained the previous X/Qs
 - ANSI 18.1 Source Term
 - Revised Thermal-Hydraulics
 - Revised flashing fraction
- Thermal-Hydraulics analysis revised using RELAP5/MOD2-B&W
- New flashing fraction determined using Computational Fluid Dynamics (CFD) and heat transfer calculation methods.

Source Term

- For SGTR and MSLB, using ANSI 18.1
 - With no event-induced fuel failures, just the RCS source term.
- For Rod Ejection, maintaining the source term
 - The Rod Ejection event induces fuel failures

Thermal-Hydraulic Model (closed)

- Modeled with RELAP5/MOD2-B&W, performed by Framatome
- Doubled-ended tube rupture at full power
- Loss of offsite power upon reactor trip
 - 9.6 minutes for early trip case (makeup/letdown mismatch), 21.6 minutes for delayed trip
- Assumptions:
 - No operator actions until 20 minutes after tube rupture
 - Single failure of ADV Block Valve on Unaffected SG
 - Operator dispatched, opened at 70 minutes

Preliminary Results

- A flashing fraction of 40% of the flow from the ruptured tube at 4 minutes after the scram in the SGTR event
- A flashing fraction of 100% everywhere else in all other analyses.
- Limiting values
 - RCS Dose Equivalent Iodine (DEI) - 24 $\mu\text{Ci/gm}$ (60 $\mu\text{Ci/gm}$)
 - RCS Primary Activity – 0.25 $\mu\text{Ci/gm}$ (1.0 $\mu\text{Ci/gm}$)
 - Primary-to-Secondary Leak Rate - 39 gallons per day (gpd) per steam generator (150 gpd)

Preliminary Results

- SGTR
 - Pre-Existing Spike:
 - Exclusion Area Boundary (EAB) 6.1 rem TEDE
 - Low Population Zone (LPZ) 1.0 rem
 - Control Room (CR) 4.8 rem
 - Accident-Induced Spike:
 - EAB 2.48 rem TEDE
 - LPZ 0.41 rem
 - CR 1.38 rem

Preliminary Results

- MSLB
 - Pre-Existing Spike:
 - EAB 0.32 rem TEDE
 - LPZ 0.18 rem
 - CR 1.08 rem
 - Accident-Induced Spike:
 - EAB 1.26 rem TEDE
 - LPZ 0.72 rem
 - CR 2.55 rem

Preliminary Results

- CEA Ejection
 - EAB 3.3 rem TEDE
 - LPZ 2.2 rem
 - CR 4.95 rem
- Locked Rotor
 - EAB 0.7 rem TEDE
 - LPZ 0.5 rem
 - CR 1.1 rem

Conclusions

- Revised TS values
 - TS 3.4.12 DEI
 $< 24 \mu\text{Ci/gm}$ ($< 60 \mu\text{Ci/gm}$)
 - TS 3.4.12 RCS I-131 Primary Activity
 $< 0.25 \mu\text{Ci/gm}$ ($< 1.0 \mu\text{Ci/gm}$)
 - TS 3.4.13 RCS Primary-to-Secondary Leak Rate
39 gpd (150 gpd)

Schedule

- LAR submittal expected by the end of April 2021
- Standard approval timeframe requested (13 months)



CLOSED SESSION