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 µCi/gm
  - TS 3.4.12 RCS I-131 Primary Activity
    < 1.0 µCi/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 µCi/gm (60 µCi/gm)
  - RCS Primary Activity – 0.25 µCi/gm (1.0 µCi/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

Conculsions

- Revised TS values
  - TS 3.4.12 DEI

    < 24 µCi/gm (< 60 µCi/gm)
  - TS 3.4.12 RCS I-131 Primary Activity

    < 0.25 µCi/gm (< 1.0 µCi/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