



**Robinson / NRC Pre-submittal Meeting:  
LAR to Revise Technical Specification 3.5.3 ECCS - Shutdown**

February 2, 2022



- Introduction
- License Amendment Request Overview
  - Current and Proposed Technical Specification (TS) 3.5.3, ECCS - Shutdown
  - Reason for the Proposed Change
  - Overview of Robinson (RNP) Emergency Core Cooling System (ECCS)
  - Safety Analysis Discussion
  - PWROG-19021-P Discussion
- Implementation Plan and Closing Remarks

## Duke Energy Attendees

Lee Grzeck (Manager, Nuclear Fleet Licensing)

Chris Courtenay (Lead Nuclear Engineer, Nuclear Fleet Licensing)

Sam Shicks (Lead Nuclear Engineer, RNP Engineering)

Brian Kawa (Nuclear Control Room Supervisor, Operations)

# Current and Proposed TS 3.5.3, ECCS - Shutdown

## ■ Current: 3.5 EMERGENCY CORE COOLING SYSTEMS (ECCS)

### 3.5.3 ECCS - Shutdown

LCO 3.5.3 One ECCS train shall be OPERABLE.

APPLICABILITY: MODE 4.

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## ■ Proposed: 3.5 EMERGENCY CORE COOLING SYSTEMS (ECCS)

### 3.5.3 ECCS - Shutdown

LCO 3.5.3 One ECCS train shall be OPERABLE.

APPLICABILITY: MODE 4.

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#### NOTE

1. One cold leg safety injection (SI) pump flow path may be isolated by closing the isolation valves for up to 24 hours to perform pressure isolation valve testing per SR 3.4.14.1.
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# Reason for the Proposed Change

- Current TS 3.5.2, ECCS - Operating:

3.5 EMERGENCY CORE COOLING SYSTEMS (ECCS)

3.5.2 ECCS - Operating

LCO 3.5.2 Two ECCS trains shall be OPERABLE.

APPLICABILITY: MODES 1, 2, and 3

1.

NOTES

1. In MODE 3, one cold leg safety injection (SI) pump flow path may be isolated by closing the isolation valves for up to 24 hours to perform pressure isolation valve testing per SR 3.4.14.1.

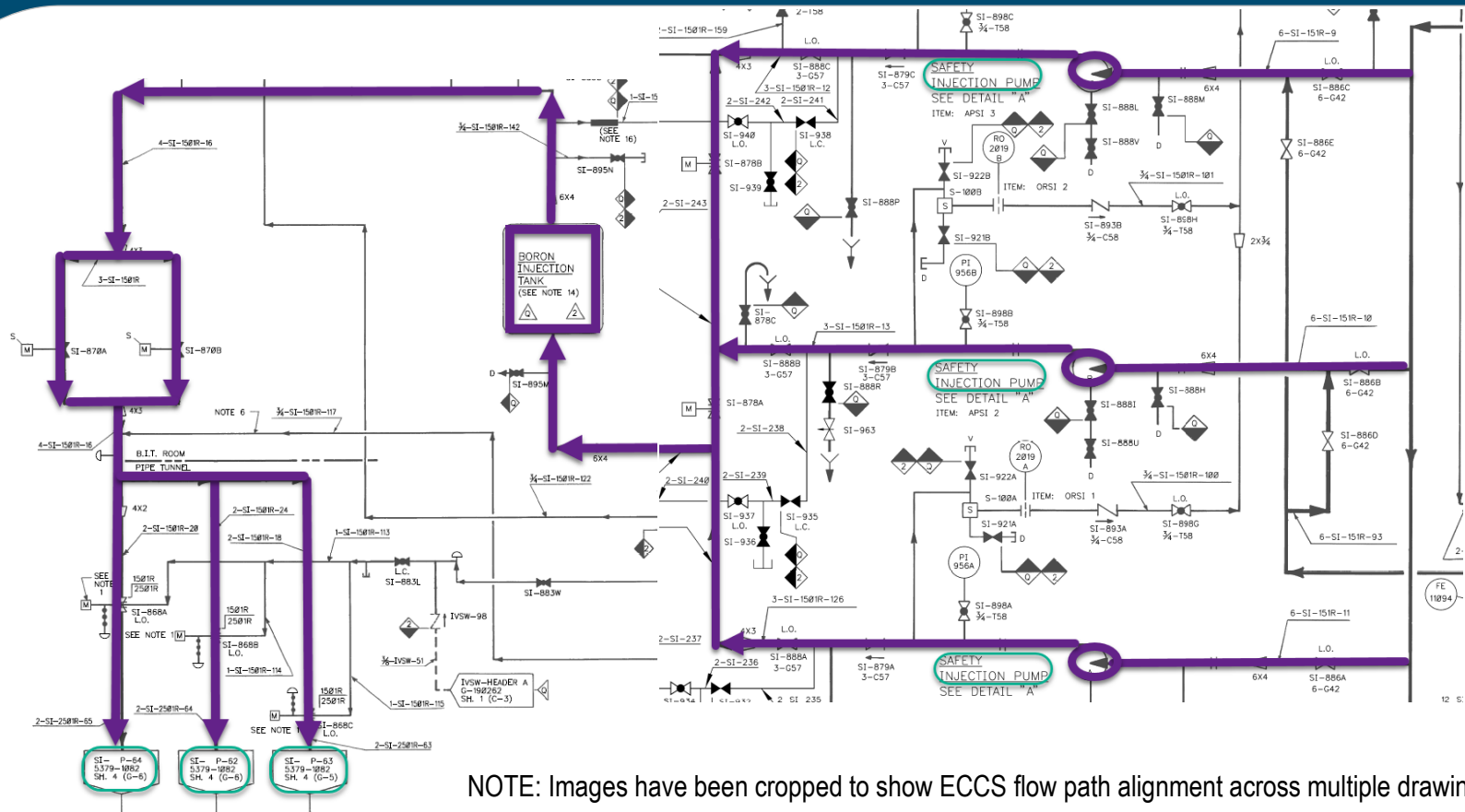
2. Operation in MODE 3 with one required SI pump declared inoperable pursuant to LCO 3.4.12, "Low Temperature Overpressure Protection (LTOP) System," is allowed for up to 4 hours or until the temperature of all RCS cold legs exceeds 375°F, whichever comes first.

- Perform testing of pressure isolation valves (PIV) earlier in plant start-up.
- Reduced ECCS flow requirements for a design basis accident (DBA) in MODE 4, with lower reactor coolant system (RCS) temperature and pressure, than in MODE 3.
- There is no industry precedent for the proposed change.

# Overview of RNP ECCS

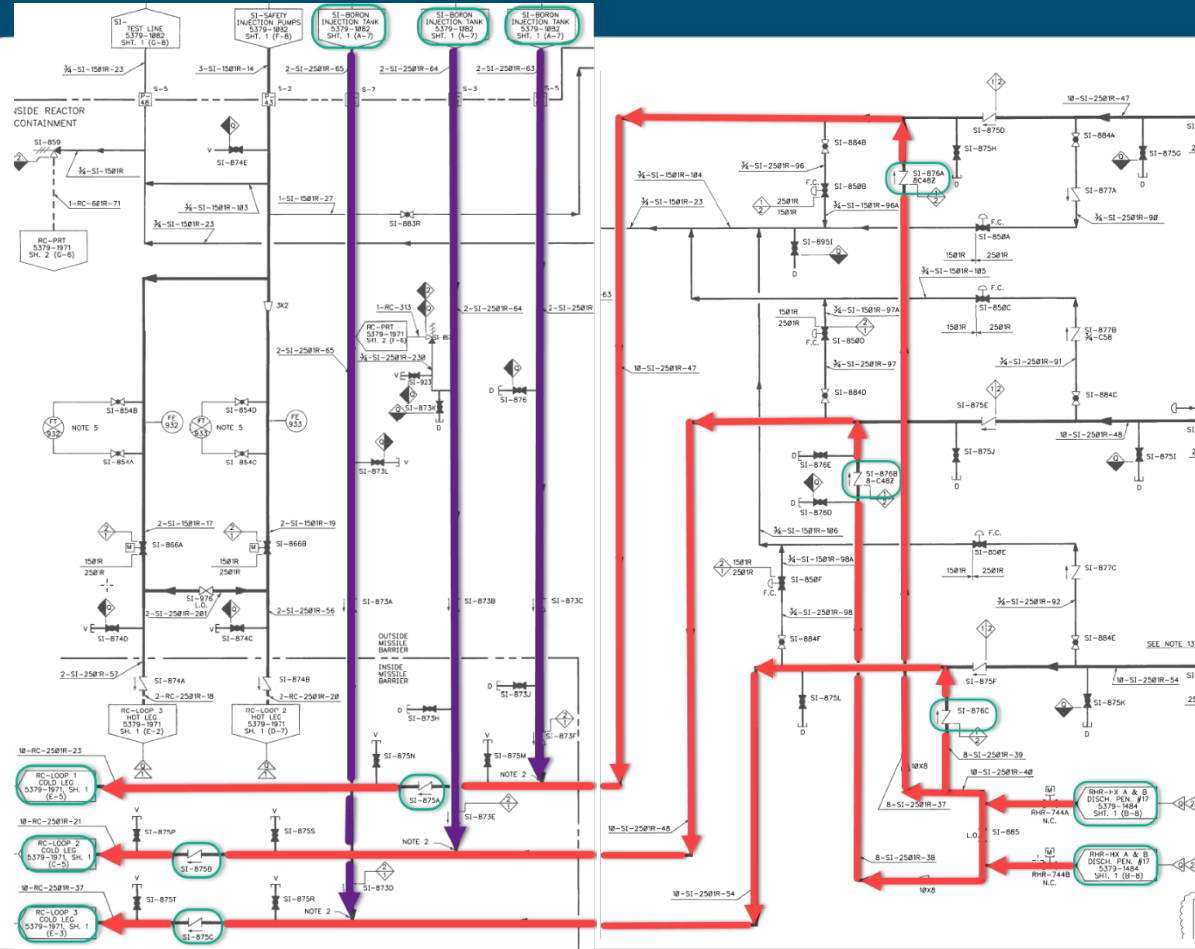
- ECCS consists of two separate subsystems:
  - Safety Injection (SI) (high head),
  - Residual Heat Removal (RHR) (low head).
- Each subsystem consists of two redundant, 100% capacity trains.
- One full train of ECCS consists of:
  - One train of SI
  - One train of RHR
- ECCS includes the flow paths, consisting of piping, valves, heat exchangers, and pumps.
  - *NOTE: ECCS accumulators and the Refueling Water Storage Tank (RWST) are also part of the ECCS but are not considered part of an ECCS flow path.*
- Discharge from the SI pumps combines into the boron injection tank, then divides into three supply lines, each going to one RCS cold leg.
- Discharge from the RHR pumps combines in a header, then divides into three supply lines, each going to one RCS cold leg.

# RNP ECCS Flow Path Drawings



NOTE: Images have been cropped to show ECCS flow path alignment across multiple drawings.

## RNP ECCS Flow Path Drawings (cont.)



NOTE: Images have been cropped to show ECCS flow path alignment across multiple drawings.



# Safety Analysis Discussion

- TS 3.5.3 Applicable Safety Analyses state the analyses of TS 3.5.2 apply.
  - Lower requirements in MODE 4 versus MODES 1/2/3 for TS 3.5.2.
  - Single Failure not required in MODE 4.
  - Therefore, 1 full train of ECCS required in MODE 4.
- TS 3.5.2 Applicable Safety Analyses establishes:
  - Each ECCS subsystem is credited for large break loss-of-coolant accident (LOCA) at full power (i.e. MODE 1). Single Failure assumed to be one RHR pump.
  - Only SI is credited for a small break LOCA. Single Failure assumed to be one full ECCS train.
  - Failure of a check valve in the injection pathways to open is not considered a credible Single Failure and therefore, the analysis does not assume a single failure of an SI cold leg injection pathway.

# Safety Analysis Discussion (cont.)

- RNP Safety Analysis performed hydraulic modeling with one SI pump in MODE 3 and MODE 4 to determine effects of having 2 of 3 cold leg injection paths available:
  - Calculation supports PWROG-19021-P, Revision 0, *Westinghouse NSSS Shutdown LOCA Analysis Basis for ARG-2*.
    - Discussed further on next slide.
  - Concluded one SI pump can provide adequate flow to the RCS cold legs with only two flow paths available.
  - In addition, there is adequate time to un-isolate the cold leg flow path undergoing testing or supplement the flow through the remaining two ECCS cold leg injection flow paths with an alternate ECCS pump if desired.
  - The resulting transient response does not result in fuel cladding failure, therefore the delayed ECCS initiation demonstrates successful mitigation of the event.

# PWROG-19021-P for Westinghouse PWRs

- PWROG-19021-P, Revision 0, replaces WCAP-12476, Revision 1, *Evaluation of LOCA During Mode 3 and Mode 4 Operation for Westinghouse NSSS*, as the technical basis for Abnormal Response Guideline ARG-2, *Shutdown LOCA*.
  - Not endorsed by NRC.
- Discusses most likely LOCA in MODE 4 is failure of RHR outside of Containment.
- Mitigating action is to isolate failed system and start up alternate.
- Westinghouse 3-loop PWRs (like RNP) can accommodate at least 40-minute delay time to start up alternate ECCS pump.
  - 40 minutes is “anticipated” time to start up the alternate pump.
  - No core uncover at 40 minutes, so additional time could be accommodated.

# Implementation and Closing Remarks

- Implementation:
  - Operations owns implementation
  - Cross-functional team supporting implementation
  - Procedure changes and training
- Closing:
  - Submit LAR in February/March 2022
  - Ready to implement LAR within 120 days of receipt of SE

