McGuire Nuclear Station
Technical Information Meeting

Atlanta, GA
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Duke Participants

- Jim Kammer, McGuire Safety Assurance Manager
- Jeff Thomas, McGuire Regulatory Compliance Manager
- Eric Henshaw, Duke Safety Analysis Senior Engineer
- Mike Weiner, McGuire Operations Senior Engineer

Agenda

- Opening Remarks
- Background
- Unresolved Issues
- Postulated Event Description
- Emergency Procedure / UFSAR Changes
- 10CFR50.59 Rationale
- Summary

Background

- 10/04 – McGuire questioned if sufficient sump level would exist to complete transfer to cold leg recirculation following certain small break loss of coolant accidents (SBLOCAs)
- Issue entered into corrective action program (PIP M-04-5115)
- Issue considered within the current licensing basis
- Entered the Operability Determination Process

Background

- Prompt Corrective Actions
  - Enhanced margin by opening refueling canal drain path from upper containment
  - Increased Refueling Water Storage Tank (FWST) level
- Subsequent Corrective Actions
  - Revised Emergency Procedures to incorporate alternate SBLOCA swapover sequence for specific SBLOCAs
  - Conducted training to enhance awareness
  - Completed Operability Evaluation confirms that sufficient water volume exists. Nonconformance with UFSAR identified (3/05)

Background

- Subsequent Corrective Actions (continued)
  - Installed precision containment sump level switches in Unit 2 (8/05) and Unit 1 (10/05)
  - Revised UFSAR to clear the nonconformance and to describe the SBLOCA scenarios in which Containment Spray is not operating and the actions to be taken to mitigate such events (9/05).

Unresolved Issues

1. Did changes to emergency procedures and/or UFSAR 6.3.2.6 require changes to Technical Specification (TS) 3.4.15, Reactor Coolant System Leakage Detection Instrumentation, per 50.59(c)(1)(i)?
2. Did changes to emergency procedures and/or UFSAR 6.3.2.6 result in more than a minimal increase in the likelihood of a malfunction of a structure system, or component (SSC) important to safety previously evaluated in the final safety analysis report per 50.59(c)(2)(ii)?

Unresolved Issues

3. Did changes to emergency procedures and/or UFSAR 6.3.2.6 create a possibility for an accident of a different type than any previously evaluated in the final safety analysis report (as updated) per 50.59(c)(2)(v)?
4. Did changes to emergency procedures and/or UFSAR 6.3.2.6 create a possibility for malfunction of an SSC important to safety with a different result than any previously evaluated in the final safety analysis report (as updated) per 50.59(c)(2)(vi)?
5. Should the changes to UFSAR 6.3.2.6 have been evaluated via a 50.59 Evaluation instead of a 50.59 Screening?

Postulated Event Description

- Overview
  - Review of Containment Response
    - Large Break LOCA
    - Small Break LOCA
  - Minimum Sump Level SBLOCA evaluations
  - Conservative Inputs
  - Typical Sequence of Events
  - Containment Spray Functions

Postulated Event Description

- Objective of minimum sump level cases

  (from an analyst's perspective)

  - Maximize leakage to incore room
  - Minimize ice melt
  - Avoid containment spray operation
    - Actuation transfers FWST fluid to containment sump
    - Actuation speeds up event time line

Postulated Event Description

- SBLOCA minimum sump level evaluation
  - Focus changed from maximizing pressure/temperature to minimizing ice melt
  - UFSAR Chapter 6 containment response analyses performed from EOC hot full power conditions, which are conservative for evaluating peak containment pressure & maximum sump temperature.
  - Peak containment pressure (UFSAR Chapter 6) not limiting for SBLOCA, and not challenged if minimum sump level is an issue (i.e., little ice melt).
  - Peak clad temperature (PCT) (UFSAR Chapter 15.6.5) not challenged for breaks that do not actuate containment spray

Postulated Event Description

- Comparison of Conservative Inputs

	Peak Containment Pressure	Min Sump Level
Decay heat	EOC (max)	BOC (min)
FWST temperature	TS max	TS min
ECCS flow rates	Min 1 train	Max 2 train
Ice temperature	TS max	Min
Lower containment ventilation	none	Max

Postulated Event Description

- Typical Sequence of Events for SBLOCA that does not cause containment spray actuation, including procedural operator actions (preliminary evaluation results)
  - Initiated from Hot Zero Power (HZP) 557 ^{o}F
  - Maximum ECCS flow
  - Cold FWST
  - Low decay heat (BOC)
  - Lower containment non-safety coolers operate
  - Start cooldown 60 minutes after Safety Injection
  - Operator performs SI reduction sequence

Postulated Event Description

- HZP 0.005 ft2 cold leg nozzle break w/ Max ECCS, 65 °F FWST
  (preliminary evaluation results)

Time [min]	Description
0	Break initiation
n/a	Reactor trip
n/a	Turbine trip
5.2	SI actuation on low RCS pressure
65.2	Operator initiates cooldown (60 min after SI)
81.1	Operator trips RCPs on loss of subcooled margin
84.8	Operator cycles Pzr PORV to obtain 25% Pzr level
87.4	Operator isolates CLAs (Pzr level > 25% & subcooled margin) (beginning of recovery)
114.1	Operator begins SI reduction sequence
186.6	Hot leg temperature reaches 350 °F (exit Mode 3, RHR initiation setpt)
299.1	End simulation - Thot reaches 250 °F (@ ~5 hours)

Postulated Event Description

- Summary of conditions at 5 hours (end of simulation)
  (preliminary evaluation results)
  - Pzr pressure = 175 psig
  - Pzr level = 52%
  - Thot = 250 ^{o}F
  - SM pressure = 13 psig
  - FWST has not reached FWST lo-level setpoint
  - ~2 hours to FWST lo-level & ~6.7 hours to FWST lo-lo level (assuming ECCS flow of 350 gpm)
  - Total ECCS flow = 347 gpm (1 charging pump)
  - RHR flow = 0 gpm
  - Containment Spray flow = 0 gpm
  - Sump level = 0.23 ft, incore room is full
  - 94.5% (1.786E6 lbm) of ice remains (initial ice mass = 1.89E6 lbm)

Postulated Event Description

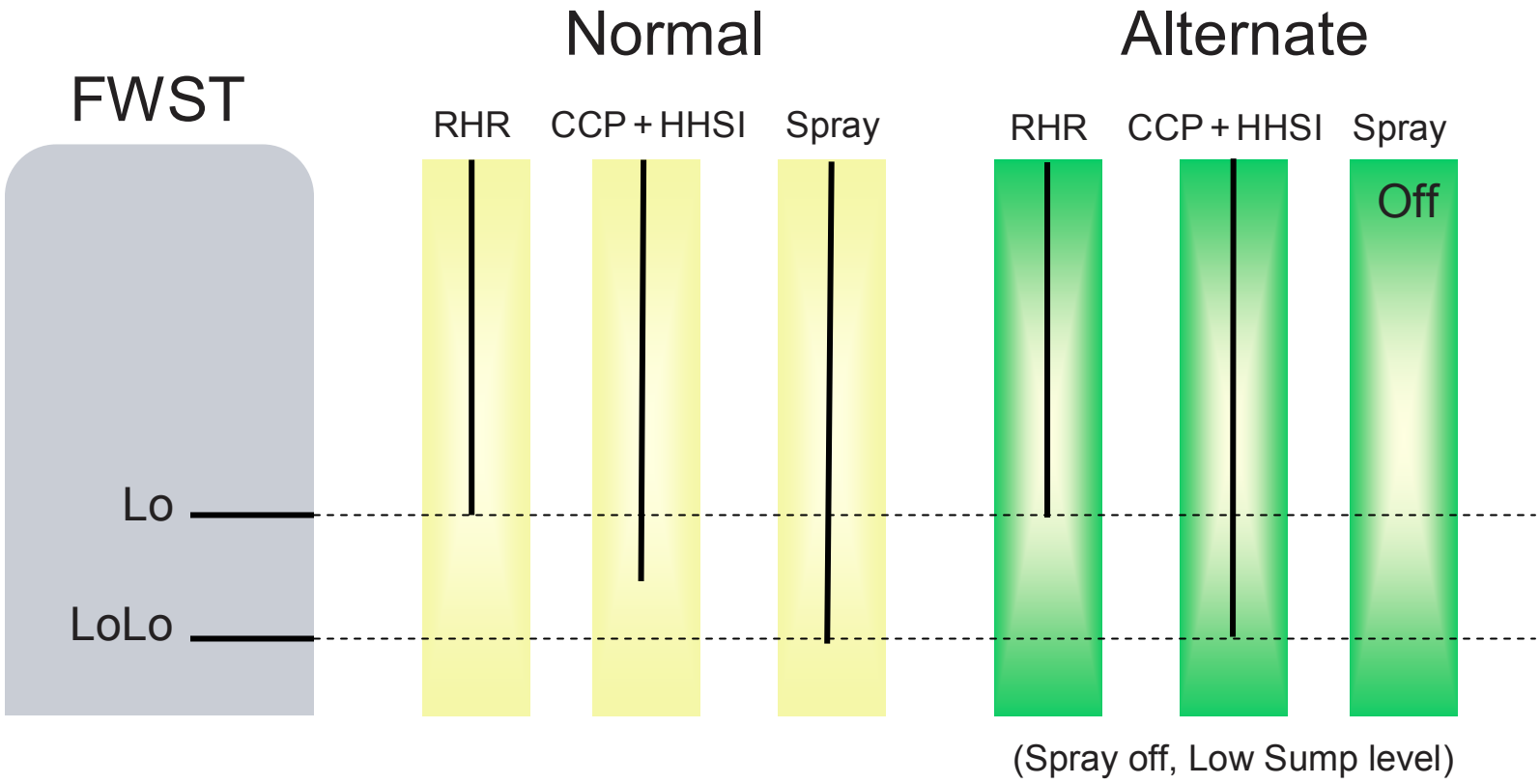
- Functions provided by Containment Spray
  - Maintain pressure below containment design.
    - Containment pressure not a concern for min sump level cases
  - Scrub atmosphere to reduce dose
    - Rod ejection provides the limiting SBLOCA source term
    - Containment spray not credited in rod ejection dose analysis
  - Remove heat from containment sump via heat exchanger
    - Function performed after FWST reaches lo-lo level setpoint
  - After FWST lo-level containment spray operation part of long-term recovery for minimum sump level cases

Emergency Procedure / UFSAR Changes

- Overview
  - Normal transfer sequence
  - Alternate sequence (procedure changes)

Emergency Procedure / UFSAR Changes

Swapover Sequence (Pumps Taking Suction From FWST)



RHR – Low Head SI CCP - Charging SI HHSI - High Head SI

Emergency Procedure / UFSAR Changes

- Normal Transfer to CLR Sequence
  - FWST lo-level alarm
  - ND pump auto-swap from FWST to containment sump
  - Operator manually re-aligns NI/NV pump suction from FWST to RHR pump discharge
  - FWST lo-lo level alarm
  - Operator stops Containment Spray pumps
  - Operator manually re-aligns Containment Spray pump suction from FWST to containment sump
  - Operator manually restarts Containment Spray pumps

Emergency Procedure / UFSAR Changes

- Transfer to Cold Leg Recirc Consideration for SBLOCA with Containment Spray off:
  - For SBLOCA with Containment Spray off, the volume in the FWST between FWST Lo and Lo Lo level will be left in the tank using the normal swapover sequence. If the break is in the incore room, we need this volume to be pumped into containment. An alternate sequence may be required to use the water between the FWST Lo and Lo Lo level setpoints.

Emergency Procedure / UFSAR Changes

- The alternate sequence enclosure of the Emergency Procedure (EP) does the following:
  - Ensures proper swap of RHR pumps to sump and confirms that RHR pumps are off
  - Ensures Spray pumps cannot start by pulling power fuses
  - NV and NI pumps to continue to run with suction on FWST until FWST Lo Lo level is reached
  - After FWST Lo Lo level is reached:
    - The ND pumps are started on sump and NV&NI are aligned to piggy back mode
    - The Spray pumps are aligned to sump
    - Manual start of one Spray pump is performed as needed with TSC concurrence

Emergency Procedure / UFSAR Changes

- Procedural Considerations
  - Without additional guidance, NI/NV pumps might be at risk following a Spray pump auto-start
  - Mass and energy release to containment decreases as RCS pressure and temperature decrease; GOTHIC analysis would not predict a Containment Spray auto-start
  - Engineering judgment leads to conclusion that while not needed, hypothetically Containment Spray auto-start still possible considering the following:
    - Instrument air in-leakage
    - Loss of non-safety coolers
  - Therefore, Containment Spray pump start should be mitigated

Emergency Procedure / UFSAR Changes

- Revised UFSAR 6.3.2.6 to note:
  - Credible NC System break locations have been identified that may cause a diversion of coolant inventory to the Incore Instrument Room
  - For SBLOCAs where Containment Spray does not actuate, Emergency Procedures (EPs) ensure ND pumps are off prior to swap to sump if the desired sump level is not confirmed.
  - When FWST lo-level is reached and desired sump level is not indicated at FWST lo-level, EPs provide an alternate swapover (as opposed to the LBLOCA sequence described in Table 6-125) to cold leg recirculation to ensure that adequate sump inventory is available (and maintained) for sump recirculation to provide adequate core cooling for such SBLOCA events

10CFR50.59 Rationale

1. Rationale for why UFSAR and/or emergency procedure changes did not require changes to TS 3.4.15
   - The changes to the UFSAR and the emergency procedures involved an alternate swap-over sequence and did not affect our ability to detect, and indicate in the control room, reactor coolant pressure boundary leakage
   - Therefore, the UFSAR and/or emergency procedure changes did not require changes to TS 3.4.15 pursuant to 50.59(c)(1)(i)

10CFR50.59 Rationale

2. Rationale for why UFSAR and/or emergency procedure changes did not result in more than a minimal increase in the likelihood of a malfunction of a SSC important to safety
   - The intended design function of Containment Spray is not required at the time the power fuses are removed
   - Regarding containment pressure response, the plant is in long term recovery where manual operator action can be credited
   - Local operator actions during containment pressure recovery are reasonable and confirmed in the control room
   - Containment Spray is not required to perform any automatic protective action to correct any abnormal situation before any safety limit is exceeded following removal of the power fuses
   - The changes do not credit manual action in place of an automatic safety limit protection

10CFR50.59 Rationale

3. Rationale for why changes to emergency procedures and/or the UFSAR did not create a possibility for an accident of a different type
   - Station response to LOCAs previously evaluated in the UFSAR is unchanged
   - The frequency of occurrence of LOCAs evaluated in the UFSAR is unchanged
   - The changes apply to the mitigation of SBLOCAs from credible break locations that do not initiate Containment Spray during post accident recovery

10CFR50.59 Rationale

4. Rationale for why changes to emergency procedures and/or UFSAR did not create a possibility for malfunction of an SSC important to safety with a different result
   - No new malfunctions or failure modes
   - SSCs important to safety are not prevented from performing their intended design functions as described in the UFSAR

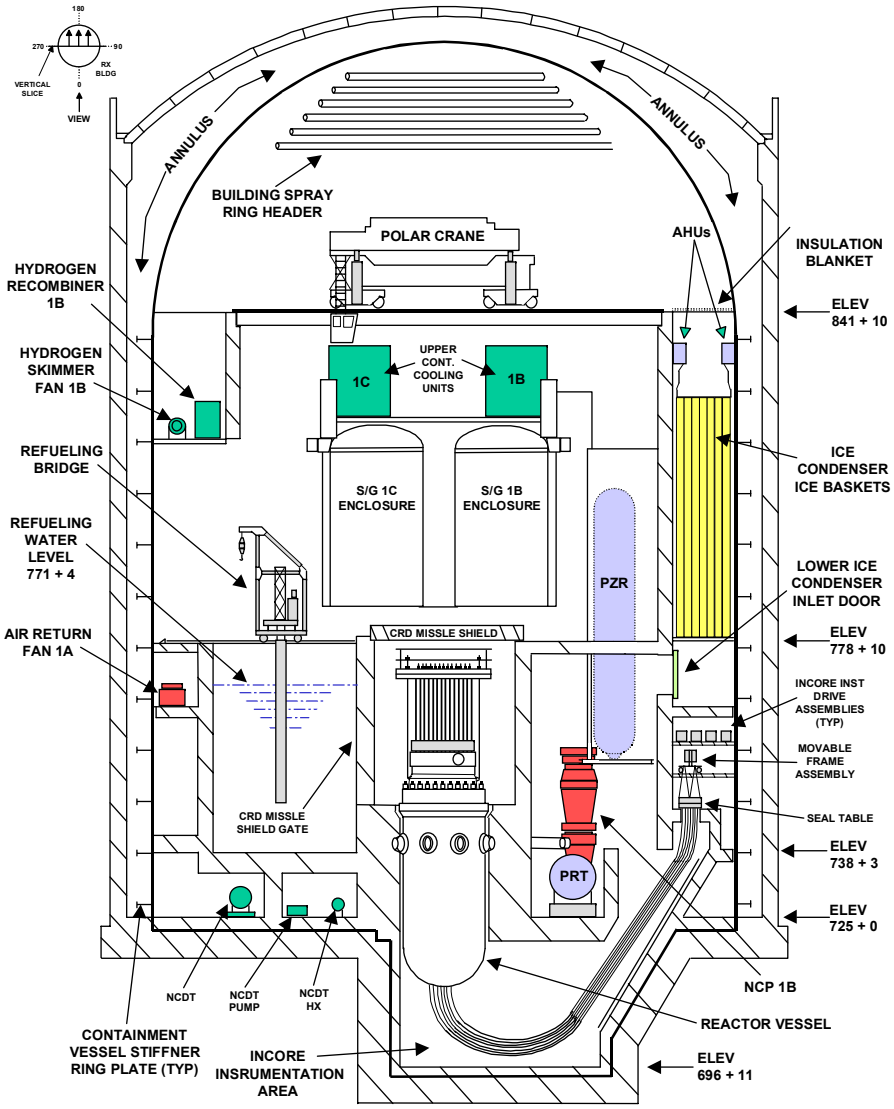
10CFR50.59 Rationale

5. Rationale for why the changes to UFSAR 6.3.2.6 were evaluated via a 50.59 Screening instead of a 50.59 Evaluation
   - The intent of the UFSAR change was to add words
   - The act of adding words did not require a change to the TS or adversely affect an SSC design function
   - The condition was considered within the licensing basis
   - Conclusions unchanged if a 50.59 Evaluation had been performed

Summary

- Complex Issue
- Conservative Decision Making
  - Conservatively evaluated scenarios using most applicable tools
  - Considered penalties associated with non-safety equipment operation not currently included in analyses
  - Ensured adequate sump level
- Followed applicable regulatory processes and guidance documents

Containment Drawing



Acronyms

BOC - Beginning of Cycle

CCP - Charging SI

CLA - Cold Leg Accumulator

CLR - Cold Leg Recirculation

ECCS - Emergency Core Cooling System

EOC - End of Cycle

EP - Emergency Procedure

FWST - Refueling Water Storage Tank

HHSI - High Head SI

HZP - Hot Zero Power

LBLOCA - Large Break Loss Of Coolant Accident

LOCA - Loss Of Coolant Accident

ND – Residual Heat Removal

NI - Safety Injection

NS - Containment Spray

NV - Chemical and Volume Control

PCT - Peak Clad Temperature

PIP - Problem Investigation Process

PORV - Power Operated Relief Valve

RCP - Reactor Coolant Pump

PZR - Pressurizer

RCS - Reactor Coolant System

RHR - Residual Heat Removal

SBLOCA - Small Break Loss Of Coolant Accident

SI - Safety Injection

SM - Main Steam

SSC - Structure System, or Component

TS - Technical Specification

UFSAR - Updates Final Safety Analysis Report

VX - Containment Air Return and Hydrogen Skimmer System