JAF BWR MSIV Leakage Optimization

NRC Pre-Submittal Meeting

June 20, 2019

Exelon Generation®

Agenda

- Introductions
- Meeting Objectives
- Project Purpose / Background Information
- Scope of Technical Specification Changes
- Approach of the LAR Submittal
- Detailed Technical Review
- Overview of Licensing Schedule and Outage Needs
- Summary and Wrap-up

Introductions

Project Manager	John Massari
Project Technical Lead	Shane Gardner
Licensing Lead	Christian Williams
Site Technical Lead	Katherine Leaveck

Meeting Objectives

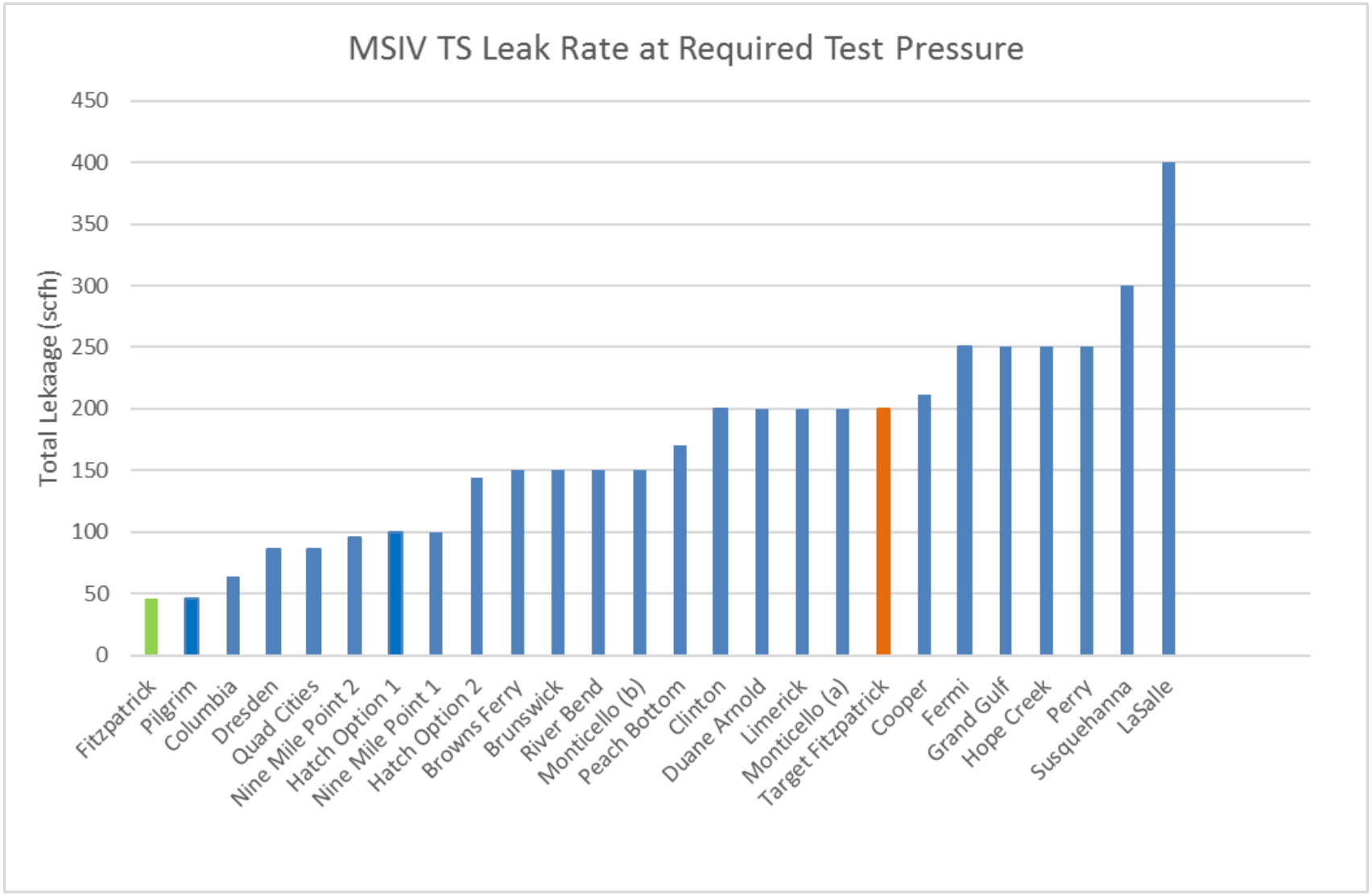
- Present information to NRC to enable a clear understanding of the overall project and proposed site-specific License Amendment Request (LAR) submittal

  – Technical Specification (TS) Changes
  – Analysis Approach
  – Full Scope Alternative Source Term (AST) Scope
  – AST LOCA Analysis Details

- Obtain feedback from the NRC on the proposed LAR to ensure high quality submittal and minimize the need for future RAIs

- Mutual understanding of the proposed schedule and corresponding outage need date in order to ensure adequate NRC resource availability

Benchmark of U.S. Fleet



Project Purpose / Background Information

Optimize AST LOCA analysis to increase MSIV local leak rate testing (LLRT) limits

- Reduce outage dose and increase safety
- Reduce number of reportable MSIV LLRT events
- Reduce MSIV maintenance costs
- Extend effective MSIV service life

Conversion of partial AST licensing basis to full implementation

- Existing licensing basis has FHA analysis only approved for AST
- Requesting approval to expand to full implementation
  - Based on LOCA analysis only

- Supporting analyses and changes
  - Drawdown analysis
  - Standby Liquid Control evaluation and TS changes
  - Definition of Dose Equivalent Iodine change
  - SGT and CR filter efficiency TS changes
  - Appendix J exemption to separate MSIV leakage from La

Approach of the LAR Submittal

- Evaluate the change impacts due to MSIV leakage rate change in accordance with Exelon configuration change process. Planned AST LOCA dose analysis requires prior NRC review:
  - Existing RG 1.3 methodology replaced with RG 1.183 AST
  - Provide information directly in support of the proposed Technical Specification Changes
- Approach to the full scope AST implementation technical evaluation
  - AST LOCA analysis utilizing a revised core inventory for future implementation of an increased core average exposure (CAVEX)
  - New drawdown analysis
  - Post-LOCA pH analysis to address suppression pool pH
  - Environmental Qualification evaluation for Standby Liquid Control (SLC) and deletion of Main Steam Leakage Collection (MSLC)
  - New Control Room X/Q values for ground-level MSIV release
  - Plant parameter input changes: MSIV Leakage, filter efficiencies.

Detailed Technical Review: Overview of LOCA Dose Analysis

- Current analysis based on RG 1.3
  - Dose pathways
    - Combined Containment & MSIV leakage (all leakage via stack)
    - ESF leakage (all leakage via stack)
    - Direct Shine
- Proposed analysis based on RG 1.183 & RIS 2006-04
  - Dose pathways
    - Containment leakage (***ground-level during drawdown***, stack thereafter)
    - ESF leakage (***ground-level during drawdown***, stack thereafter)
    - ***MSIV leakage (ground-level)***
    - Direct Shine
  - Notable plant input changes
    - MSIV leak rate increase
    - SGT and CR filter efficiency increased
    - More conservative core radionuclide inventory for future implementation

Detailed Technical Review: MSL Aerosol Deposition

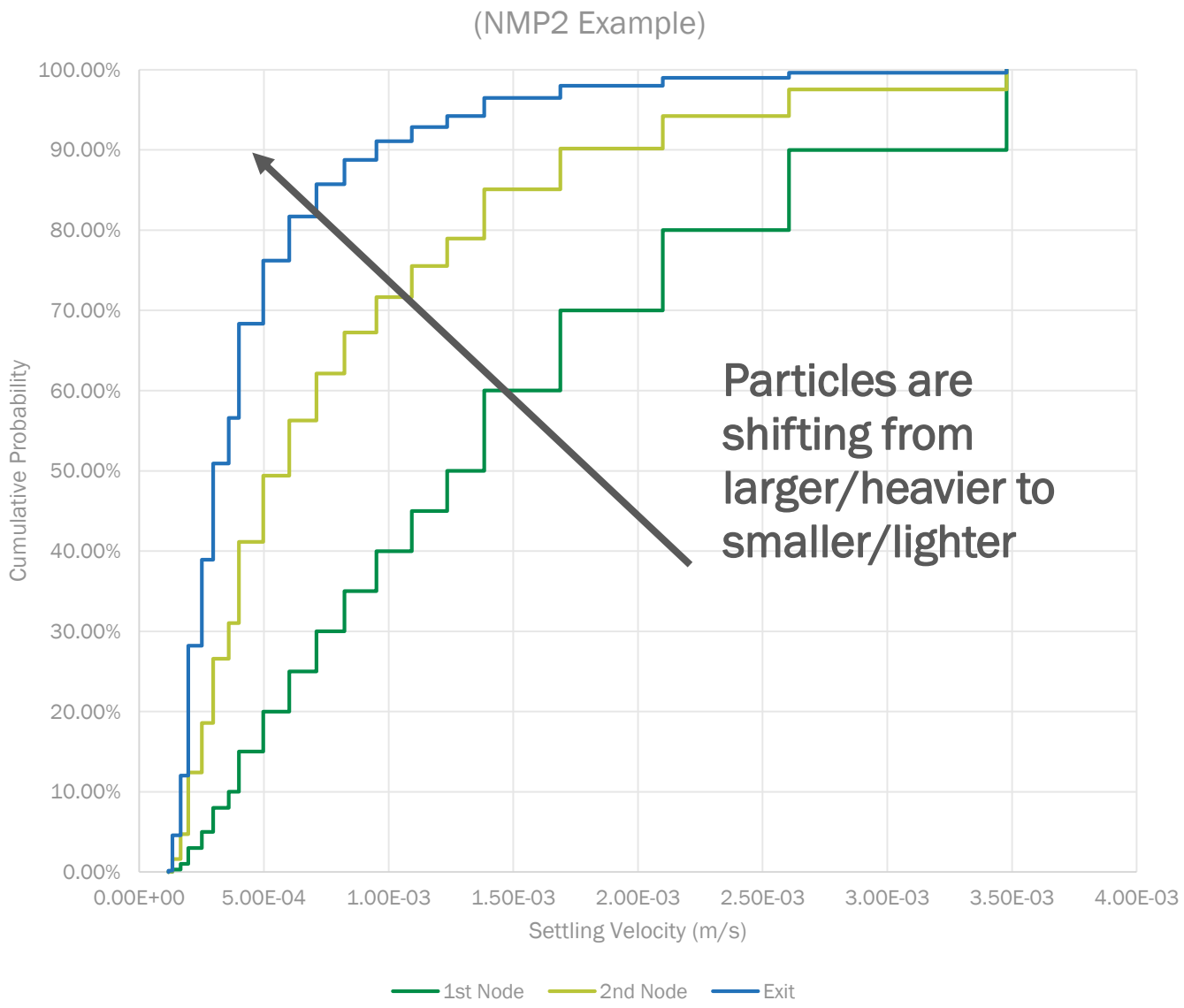
- Uses 20-group model previously approved at Clinton (ML052570461), Limerick (ML062210214), and LaSalle (ML101750625)

- Model is based on AEB 98-03 using JAF-specific inputs, which is acceptable per RIS 2006-04. Assumptions and justifications for applicability to the revised analysis provided in accordance with RIS 2006-04

- The settling velocity is a randomly sampled range of the three (3) critical aerosol parameters, density/weight (logarithmically distributed), diameter/size (uniformly distributed), and shape (uniformly distributed); and three (3) constants; gravitational acceleration, Cunningham slip factor, and viscosity.

- A distribution of removal factors are calculated using the typical AEB 98-03 formulations and are combined statistically to determine a net removal fraction. This accounts for a range of aerosol particle parameters and also accounts for change in the aerosol characteristics as the particles transport through the MSL

Detailed Technical Review: MSL Aerosol Deposition Cont.



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Detailed Technical Review: Other Analyses & Changes

- Drawdown Analysis
  - Required for TSTF-551 & RG 1.183 Appendix A
  - GOTHIC based analysis; 4 external environment cases for conservatism
  - Follows Quad Cities LAR as precedent
  - Result: 20 minute drawdown time in dose model
- Post-LOCA pH Analysis
  - Methodology is based on NUREG/CR-5950
  - Maximum injection duration of SLC buffer (< 1 hour) before 71 hours
  - Result: Minimum pH: 8.1 at 30 days
- SLC Evaluation
  - "Guidance on the Assessment of a BWR SLC system for pH Control," Dated February 12, 2004, (ADAMS Accession No. ML040640364)
  - All requirements met, including 50.49 Environmental Qualification
  - An attachment detailing this evaluation will be provided in the LAR
- SGT and CR Filter Efficiency Changes
  - TS change to lower charcoal penetration to 1.5%
  - Filter efficiencies credited in AST dose analysis increased

Detailed Technical Review: Other Analyses & Changes

- Leakage Collection System Removal EQ Evaluation
  - Change results in a post-LOCA source term in the TB
  - LOCA dose in the TB not previously evaluated
  - Analysis is performed to determine radiological environment using TID Methodology
  - EQ Evaluation is performed to evaluate SR equipment for inclusion
  - EQ documentation will be updated to reflect the new evaluation and disposition of equipment

Overview of Licensing Schedule and Outage Needs

- Goal is to implement at first outage opportunity
- Submit LAR according to schedule outlined below
- Request NRC review and approval in 12 months

Plant	LAR Submittal	NRC Approval	First Opportunity
Fitzpatrick	June 2019	July 2020	September 2020

Summary and Wrap-up

Summary

- NRC approval of full scope AST and the increased MSIV leakage limits will:
  - Reduce outage dose and increase safety
  - Reduce number of reportable MSIV LLRT events
  - Reduce MSIV maintenance costs
  - Extend effective MSIV service life
- A revised AST LOCA dose analysis is planned that supports increased MSIV leakage while maintaining margin by:
  - Beneficially optimizing Control Room dose while retaining substantial margin to the limits
  - Adjusting inputs and elements of the method to provide additional margin in some cases and extract margins in other cases
  - Aggregate effect of all revisions maintains reasonable conservatism

Recap of Actions

Fitzpatrick Full Scope AST

DISCUSSION

Fitzpatrick Full Scope AST

Backup Slides

Scope of Technical Specification Changes

Preliminary MSIV leakage rate

SR 3.6.1.3.10	Verify combined main steam line leakage rate is ≤ ~~46~~ scfh when tested at ≥ 25 psig.	In accordance with the Primary Containment Leakage Rate Testing Program
SR 3.6.1.3.11	Verify the leakage rate of each air operated testable check valve associated with the LPCI and CS Systems vessel injection penetrations is within limits.	In accordance with the Primary Containment Leakage Rate Testing Program

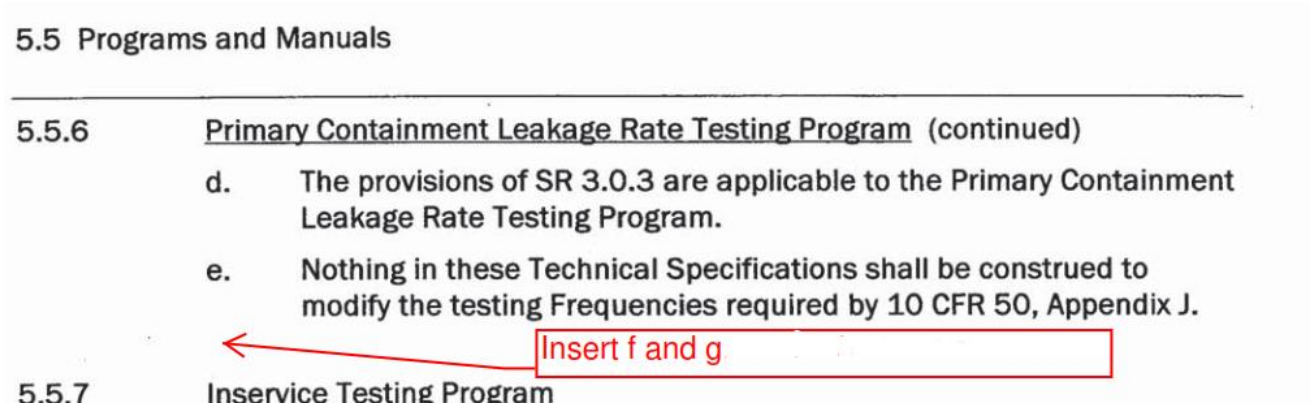
200

The leakage limit for a single main steam line is ≤100 scfh when tested at ≥ 25 psig.

JAFNPP 3.6.1.3-9 ~~Amendment 301~~

Scope of Technical Specification Changes Continued

Exemption to Appendix J to remove MSIV leakage from La requirement.



5.5 Programs and Manuals

5.5.6 Primary Containment Leakage Rate Testing Program (continued)

d. The provisions of SR 3.0.3 are applicable to the Primary Containment Leakage Rate Testing Program.

e. Nothing in these Technical Specifications shall be construed to modify the testing Frequencies required by 10 CFR 50, Appendix J.

Insert f and g

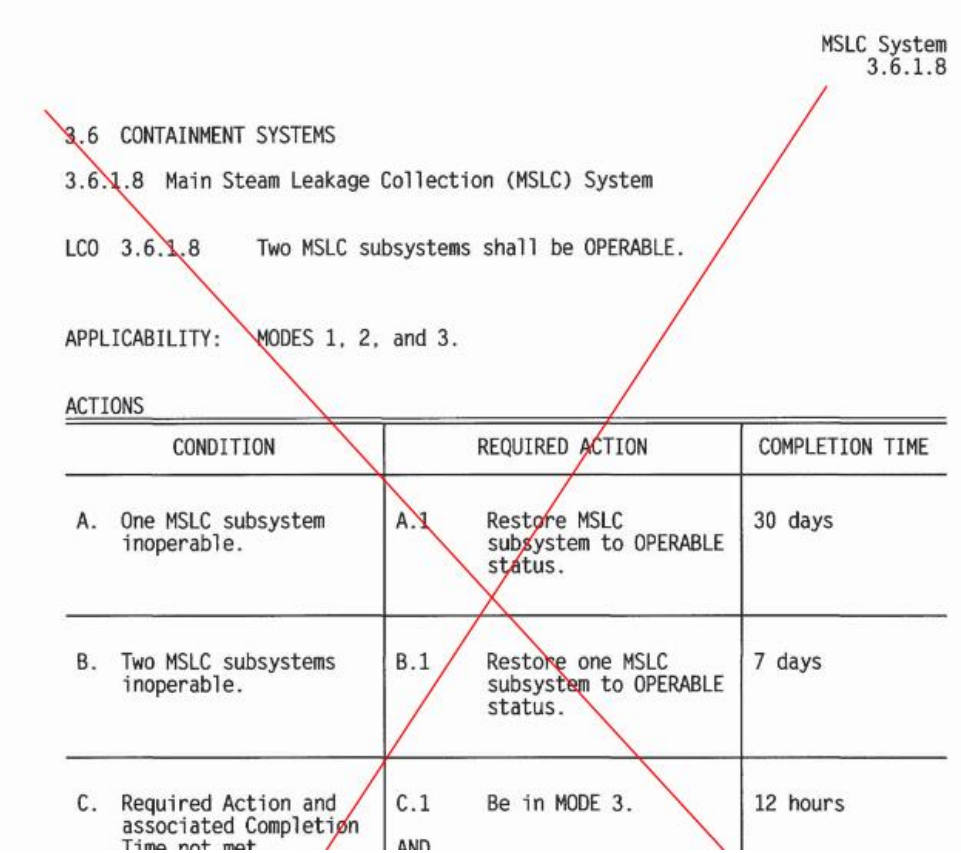
5.5.7 Inservice Testing Program

f. Exemption from Section III.A of 10 CFR Part 50, Appendix J, Option B, to allow the leakage contribution from MSIV leakage to be excluded from the overall integrated leakage rate from Type A tests.

g. Exemption from Section III.B of 10 CFR Part 50, Appendix J, Option B, to allow the contribution from MSIV leakage to be excluded from the sum of the leakage rates from Type B and Type C tests.

Scope of Technical Specification Changes Continued

Deletion of Main Steam Leakage Collection System. No longer credited in safety analysis.



MSLC System
3.6.1.8

3.6 CONTAINMENT SYSTEMS

3.6.1.8 Main Steam Leakage Collection (MSLC) System

LCO 3.6.1.8 Two MSLC subsystems shall be OPERABLE.

APPLICABILITY: MODES 1, 2, and 3.

ACTIONS

CONDITION	REQUIRED ACTION		COMPLETION TIME
A. One MSLC subsystem inoperable.	A.1	Restore MSLC subsystem to OPERABLE status.	30 days
B. Two MSLC subsystems inoperable.	B.1	Restore one MSLC subsystem to OPERABLE status.	7 days
C. Required Action and associated Completion Time not met.	C.1 AND	Be in MODE 3.	12 hours

Scope of Technical Specification Changes Continued

Ventilation Filter Testing Program penetration requirement reduction

5.5 Programs and Manuals

5.5.8 Ventilation Filter Testing Program (VFTP) (continued)

c. Demonstrate for each of the Engineered Safeguards systems that a laboratory test of a sample of the charcoal adsorber, when obtained as described in Section C.6.b of Regulatory Guide 1.52, Revision 2, shows the methyl iodide penetration less than the value specified below when tested in accordance with ASTM D3803-1989 at a temperature of ≤ 30°C (86°F) and the relative humidity specified below.

Engineered Safeguards Ventilation System	Penetration	RH
Standby Gas Treatment System	~~5%~~ 1.5%	≥ 70%
Control Room Emergency Ventilation Air Supply System	~~5%~~ 1.5%	≥ 95%

Penetration is for both 2-inch charcoal adsorbers tested in series

d. Demonstrate for each of the Engineered Safeguards systems that the pressure drop across the combined HEPA filters and the charcoal adsorbers is less than the value specified below when tested at the system flowrate specified below:

Scope of Technical Specification Changes Continued

Standby Liquid Control System mode requirements

3.1 REACTIVITY CONTROL SYSTEMS

3.1.7 Standby Liquid Control (SLC) System

LCO 3.1.7 Two SLC subsystems shall be OPERABLE.

APPLICABILITY: ~~MODES 1 and 2.~~ MODES 1, 2, and 3

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One SLC subsystem inoperable.	A.1 Restore SLC subsystem to OPERABLE status.	7 days
B. Two SLC subsystems inoperable.	B.1 Restore one SLC subsystem to OPERABLE status.	8 hours
C. Required Action and associated Completion Time not met.	C.1 Be in MODE ~~3.~~ 4.	12 hours

Table 3.3.6.1-1 (page 5 of 6)
Primary Containment Isolation Instrumentation

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	REQUIRED CHANNELS PER TRIP SYSTEM	CONDITIONS REFERENCED FROM REQUIRED ACTION C.1	SU RE
5. Reactor Water Cleanup (RWCU) System Isolation				
a. RWCU Suction Line Penetration Area Temperature – High	1,2,3	1	F	SF SF
b. RWCU Pump Area Temperature – High	1,2,3	1 per room	F	SF SF
c. RWCU Heat Exchanger Room Area Temperature – High	1,2,3	1	F	SF SF
d. SLC System Initiation	1,2	2(d)	I	SF
e. Reactor Vessel Water Level – Low (Level 3)	1,2,3	2	F	SF SF SF SF

, 3

Scope of Technical Specification Changes Continued

TSTF-551 associated modifications

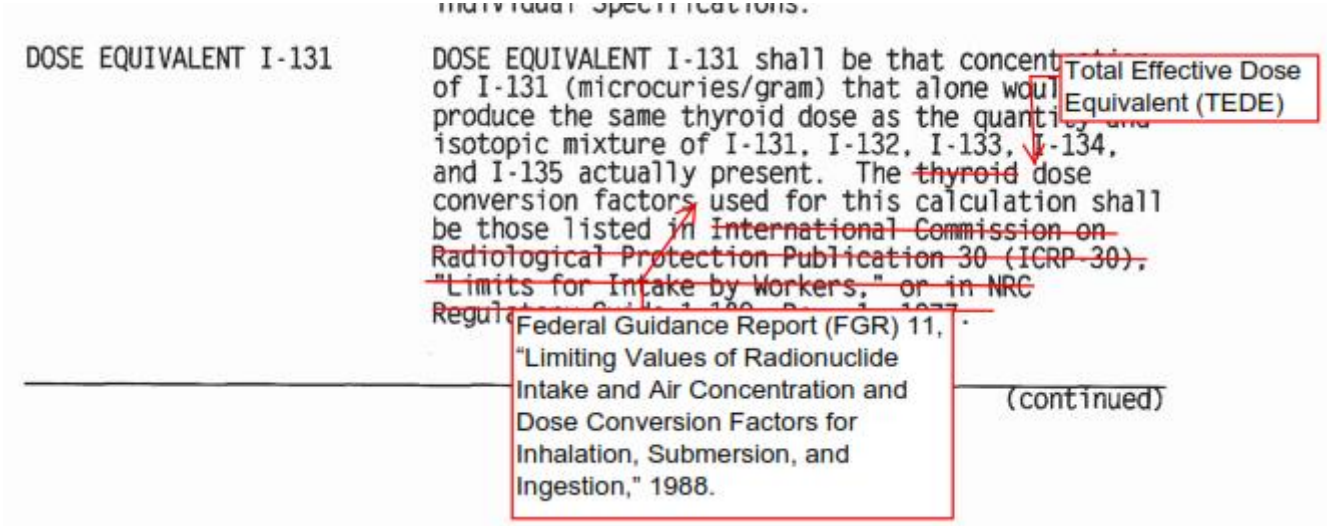
SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.6.4.1.1	Verify secondary containment vacuum is ≥ 0.25 inch of vacuum water gauge.	In accordance with the Surveillance Frequency Control Program
SR 3.6.4.1.2	Verify all secondary containment equipment hatches are closed and sealed.	In accordance with the Surveillance Frequency Control Program
SR 3.6.4.1.3	Verify one secondary containment access door in each access opening is closed, except when the access opening is being used for entry and exit.	In accordance with the Surveillance Frequency Control Program
SR 3.6.4.1.4	Verify the secondary containment can b ≥ 0.25 inch of vacuum water gauge for one SGT subsystem at a flow rate ≤ 6000 cfm.	Frequency Control Program

----------NOTE----------
Not required to be met for 4 hours if analysis demonstrates that one standby gas treatment (SGT) subsystem is capable of establishing the required secondary containment vacuum.

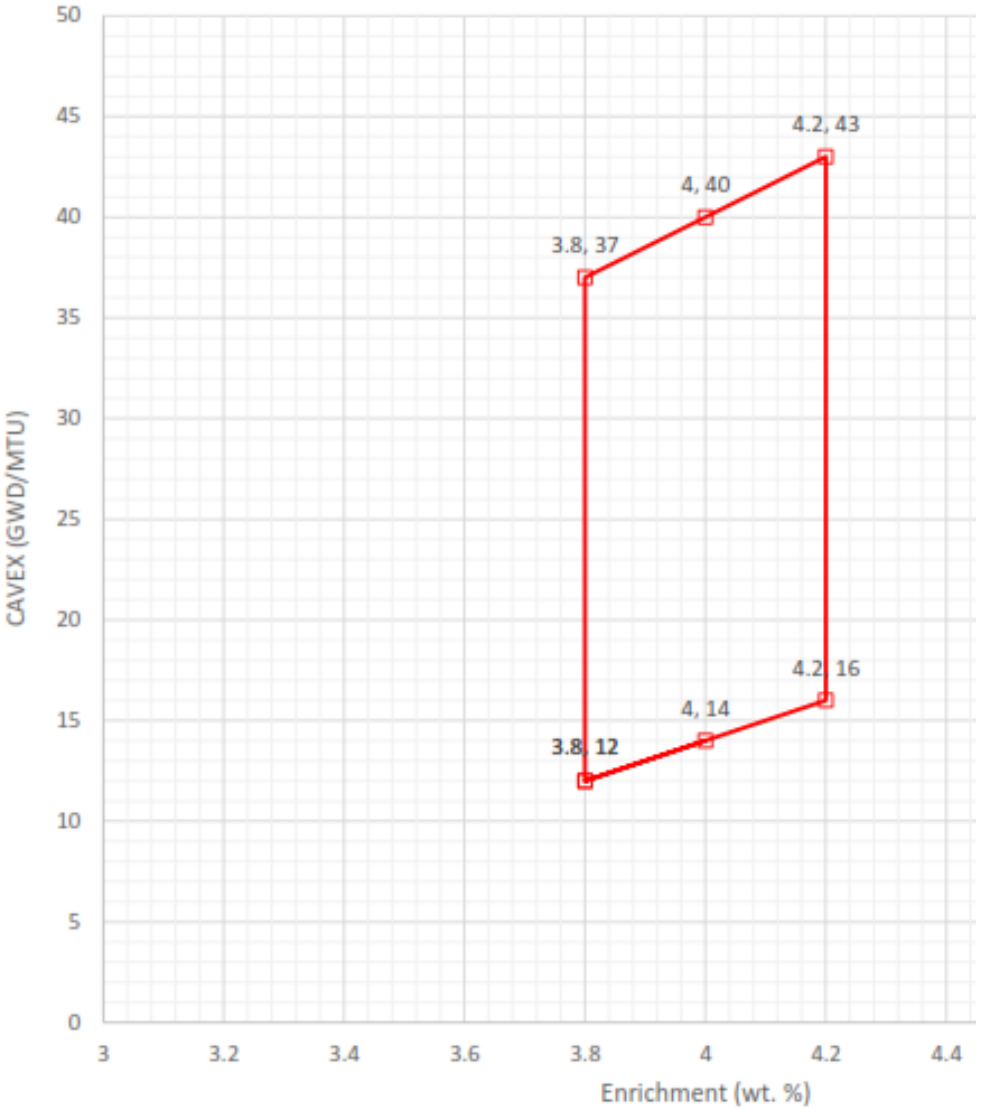
Scope of Technical Specification Changes Continued

Dose Equivalent I-131 definition update for AST



Detailed Technical Review: Overview of Revised Core Inventory

- Revised core radionuclide inventory
  - Increases the range of Core AVerage EXposure (CAVEX) and enrichment previously evaluated
  - Provides margin for future optimization of core design
  - Utilizes ORIGEN-ARP in accordance with RG 1.183 Section 3.1



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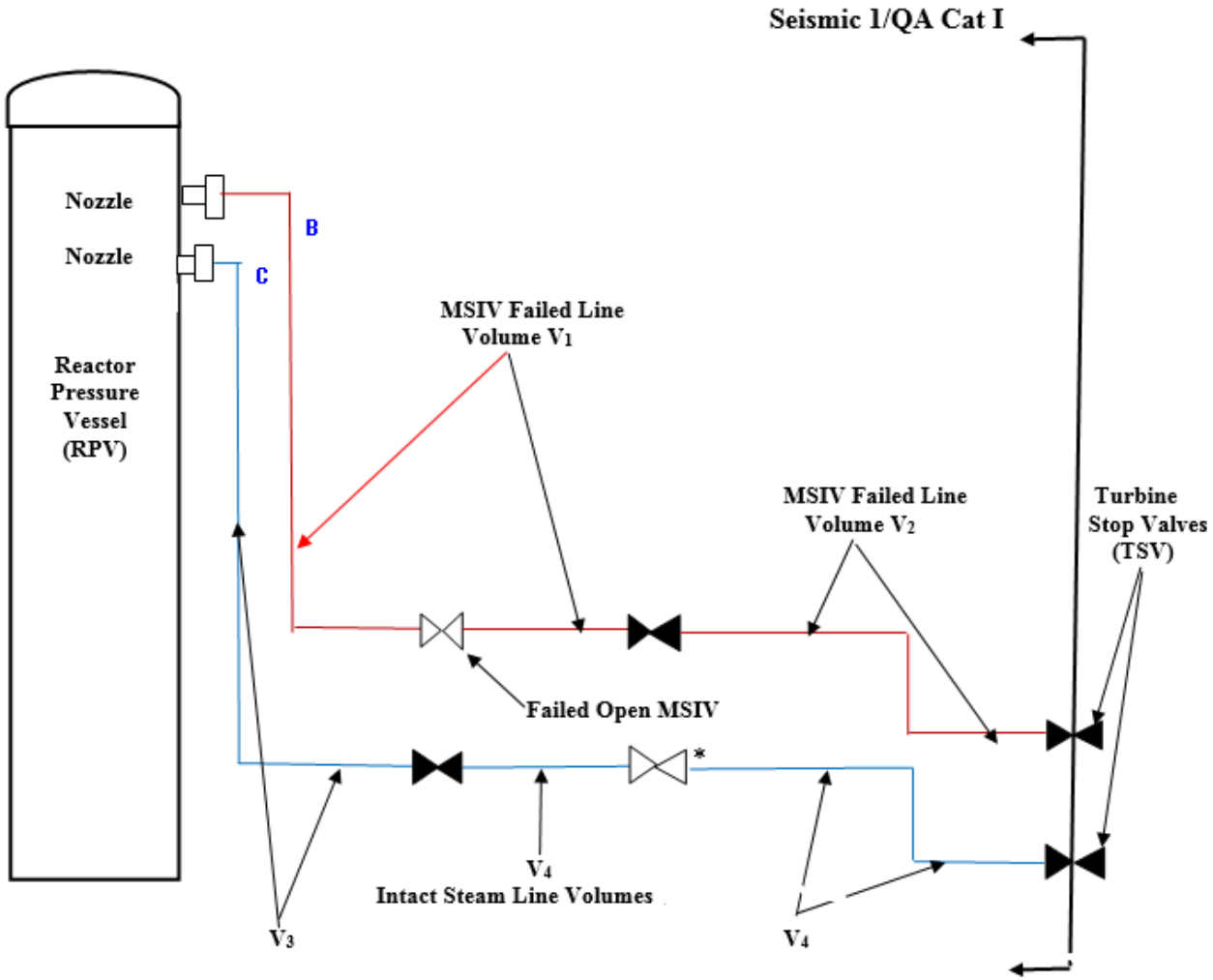
Detailed Technical Review: Overview of MSIV Model

V1 = RPV Nozzle "B" to Outboard MSIV
V2 = Outboard MSIV to TSV
V3 = PRV Nozzle "C" to Inboard MSIV
V4 = Inboard MSIV to TSV
*Note: Valve is assumed open for modelir purposes. It is not failed open.



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Detailed Technical Review: Comparison of LOCA AST Analysis

(Preliminary)

Design Input	CLB Analysis	Revised Analysis
CR Dose	8.77 rem Thyroid, 1.01E-2 rem Whole Body, appx. 0.27 rem TEDE	4.55 rem TEDE
EAB Dose	62.5 rem Thyroid, 2.34 rem Whole Body, appx. 4.2 rem TEDE	0.70 rem TEDE
MSIV Leak Rate	46 scfh total @ 25 psig	200 scfh total @ 25 psig (including 50% reduction at 24 hrs)
MSIV Leak Rate Distribution	N/A via LCS	Among two MSLs (100/100/0/0)
MSIV Release Pathways	N/A via LCS	Release via one (1) MSIV failed & one (1) intact MSL
Well Mixed Volume	N/A	Two well mixed volumes for each pathway
MSL Credited for Aerosol Deposition	N/A	Inboard, Interstitial, & outboard MSL segments
Aerosol Settling Velocity	N/A	20-group Monte Carlo probabilistic settling velocity distribution MSIV Leakage (using 100% leak rate 0-720 hrs)

Detailed Technical Review: Comparison of LOCA AST Analysis

Design Input	CLB Analysis	Revised Analysis
System Bypass Leak Aerosol Removal Efficiencies	N/A - System Bypass Leakage is not part of Technical Specifications and not modeled (RG 1.183 App. A 4.5)	
MSL Elemental Iodine Removal	N/A	Time-dependent elemental iodine removal (J.E. Cline)
Containment Leakage	1.5% per day 0 to 720 hours	1.5% per day 0 to 24 hours; 0.75% per day 24 to 720 hours
ESF Leakage	5 gpm program; 50 gpm passive failure for 30 minutes	5 gpm program
Drywell Spray	N/A	Credited 20 minutes to 4 hours using conservative application of SRP 6.5.2 models
SGTS Exhaust Flowrate for Containment Leakage	N/A - No credit for reactor building holdup	6,000 cfm
SGTS Exhaust Flowrate for ESF Leakage	6,000 cfm	6,000 cfm
CR Ventilation Unfiltered Inleakage	Same 300 cfm for both analyses - Not effected	
CR Ventilation Modeling	15,000 cfm (includes recirculation)	2,112 cfm (outside air component)

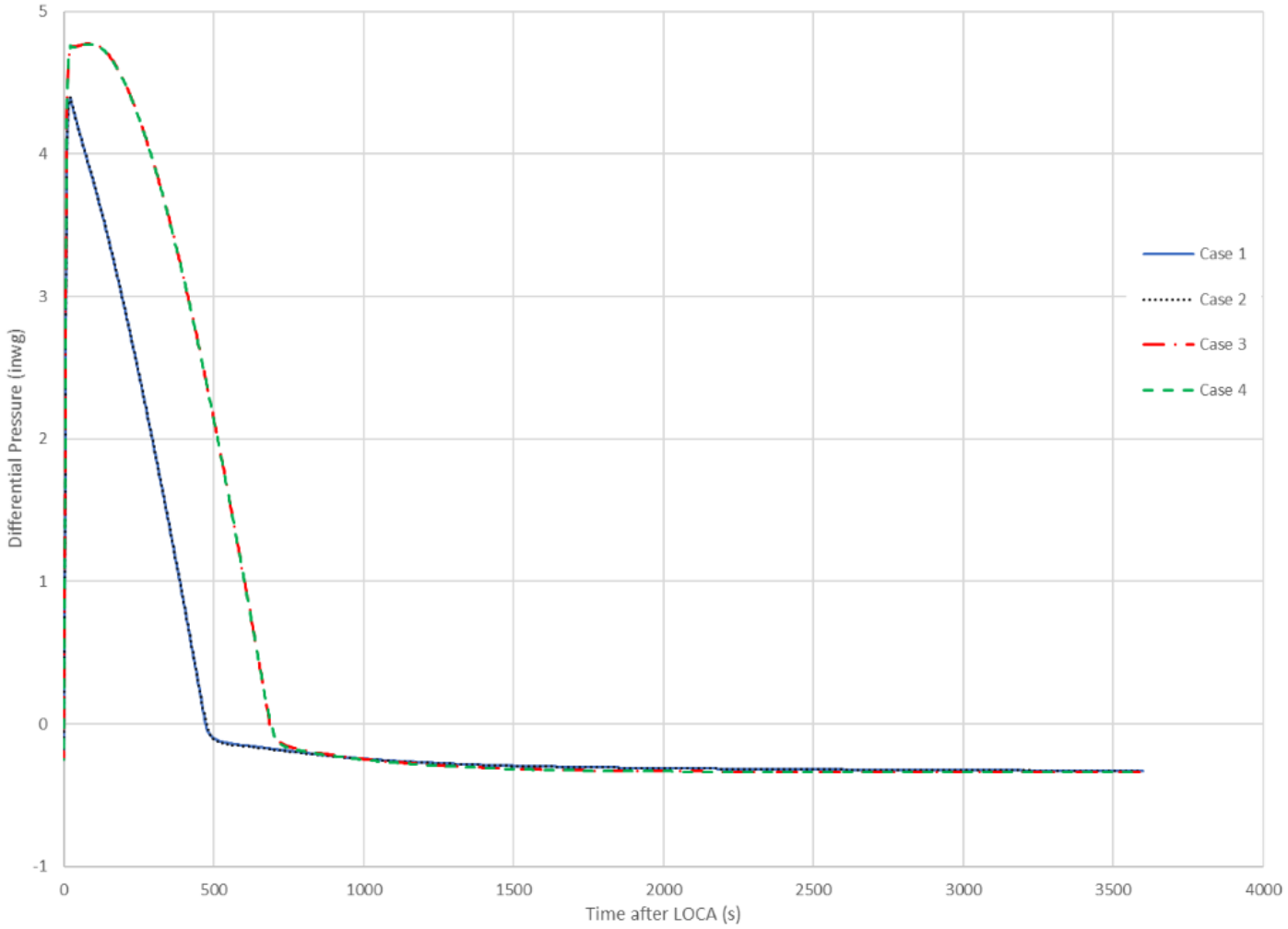
Detailed Technical Review: Comparison of LOCA AST Analysis

Design Input	CLB Analysis	Revised Analysis
CR Charcoal Efficiencies	90%	97%
SGTS Charcoal Efficiencies	90%	97%
SGTS and CR HEPA Efficiencies	90%	98%

Detailed Technical Review: Drawdown Analysis

- Required to fully implement TSTF-551, “Revise Secondary Containment Surveillance Requirements”
- GOTHIC v8.2 analysis to determine time that Secondary Containment is positive with respect to ambient pressure
- RG 1.183 requirements that lead to the four cases evaluated (summer, no wind; summer, with wind; winter, no wind; winter, with wind)
  - Evaluate high wind impact on ability to maintain negative pressure
  - Conservative ambient temperature assumption
- Conservative assumptions for heat transfer, initial temperatures, heat loads, etc. within the GOTHIC model
- Assume ground-level release anytime Secondary Containment does not meet TS defined criteria for negative pressure
- 20 minute drawdown time used in dose analysis

Detailed Technical Review: Drawdown Analysis



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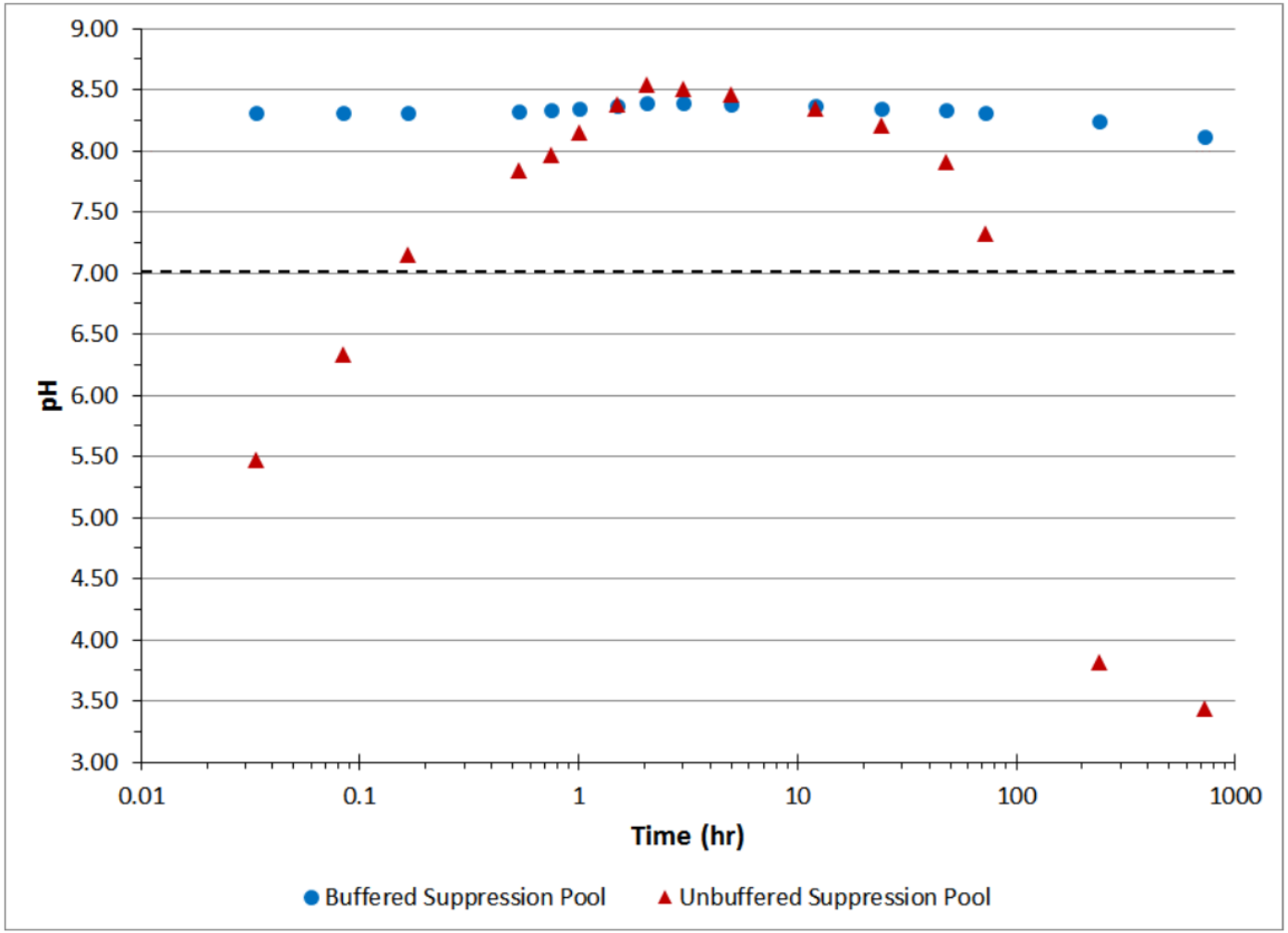
Detailed Technical Review: Post-LOCA Suppression Pool pH

- Methodology is based on NUREG/CR-5950
  - Acids: Hydriodic, Carbonic, Nitric, Hydrochloric (cable jacket), Boric (from Sodium Pentaborate)
  - Bases: Cesium Hydroxide (fuel), Sodium Pentaborate (SLC buffer)
  - Fuel inputs include increased CAVEX

- Calculate buffered and unbuffered pH response
  - Maximum injection duration of SLC buffer (< 1 hour)
  - Maximum time to inject 71 hours
  - Validate pH remains > 7
  - Minimum pH: 8.1 at 30 days

- Notable Assumptions
  - Nitric acid production rate conservatively assumed at 86 deg. F rather than high T
  - Minimum suppression pool water volume; no credit for additions
  - 100 gal of buffer solution held up in SLC piping for conservatism

Detailed Technical Review: Post-LOCA Suppression Pool pH



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Detailed Technical Review: SLC Design Evaluation

- System Capability Evaluated
  - "Guidance on the Assessment of a BWR SLC system for pH Control," Dated February 12, 2004, (ADAMS Accession No. ML040640364)
- All requirements met, without issue
- 50.49 Environmental Qualification
  - Bounding SLC radiation environment established
  - Equipment evaluated against EQ service environments
- Procedure to ensure SLC injection evaluated and are acceptable or will be updated accordingly as part of the engineering change
- An attachment detailing this evaluation will be provided in the LAR

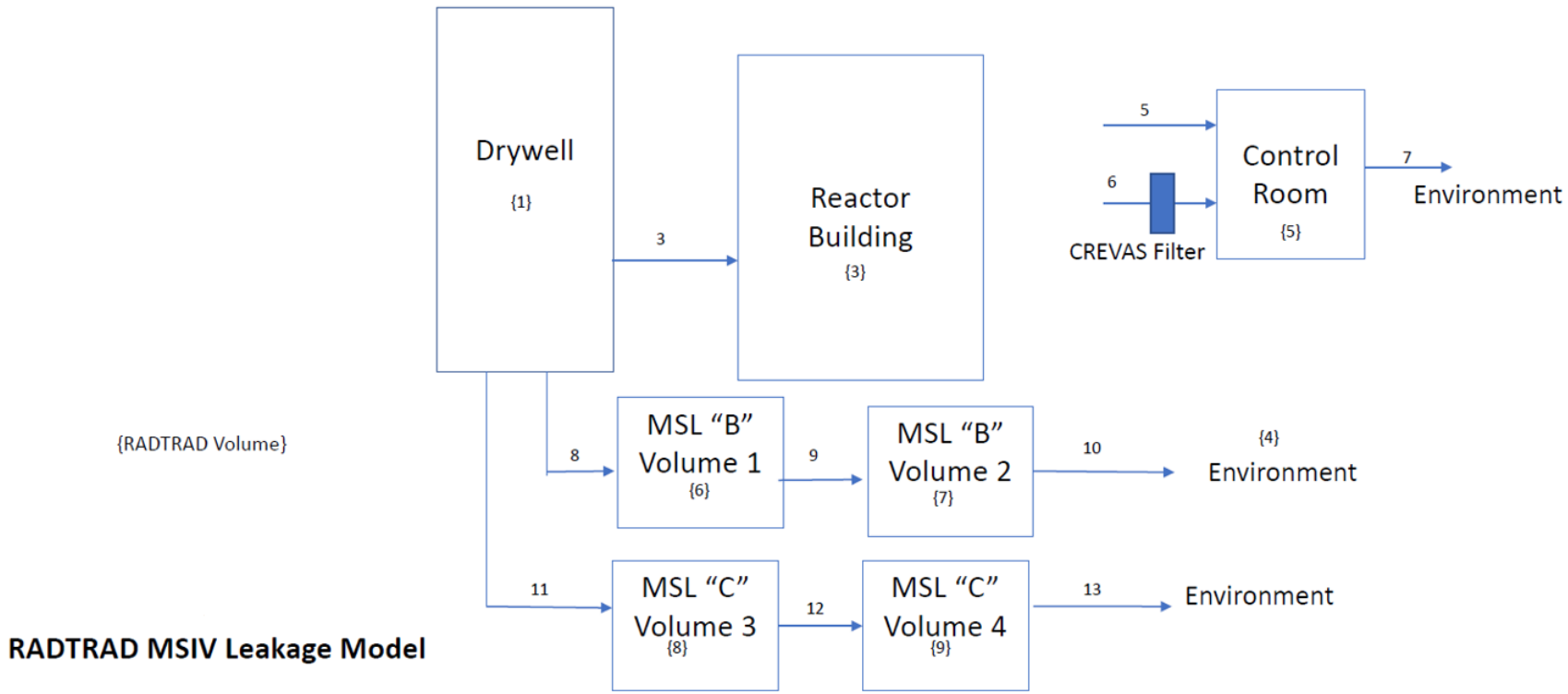
Detailed Technical Review: Filter Efficiency Changes

- Proposed change to Technical Specification 5.5.8 to reduce filter penetration testing
  - This is supported based on review of filter capability and past testing
  - Charcoal penetration changed from 5% to 1.5% (charcoal).

- AST LOCA dose analysis credits a higher filter efficiency
  - Generic Letter (GL) 99-02 safety factor of 2 included
  - New charcoal filter efficiency of 97% is determined
  - New HEPA filter efficiency of 98% is determined

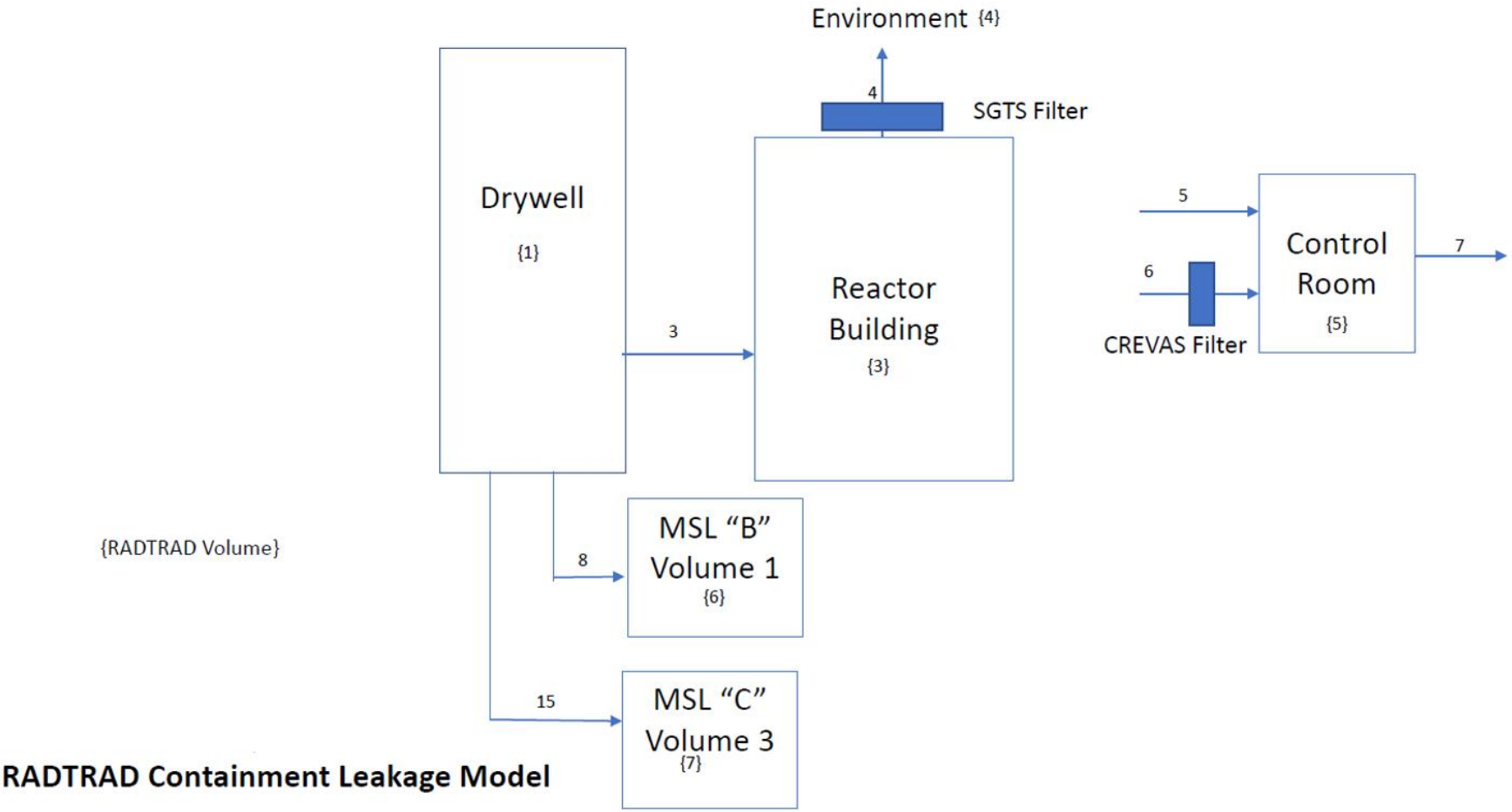
- Filter efficiency changes applied to SGT and CR models

LOCA AST RADTRAD Models



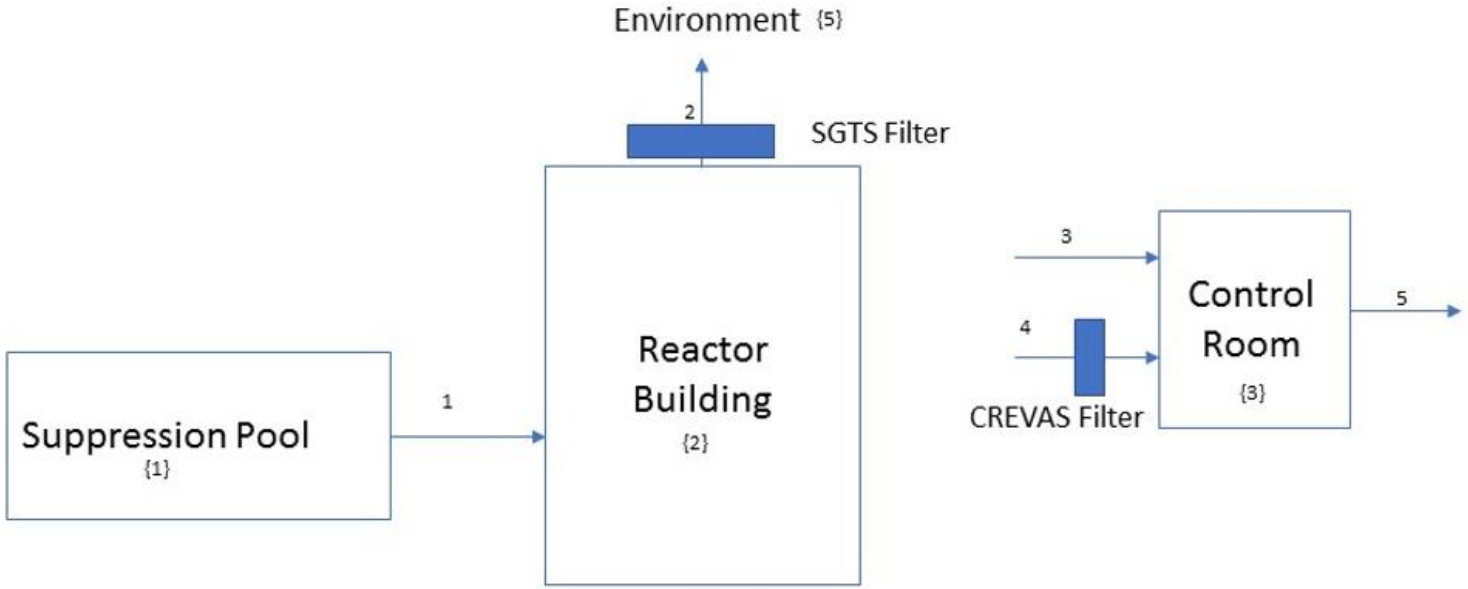
RADTRAD MSIV Leakage Model

LOCA AST RADTRAD Models



RADTRAD Containment Leakage Model

LOCA AST RADTRAD Models



RADTRAD ESF Leakage Model