
MCR Emergency Habitability System (VES)

Passive Filtration & Main Control Room Habitability

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Presentation Overview

- General overview of AP1000 Main Control Room Habitability design changes
- Passive Filtration Testing
- Resolution to outstanding design related open items
 - Operating Experience, Single Failure, & Flow Instrumentation
- Resolution to outstanding open items related to Technical Specifications

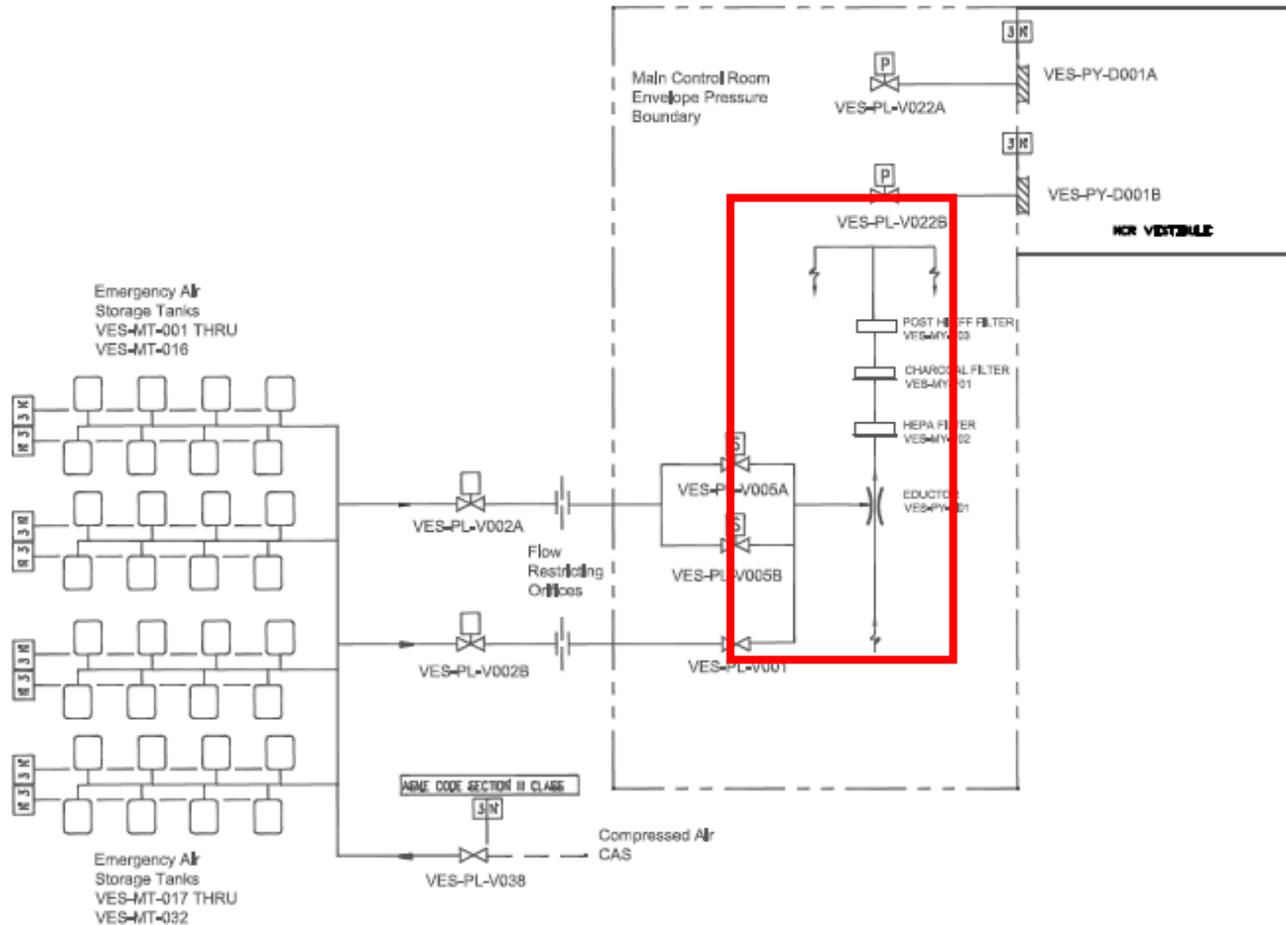
Presentation Objectives

- Understand VES passive filtration
- Understand VES testing conducted by Westinghouse
- Understand eductor operating experience and passive filtration line's susceptibility to a single failure
 - RAI-SRP6.4-SPCV-9, -12, -13
- Understand impact of VES passive filtration relative to Technical Specifications
 - RAI-SRP 6.4-SPCV-10, -11, -14

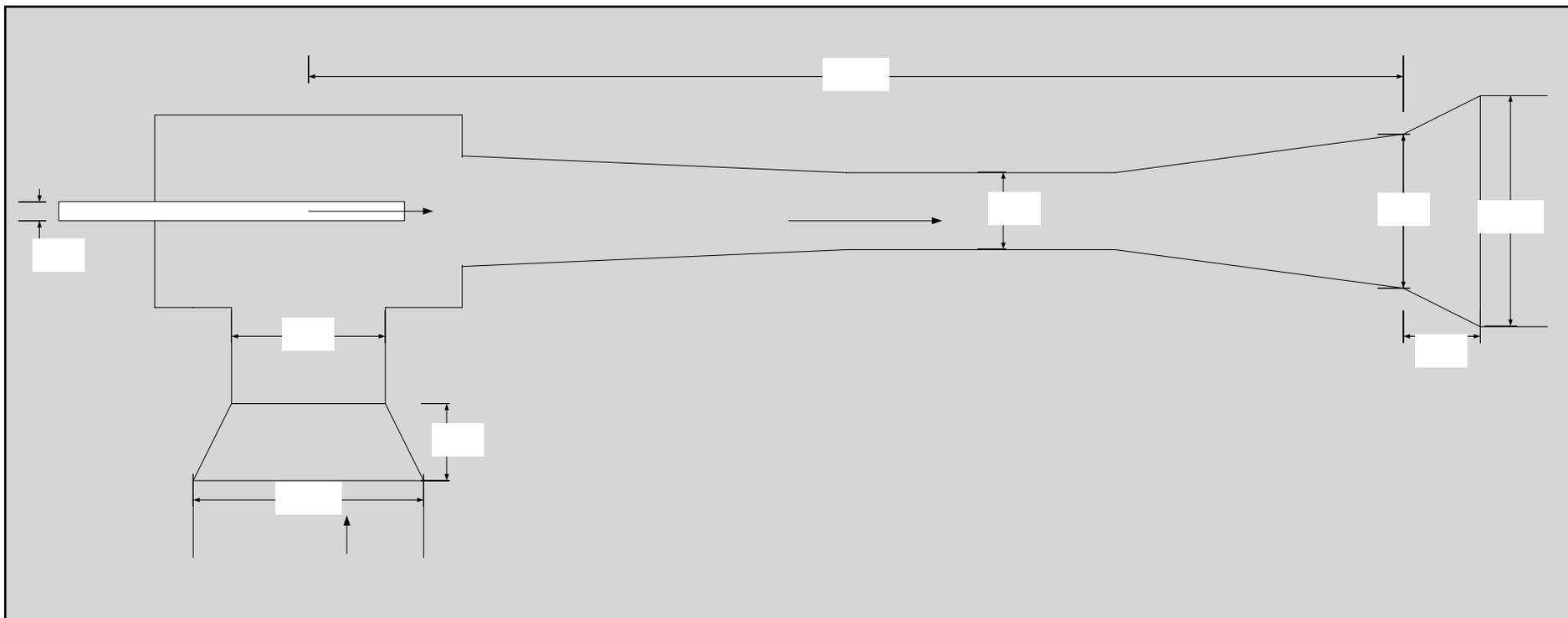
AP1000 Main Control Room Habitability

- Chi/Q values for AP1000 changed between DCD Rev. 15 and DCD Rev. 17 to bound potential new sites
- Concerns regarding unfiltered in-leakage into the main control room during VES operation prompted system design changes
- A passive filtration flow path was added to the existing VES design to filter potential unfiltered in-leakage
- An eductor induces passive filtration flow using bottled air from the emergency air storage tanks

VES Design Enhancements



Eductor – Air Ejector



*All dimensions are given in inches

AP1000 VES Passive Air Filtration

- System performance allows for 15 cfm of unfiltered in-leakage while maintain operator dose below 5 rem TEDE
 - Accept 5 cfm leakage through the vestibule
 - Accepts up to 10 cfm in-leakage from sources other than the vestibule
 - Actual in-leakage is expected to be zero
- Passive filtration eliminates need for VES actuation on low pressurizer pressure
- System configuration is similar to active system designed to meet Regulatory Guide 1.52

AP1000 Passive Filtration DCD Impacts

- Tier 1, Section 2.7.1
- Tier 2
 - Section 1.2, 1.9, & Appendix 1A
 - Section 3.2, 3.9, 3.11, & 3I
 - Section 6.4
 - Section 7.2 & 7.3
 - Section 8.3
 - Section 9.4, 9.5, & Appendix 9A
 - Section 14.2
 - Section 15.6
 - Technical Specifications

MCR Emergency Habitability System (VES)

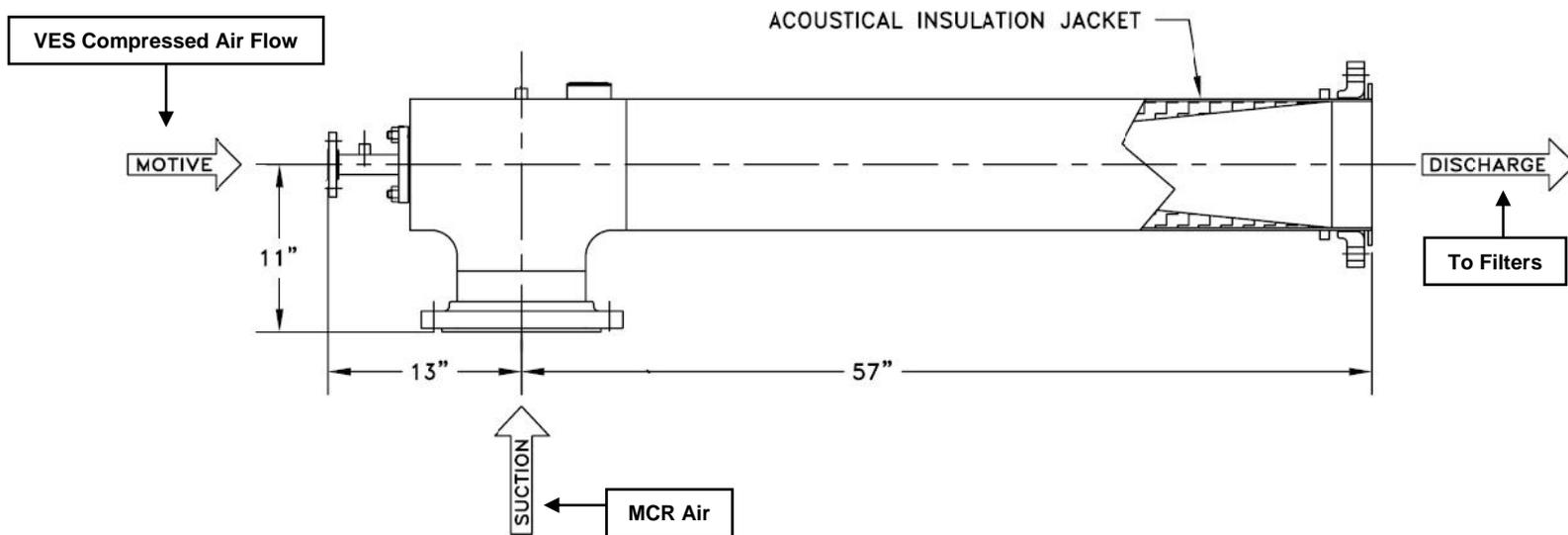
Passive Filtration Testing

Passive Filtration Testing

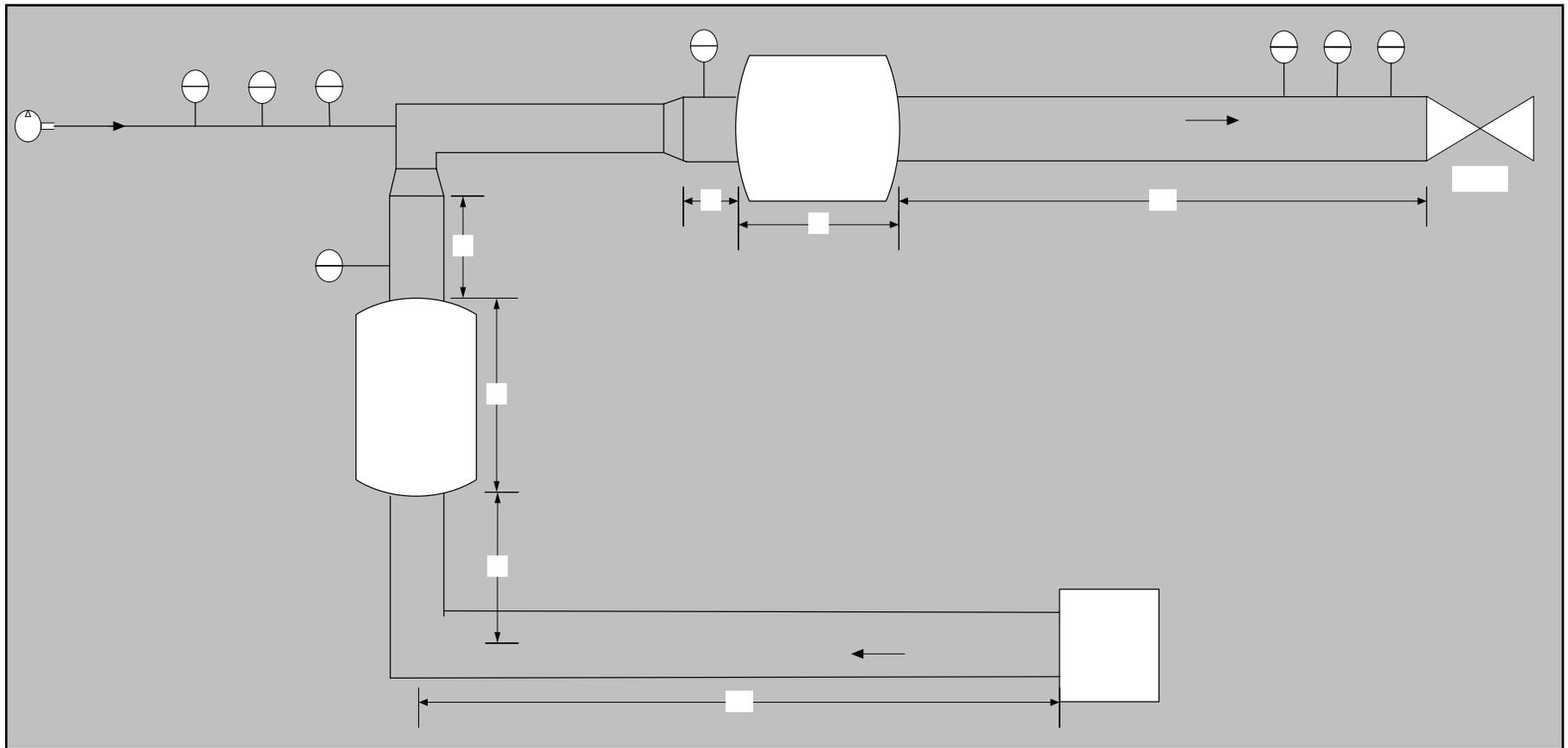
- Westinghouse
 - Waltz Mill facility
- Testing to confirm the operability and performance of the passive filtration design

Eductor – Air Ejector

- Venturi device that uses the energy in the compressed air to create a vacuum that entrains the MCR ducting airstream
- Amplification of the 65 ± 5 scfm delivery flow is roughly 10 times at an inlet pressure of 115 ± 5 psig



Passive Air Filtration Testing



Q-1

T-1

P-1

Testing Objectives and Results

- Test the operability and performance of the MCR Passive Air Filtration design addition to VES
 - Determine whether a compressed air flow rate of at least 60 scfm induces a filtration flow of at least 600 scfm with varying backpressure on the eductor
- Can induce required filtration flow with up to 5 inches of back pressure on the eductor
 - Eductor inlet pressure and feed flow from air tanks relate linearly
 - Feed flow and filtration (amplified) flow relate linearly



Passive Air Filtration Testing



Passive Air Filtration Testing





Passive Air Filtration Testing



MCR Emergency Habitability System (VES)

Closure of Open Items

Eductor Operating Experience

- RAI-SRP 6.4-SPCV-09
- Eductor is a venturi device that uses energy in the VES compressed air to induce a MCR filtration flow
- Similar eductors have been used to continuously convey abrasive powders for 10 years without a need for maintenance
- AP1000 eductor will not be used to normal plant operation & will be tested at an 18 month surveillance to verify operability

Passive Filtration Line Single Failures

- RAI-SRP 6.4-SPCV-13
- In accordance with SECY-77-439 a passive failure is an event such as line blockage or structural failure that limits a component's effectiveness
- Passive failures are not assumed until 24 hours after initiation of design basis events

Passive Filtration Line Single Failures

- Dose analysis demonstrates that VES passive filtration is not required 24 hours after accident initiation
- Large break LOCA & steam line breaks were analyzed to demonstrate operator dose rates remain below 5.0 rem TEDE with no passive filtration after 24 hours
- Large break LOCA & steam line break are limiting since they involve a release after 24 hours

Passive Filtration Line Single Failures

Comparison of Limiting VES Operating Cases

<i>Scenario</i>	<i>VES Filtration Operating for 72 Hours</i>	<i>VES Filtration Operating for 24 Hours</i>
Large Break LOCA	4.41 rem TEDE	4.41 rem TEDE
Steam Line Break (pre-existing iodine spike)	3.9 rem TEDE	3.91 rem TEDE
Steam Line Break (Accident initiated iodine spike)	4.0 rem TEDE	4.41 rem TEDE

Passive Filtration Line Single Failures

- 65 ± 5 scfm of breathable air from the VES emergency air storage tanks is required after 24 hours
- The configuration of the air delivery system has not changed since Revision 15 of the DCD
- Redundant active components exist in the air delivery flow path that are capable of providing breathable air to the MCR

Passive Filtration Line Single Failures

- Air delivery is monitored by a safety related flow instrument
- CAS provides air to the emergency air storage tanks
 - CAS contains a filtration package & air purifier/dryer to maintain breathable air meeting requirements of ANSI/CGA G7.1
- No credible source of line blockage in the VES line from the air bottles to the eductor

Passive Filtration Line Flow Instruments

- RAI-SRP 6.4-SPCV-12
- VES passive filtration flow instrumentation is not required to be safety related since filtration is not required after 24 hours
- Instrumentation is not required to ensure function of safety related components
- Instrumentation provides no automatic actuation or control of safety related equipment
- Instrumentation has been categorized as an E3 PAMs variable

MCR Emergency Habitability System (VES)

Changes to Technical Specification 3.7.6

Changes to Technical Specifications

- Chapter 16 – Tech Spec – 3.7.6 – MCR Habitability Systems (VES)
- LCO 3.7.6 – The MCR Habitability System shall be OPERABLE
- Changes to TS 3.7.6 as a result of NRC RAIs
- Two open items of concern:
 1. LCO 3.7.6, Condition D – “One bank of VES air tanks (8 tanks) inoperable”
 2. TS 5.5.13 – Ventilation Filter Testing Program (VFTP)

Changes to Technical Specifications

1. LCO 3.7.6, Condition D – “One bank of VES air tanks (8 tanks) inoperable” (RAI-SRP 6.4-SPCV-14)
 - Time limit of 7 days proposed
 - Reliable compensatory measures are available to ensure compliance with GDC 19 dose limits with 54 hours of compressed air
 - VBS fans initiated at 54 hours
 - Standard Tech Specs allow for 7 day completion time for one train MCR HVAC out of service
 - Expected time breakdown (assuming ideal conditions):
 - Vent – 2.5 hours, Maintenance Activities – 24 hours, Refill (using CAS HP compressor)– 24 hours

Changes to Technical Specifications

2. TS 5.5.13 – Ventilation Filter Testing Program (VFTP), (RAI-SRP 6.4-SPCV-10, -11)
 - Editorial error for combined penetration leakage corrected to say less than 0.05% instead of 0.5%
 - Incorporating DP testing across the HEPA filter and adsorber
 - In accordance with Standard Tech Specs
 - The total flow verification of passive filtration line during VFTP remains the same

Conclusions

- Passive Filtration design addition and implementation into DCD
- Passive Filtration testing provided data that confirms system operability and performance
- Resolution to outstanding design related open items
 - Eductor operating experience
 - Dose analysis shows no filtration needed after 24 hours
 - Passive Filtration flow instrumentation is non-safety related and a PAMs E3 variable
- Resolution to outstanding open items related to Technical Specifications
 - 7 day completion time for Condition D
 - System remains single failure tolerant and meets GDC 19 requirements with compensatory measures
 - Incorporating DP testing across the filters