

## Davis-Besse RI-IST Submittal for AOVs

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- Greg Estep - AOV Component Engineer
- Brett Gallatin - Supervisor - Codes
- Tim Thompson - IST Engineer
- Gerry Wolf - Licensing Engineer

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## Davis-Besse RI-IST Submittal for AOVs

- Objectives
  - Gain NRC Acceptance of Davis-Besse Submittal
  - Present Davis-Besse AOV Program Details

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## RI-IST Demonstration Project

- Topical Report BAW-2359
  - Davis-Besse is B&WOG Lead Plant
  - B&WOG approach follows ASME RI-IST Methodology and RG 1.175
  - B&WOG Topical Report contains generic RI-IST Program Description
    - Modify test strategy for other component types
  - Plant-specific implementation by referencing and/or adapting Program description in Topical Report

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## Davis-Besse Submittal

- Serial 2668
  - ◆ Requests Alternative to 10 CFR 50.55a(f)
  - ◆ AOVs Target Component
  - ◆ Process will apply to other target components
  - ◆ Code of Record Update for remaining components

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## Davis-Besse Submittal

- Key Points
  - ◆ Takes credit for the AOV Program to satisfy IST Program Objectives
  - ◆ Utilizes ASME Code Cases for Categorization and Test Strategies
  - ◆ Utilizes B&WOG Demonstration Project as Snapshot of differences in Safety Significant Equipment at B&W Plants
  - ◆ Meets minimum requirements of the JOG AOV Program

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## Davis-Besse AOV Program

- AOV Program Elements
  - ◆ Scope & Categorization
  - ◆ Design Basis Reviews
  - ◆ Setpoint Control
  - ◆ Testing
  - ◆ Preventive Maintenance
  - ◆ Training
  - ◆ Feedback
  - ◆ Documentation/Data Management
  - ◆ Tracking & Trending

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## Davis-Besse AOV Program

- Scope
  - ◆ AOV Inclusion Criteria
    - ✦ AOVs modeled explicitly or implicitly in the PSA
    - ✦ AOVs confirmed to actively support a Maintenance Rule Function
      - Emergency Operating Procedure Function
    - ✦ AOVs currently in the IST Program
    - ✦ All Q-Related AOVs
    - ✦ All AQ-Related AOVs
    - ✦ All PQ-Related AOVs
    - ✦ Historical Poor Performers

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## Davis-Besse AOV Program

- Categorization
  - ◆ OMN-3 Code Case
    - ✦ HSSC/LSSC Determination
    - ✦ Importance Measures
      - Fussell-Vesely (F-V)
      - Risk Achievement Worth (RAW)
    - ✦ Sensitivity Studies
    - ✦ Qualitative Assessments
    - ✦ Aggregate Risk
    - ✦ Expert Panel

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## Davis-Besse AOV Program

- Categorization
  - ◆ Davis-Besse PSA Analysis
    - ✦ Pilot for B&WOG Peer Certification Review Process in November 1999
    - ✦ Update process in place to reflect plant changes including changes to component reliability
    - ✦ Analysis provided Level 1 (CDF) and Level 2 (LERF) results

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## Davis-Besse AOV Program

- Categorization
  - ◆ Davis-Besse PSA Analysis
    - ✦ Key initiating events are explicitly modeled
    - ✦ PSA Analysis for AOV risk ranking performed at truncation sufficient to generate about 40,000 cutset
    - ✦ Level 3 PSA Model recently completed and external event modeling is in progress

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## Davis-Besse AOV Program

- Categorization
  - ◆ Davis-Besse PSA Analysis
    - ✦ Calculation of Fussell-Vesely and Risk Achievement Worth
  - ✦ Sensitivity Studies
    - Data Uncertainties
    - Testing and Maintenance Unavailabilities
    - Human Actions
    - LSSC Failure Rates
    - Common Cause
    - Truncation

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## Davis-Besse AOV Program

- Categorization
  - ◆ Davis-Besse PSA Analysis
    - ✦ Importance Measures
      - $F-V > 0.005$
      - $RAW > 2$
    - ✦ Design Criteria
      - Quadrant A
        - $F-V < 0.005$  and  $RAW < 2$
      - Quadrant B
        - $F-V < 0.005$  and  $RAW > 2$
      - Quadrant C
        - $F-V > 0.005$  and  $RAW > 2$
      - Quadrant D
        - $F-V > 0.005$  and  $RAW < 2$

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## Davis-Besse AOV Program

- Categorization
  - ◆ Davis-Besse PSA Analysis
    - ✦ Aggregate Risk
      - All LSSC AOVs set to Maximum Interval
      - Sensitivities were performed to evaluate impact of higher failure rate
      - $\Delta CDF$  and  $\Delta LERF$  effectively zero

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## Davis-Besse AOV Program

- Categorization
  - ◆ Expert Panel Decision Criteria
  - ◆ Quantitative
    - ✦ Importance Measures
      - Modeled Components
        - $F-V > 0.001$
        - $RAW > 2$
      - Non-modeled Components
        - Redundant Train
      - Quad Chart
        - 4 Quadrants

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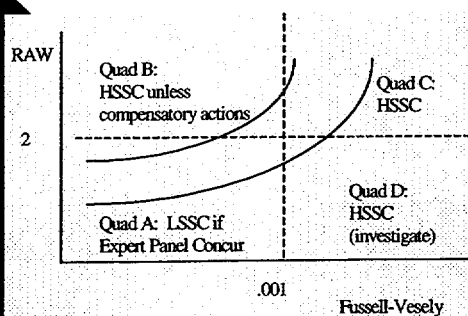
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## Importance Classification




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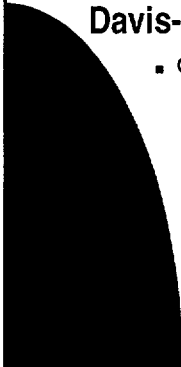
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## Davis-Besse AOV Program

- Categorization
  - ◆ Expert Panel Decision Criteria
    - ✦ Qualitative
      - Modeled/Non-Modeled IST Components
        - Impact of Initiating Events
        - Consequences of Shutdown
        - Response to External Events
      - Conditions and Events not Modeled
        - Prevent or Mitigate Accidents
        - Reach/Maintain Safe Shutdown
        - Preserve Reactor Coolant Pressure Boundary
        - Maintain Containment Integrity

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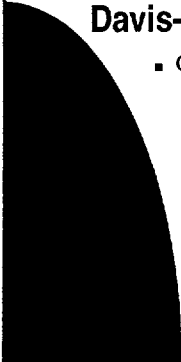
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## Davis-Besse AOV Program

- Categorization
  - ◆ Expert Panel Decision Criteria
    - ✦ Qualitative
      - Additional Assessments
        - Safety Function
        - Redundancy
        - Ability to recover from failure
        - Performance History
        - Technical Specifications
        - EOP Functions
    - ✦ Consensus/Reconciliation

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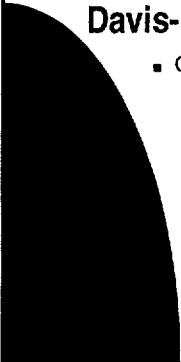
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## Davis-Besse AOV Program

- Categorization
  - ◆ Expert Panel Decision Criteria
    - ✦ Expert Panel Composition
      - Operations, PSA, Regulatory Affairs, Maintenance, Systems, IST, Component
    - ✦ Documentation of Basis
      - DB-PF-00003 - Maintenance Rule
        - HSSC/LSSC Decision Criteria
      - DB-PF-01000 - Programs
        - AOV Program Scoping Sheet

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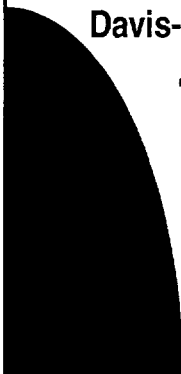
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## Davis-Besse AOV Program

- Categorization
  - ◆ 3 Categories
    - ✦ Category 1
      - Active, HSSC
    - ✦ Category 2
      - Active, LSSC or Expert Panel Deliberations
    - ✦ Category 3
      - Active/Passive LSSC, or Remaining Safety-Related not Category 1 or 2, or Expert Panel Deliberations

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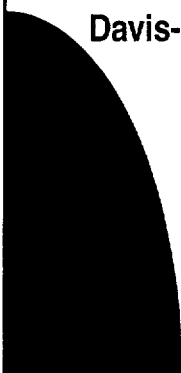
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## Davis-Besse AOV Program

- Categorization
  - ◆ Grouping
    - ✦ Category 1 & 2
      - Grouped based upon valve, actuator and service conditions
    - ✦ Category 3
      - Based on Actuator
      - Cross pollination with Category 1 & 2

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## Davis-Besse AOV Program

- Active Definition
  - ◆ IST Definition
    - ✦ IWA-9000 (1986 Code)
      - A valve that must perform a mechanical motion during the course of accomplishing a system safety function
    - ✦ ISTC 1.3 (1996 Addenda)
      - Valves that are required to change obturator position to accomplish the required function(s) as specified in para. ISTC 1.1

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## Davis-Besse AOV Program

- Active Definition
  - ◆ PSA Model Definition
    - ✦ AOVs explicitly modeled
      - Failure Modes Analyzed
        - Fail to Open
        - Fail to Close
        - Fail to Remain Open
        - Fail to Remain Closed

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## Davis-Besse AOV Program

- Active Definition
  - ◆ AOVs in non-safety position
    - ✦ Ultimately determined by SRO
      - Maintenance
        - Operability determined by SRO Review
      - Testing
        - Operability typically addressed by Procedure

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## Davis-Besse AOV Program

- Design Basis Reviews
  - ◆ Category 1
    - ✦ Vendor supplied data under 10 CFR 50 Appendix B
    - ✦ First Principles
    - ✦ Available Validated Methodologies
    - ✦ Valve/Actuator Weak Link
  - ◆ Category 2
    - ✦ Vendor supplied available data
    - ✦ First Principles
    - ✦ Available Validated Methodologies

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## Davis-Besse AOV Program

- Design Basis Reviews
  - ◆ Category 3
    - ✦ Based upon issues identified during DBRs of Category 1 & 2

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## Davis-Besse AOV Program

- Design Basis Reviews
  - ◆ System Level Reviews
    - ✦ Minimum and Maximum Worst Case Operating Conditions
  - ◆ Component Level Reviews
    - ✦ Valve minimum required thrust or torque
    - ✦ Actuator Capability
    - ✦ Margin

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## Davis-Besse AOV Program

- Design Basis Reviews
  - ◆ Margin
    - ✦ Acceptable is > 0% including all uncertainties and degradations
    - ✦ Margin improvement for the AOVs with < 20% margin
  - ◆ Verification of Component Capabilities
    - ✦ Solenoid, Positioner, Controller, Booster, Regulator, Other Accessories

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## Davis-Besse AOV Program

- Design Basis Reviews
  - ◆ Degradation
    - ◆ Valves
      - Valve & Bearing Friction
        - EPRI PPM Bounding Values
        - Dynamic Testing
        - JOG Periodic Verification
    - ◆ Actuators/Accessories
      - Spring relaxation
      - Setpoint Drift
      - Actuator Friction

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## Davis-Besse AOV Program

- Setpoint Control
  - ◆ Controlled via the Mod Process
    - ◆ Procedure NG-EN-00301
  - ◆ Maintained on a Setpoint List
    - ◆ Drawing M720-I
  - ◆ Field Implementation via I&C Data Package
    - ◆ Procedure DB-MI-00001

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## Davis-Besse AOV Program

- Setpoint Control
  - ◆ Source
    - ◆ Category 1 & 2 AOVs
      - Established/Confirmed via DBR
    - ◆ Category 3
      - Vendor Supplied Values
  - ◆ Controlled Setpoints
    - ◆ Regulator
    - ◆ Bench Set
    - ◆ Travel

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### Davis-Besse AOV Program

- Testing
  - ◆ Category 1
    - ✦ Baseline
      - Stroke Time & Diagnostic
        - Static
        - Dynamic if appropriate
      - Confirm Setpoints
      - Establish Reference Parameters
    - ✦ Periodic
      - Stroke Time & Diagnostic
        - Static
        - Dynamic if appropriate
      - Verification of Setpoints
      - Verification of Reference Parameters
      - Potential Degradation

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### Davis-Besse AOV Program

- Testing
  - ◆ Category 2
    - ✦ Baseline
      - Diagnostic
        - Static
      - Confirm Setpoints
      - Establish Reference Parameters
    - ✦ Periodic
      - Diagnostic
        - Static
      - Verification of Setpoints
      - Verification of Reference Parameters
      - Potential Degradation

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### Davis-Besse AOV Program

- Testing
  - ◆ Category 3
    - ✦ Baseline
      - Pre/Post Maintenance Diagnostic
        - Static
      - Confirm Setpoints
      - Establish Reference Parameters
    - ✦ Periodic
      - Pre/Post Maintenance Diagnostic
        - Static
      - Verification of Setpoints
      - Verification of Reference Parameters
      - Cross Pollination with Category 1 & 2

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## Davis-Besse AOV Program

- Testing
  - ◆ Acceptance Criteria
    - ✦ Category 1
      - Stroke Time
      - Setpoints
      - Margin
    - ✦ Category 2
      - Margin
      - Setpoints
    - ✦ Category 3
      - Setpoints

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## Davis-Besse AOV Program

- Testing
  - ◆ Test Intervals - Performance Based
    - ✦ Category 1
      - Once per cycle going to once per two cycles max
    - ✦ Category 2
      - Once per three cycles going to once per five cycles max
    - ✦ Category 3
      - Once per five cycles max

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## Davis-Besse AOV Program

- Preventive Maintenance
  - ◆ Applies to Category 1, 2 & 3
    - ✦ EPRI Template
    - ✦ Davis-Besse Experience
    - ✦ Industry Experience
  - ◆ Focus on Elastomer Replacement
  - ◆ Replacement of Accessories
  - ◆ Actuator/Valve Inspections
  - ◆ Packing

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### Davis-Besse AOV Program

- Preventive Maintenance
  - ◆ Procedures
    - ✦ Category 1
      - Valve/Actuator Specific
        - Inspection
        - Repair
        - Rebuild
    - ✦ Category 2 & 3
      - May be Valve/Actuator Specific
        - Inspection
        - Repair
        - Rebuild

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### Davis-Besse AOV Program

- Preventive Maintenance
  - ◆ Procedures
    - ✦ Diagnostic
    - ✦ Calibration

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### Davis-Besse AOV Program

- Training
  - ◆ Mechanical
    - ✦ Valve Inspection/Repair/Rebuild
    - ✦ Packing
  - ◆ I&C
    - ✦ Actuator Inspection/Repair/Rebuild
    - ✦ Calibration
    - ✦ Setpoint Control
    - ✦ Diagnostics

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## Davis-Besse AOV Program

- Training
  - ◆ Engineering
    - ✦ Calculations
    - ✦ Software
    - ✦ Diagnostic
      - Test Methods
      - Trace Interpretation

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## Davis-Besse AOV Program

- Tracking & Trending
  - ◆ Category 1
    - ✦ Setpoints
      - Regulator Setpoint
      - Bench Set
      - Travel
    - ✦ Reference Parameters
      - Valve/Actuator Friction
      - Seating Force
      - Unseating Force
      - Stroke Time

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## Davis-Besse AOV Program

- Tracking & Trending
  - ◆ Category 2 & 3
    - ✦ Setpoints
      - Regulator Setpoint
      - Bench Set
      - Travel
    - ✦ Reference Parameters
      - Valve/Actuator Friction
      - Seating Force
      - Unseating Force

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## Davis-Besse AOV Program

- Tracking & Trending
  - ◆ Program Effectiveness
    - ✦ Corrective Work Orders
    - ✦ Preventive Work Orders
    - ✦ Condition Reports
    - ✦ Corrective Actions

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## Davis-Besse AOV Program

- Feedback
  - ◆ General
    - ✦ INPO EPIX Database
    - ✦ NRC Communication
    - ✦ EPRI
  - ◆ Scope & Categorization
    - ✦ Confirmation by Expert Panel
      - Work Orders
      - Condition Reports
      - PSA Updates
      - Maintenance Rule

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## Davis-Besse AOV Program

- Feedback
  - ◆ Design Basis
    - ✦ Testing Values
      - Friction
      - Seating/Unseating
      - Potential Degradation Where Dynamically Tested
  - ◆ Preventive Maintenance
    - ✦ Performance History
      - Work Orders
      - Condition Report
      - Inspection Procedures

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## Davis-Besse AOV Program

- Documentation/Data Management
  - ◆ AOV Program Document
  - ◆ Bases Documents
    - ✦ Scoping & Categorization
    - ✦ Preventive Maintenance
  - ◆ Guidelines
    - ✦ Calculation Methodologies
  - ◆ Calculations
    - ✦ System/Valve/Actuator/Margin

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## Davis-Besse AOV Program

- Documentation/Data Management
  - ◆ Setpoint List
  - ◆ Test Results
  - ◆ Tracking & Trending Reports
  - ◆ Training Records
- All records available at the site or upon specific request.

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## Davis-Besse Programs

- Air System Quality
  - ◆ Station/Instrument Air System
    - ✦ Original Plant Design
      - 2 Oil-Free Reciprocating Compressors
        - 100% Capacity
      - 1 Dryer
        - 100% Capacity
      - Coalescing Pre-filter >0.6 Microns
      - Particulate After-filter > 0.9 Microns
      - Point of Use Filter/Regulators

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## Davis-Besse Programs

- Air System Quality
  - ◆ Station/Instrument Air System
    - ✦ Modifications
      - Added 1 Oil-Free Centrifugal Compressor
        - 100% Capacity
      - Added 1 Dryer
        - 100% Capacity
      - Larger Station Air Automatic Blowdown Drain Valves
      - Improved Station Air Receiver Moisture Traps

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## Davis-Besse Programs

- Air System Quality
  - ◆ Station/Instrument Air System
    - ✦ Monitoring
      - Dewpoint
      - In-service IA Dryer Parameters monitored each shift
        - Inlet/Outlet Pressures
        - Moisture Indication
        - Filter D/Ps
      - Sampling of Safety-Related AOV Accumulators for Moisture and Particulate

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## Davis-Besse Programs

- Air System Quality
  - ◆ Station/Instrument Air System
    - ✦ Preventive Maintenance
      - Desiccant Replacement
      - Pre-filter/After-filter Replacement
      - Dryer Valve Maintenance
      - Dryer Solenoid Replacement
      - Moisture/Particulate Check of all AOV Accumulator Tanks
      - Point of use Filter/Regulator Replacement

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### Davis-Besse Programs

- Dampers
  - ◆ Scoping
    - Safety-Related Dampers in HVAC Systems
  - ◆ Categorization
    - Expert Panel Deliberation Results
      - No dampers in Category 1 or 2
      - All Safety-Related Dampers in Category 3
        - CREVs
        - ECCS Room Isolation Dampers

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### Davis-Besse Programs

- Dampers
  - ◆ Testing & Maintenance Strategy
    - ◆ Preventive Maintenance
      - Dampers
        - Inspection of Seats
        - Lubrication
      - Actuators
        - Leak Check
        - Replacement of elastomers
        - Replacement of accessories

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### Davis-Besse Programs

- Dampers
  - ◆ Testing & Maintenance Strategy
    - ◆ Testing
      - Stroke Time at Design Basis Conditions
      - Positive Pressure

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## Summary

- Gain NRC Acceptance of Davis-Besse Risk-Informed IST Submittal
  - ◆ Inter-Related Programs
    - ✦ AOV Program
    - ✦ PM Program
    - ✦ Instrument Air Quality Program
    - ✦ Maintenance Rule Program
    - ✦ Damper Program
    - ✦ LLRT Program

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