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Protecting People and the Environment

Air Operated Valve Regulatory Activities

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AOV Users' Group
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NRC Regulations

- 10 CFR 50.55a – Codes and Standards (Inservice Testing)
- 10 CFR 50.65 – Maintenance Rule
- 10 CFR 50.69 – Risk-Informed Treatment
- 10 CFR Part 50, Appendix A – General Design Criteria
- 10 CFR Part 50, Appendix B – Quality Assurance
- 10 CFR Part 100 – Reactor Site Criteria (Seismic)

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Current AOV Issues/Activities

- 50.55a Rulemaking
- Regulatory Guide 1.192 Revision 1
- OE AOV 2015 Events
- AOV Stem Separation Failure Study
- IN 2015-13 Main Steam Isolation Valve Failure Events
- ASME OM Code Case OMN-20
- Cyber Security Issue

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50.55a Rulemaking

- Rulemaking for ASME OM Code 2009 Edition, 2011 Addenda, and 2012 Edition completed
- Published in the Federal Register and issued for public comment September 2015
- Public comment period ended 12/2/2015
- NRC staff working on addressing public comments
- Final rule tentatively issued in September 2016

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Reg Guide 1.192 Operation and Maintenance Code Case Acceptability, ASME OM Code

- Regulatory guide lists OM Code Cases that are acceptable to the NRC for implementation in the Inservice Test (IST) of light-water-cooled nuclear power plants
- Revision 1 to RG 1.192 (NRC approval of ASME OM Code Cases, 2002-2006 Edition / Addenda) – Approved and effective in the Federal Register 12/05/2014
- RG 1.192 to be updated after final rulemaking is issued (tentatively fall of 2016)

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2015 AOV Events

- North Anna 1 – AFW terry turbine main steam supply replaced due to hairline crack on valve body. Discovered from stroke time failure (6/15)
- Waterford 3 – Secondary side heater drain control valve disc separated failing closed. Unit was manually tripped (6/15)
- Waterford 3 – Emergency feedwater backup flow control valves erratic oscillations. Root cause - valves were not configured to operate or tested under existing conditions (6/15)
- Catawba 2 – SW to component cooling AOV positioner detached from valve stem (6/15)

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AOV Stem Separation Failure Study

- Study was performed to assist ASME OM AOV Subgroup on improving the testing requirements of the ASME OM Code for AOVs
- Comment:
  - Data presented is what is contained in INPO database. Many data points contain data that are not safety-related. I believe that there has been many other failure events of this nature (non-safety) that did not make it into the INPO database due to over 30 years of data entry and the inconsistency of what had to be entered. Early days of reporting guidelines were less stringent than today.

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AOV Stem Separation Failure Study (cont'd)

- All records in INPO ICES database examined using search criteria:
  - Valves, valve operators, pneumatic cylinders, AOV operators
  - Key words "Separated" and "Separation"
  - All records up to and including 1/26/2015
  - Did not capture events where diaphragm had separated
  - Did not capture air operated check valve failures
  - Purpose of the study was to evaluate the failure attributes so that lessons learned could be incorporated into the ASME OM Code

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AOV Stem Separation Failure Study (cont'd)

- Total number of failures over 30 year span = 109. Valve types included:
  - 77 Globe valves
  - 10 Gate valves
  - 10 Butterfly valves
  - 2 Ball valves
  - 10 Unknown type (INPO data not reported)
- Number of failures by year:
  - 1975 to 1985 = 9
  - 1985 to 1995 = 52
  - 1995 to 2005 = 22
  - 2005 to 2015 = 26

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AOV Stem Separation Failure Study (cont'd)

- Review of the data:
  - 63% of events involved main steam and/or feedwater systems
  - 90% of events were identified immediately via monitoring of system parameters (i.e. flow, pressure, temperature etc.)
  - Many failure events identified by visual in the field observations
  - Valves with diaphragm failures were identified immediately via field observation (valve didn't move)
  - Many failure events noted in high stress systems (Main Steam, Feedwater)
  - Many failure events noted in untreated water systems

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IN 2015-13 Main Steam Isolation Valve Failure Events

- IN Discusses 4 MSIV failure events:
  - Shearon Harris Unit 1 on 4/21/2012
  - Vogtle Unit 1 on 10/7/2012
  - St. Lucie Unit 1 on 3/12/2013
  - LaSalle Unit 2 on 8/5/2014
- Key contributors to events
  - Deficiency in licensee processes
  - Deficiency in procedures
  - Deficiency in quality assurance process
  - Deficient process for deferring maintenance

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IN 2015-13 Main Steam Isolation Valve Failure Events

- Shearon Harris Event:
  - Two out of three MSIV failed their stroke time test (3 – 5 sec.) One closed after 1 hour and 14 minutes while the other closed after 4 hours and 37 minutes
  - Root cause was long term corrosion and oxidation of the valve piston rings
- Contributors:
  - Valves had never been disassembled for inspection since 1986
  - AOV program classified them as Category 2 = no diagnostics
  - Missed opportunities of not evaluating erratic stroke and actuator timing adjustments and no diagnostic testing

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IN 2015-13 Main Steam Isolation Valve Failure Events

- Vogtle Event:
  - 2 MSIV sheared approximately 2 inches above the stem to disc connection
  - Root cause was temperature aging embrittlement
- Contributors:
  - Inadequate procedural guidance on how to minimize the effects of thermal embrittlement of valve stems and other susceptible components

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IN 2015-13 Main Steam Isolation Valve Failure Events

- St. Lucie Event:
  - Unit tripped on thermal margin/low pressure transient signal
  - Root cause was MSIV had a spindle to disk separation
- Contributors:
  - Valve that failed had been upgraded with new internals to support power uprate
  - New internals did not meet design specifications
  - Oversized internals did not allow valve to back seat thus leaving the valve disc partially in the flow stream causing accelerated wear
  - Engineering change package did not verify modified valves would open full to backseat

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IN 2015-13 Main Steam Isolation Valve Failure Events

- LaSalle Event:
  - MSIV failed shut due to stem to disk separation
  - Inspection concluded failure due to mechanism that was previously identified at another plant
- Contributors:
  - Valve vendor issued improved valve design change to affected plants
  - LaSalle installed mod on 7 of 16 MSIVs in 2007
  - In 2008, maintenance activity to upgrade was deferred on remaining valves
  - Licensee later determined process for deciding deferral was deficient

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IN 2015-13 Main Steam Isolation Valve Failure Events

- Overall there have been at least 28 events involving MSIV in the last 5 years
- Failure cause include:
  - Wear
  - Corrosion
  - Failed circuitry
  - Material fatigue
  - Embrittlement
  - Material defect
  - Lack of lubrication
  - Human performance

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ASME OM Code Case OMN-20 Inservice Test Frequency

- Currently, ASME OM Code does not allow a grace period on test frequency intervals
- Disconnect between Plant Technical Specifications (TS) and Inservice Test Program (IST)
- TS has grace period – IST does not
- Issue is many TS state grace is applicable to IST
- Grace period only allowed for those components that require TS surveillance (RIS 2012-10)
- OMN-20 closes gap in that it allows IST same grace as TS

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ASME OM Code Case OMN-20 Inservice Test Frequency (cont'd)

- Relief Request needed to use OMN-20
- When requesting relief, be sure to include all IST requirements that are applicable to test intervals
- Include any adopted ASME OM Code Cases that have applicable test intervals (i.e. OMN-1)
- Include any ASME OM Code Cases that may be adopted during the 10 Year test interval

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Cyber Security Issue

- Cyber Rule - The licensee shall protect digital computer and communication Systems and networks associated with:
  - (iv) Support systems and equipment which, if compromised, would adversely impact safety, security, or emergency preparedness (SSEP) functions.
- Recent Security Inspections identified 2 laptop computers used to set, measure, and/or verify valve performance to contain a virus
- Initial conclusion – laptop computer is used to set safety related valve and met the definition of Critical Digital Asset (CDA)

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Cyber Security Issue
(cont'd)

- Cyber Security Director requested input from Engineering on the subject of infected laptop computers used to set/verify valve capability
- Final Position:
  - Analog components (i.e. valves, pumps, etc.) that have no digital features, processors, or other electronic smart accessories should not be considered as CDA. The laptops that contain the software for analysis and verification that a pump, valve, etc. is set up properly should fall under the rules of Appendix B section XII "Control of Measuring and Test Equipment."

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QUESTIONS?

Future Questions

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