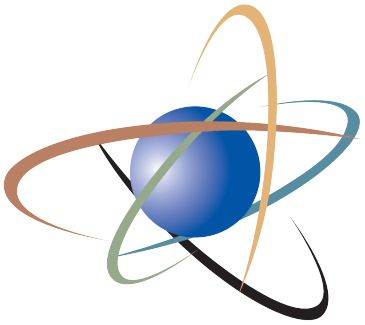

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Motor-Operated Valve Regulatory Activities

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MOV Users' Group
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NRC Regulations

- 10 CFR 50.55a(b)(3)(ii) Motor-Operated Valve Testing
  - Licensees shall comply with the provisions for testing motor-operated valves in OM Code ISTC 4.2, 1995 Edition with the 1996 and 1997 Addenda, or ISTC-3500, 1998 Edition through the latest edition and addenda incorporated by reference in paragraph (a)(1)(iv) of this section, and must establish a program to ensure that motor-operated valves continue to be capable of performing their design basis safety functions.

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Current MOV Issues/Activities

- 50.55a Rulemaking
- Regulatory Guide 1.192 Revision 1
- 2015 MOV Events/Issues/Activities
  - MOV History
  - 2015 MOV event summary
  - ASME OM Code Case OMN-20
  - Cyber Security Issue
  - 10 Year Test Interval

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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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50.55a Rulemaking – Impact on MOV

- Mandatory Appendix III will now be required when updating to the next 10 Year IST interval
- ASME OM Code Case OMN-20 “Inservice Test Frequency” endorsed by NRC (grace period)
- MOV program will now be a requirement vs. a commitment
- MOV program scope likely to increase when transitioning from MOV program commitment to IST program requirement

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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)
- ASME OMN-1 is acceptable as an alternative to MOV quarterly stroke-time testing using periodic diagnostic testing and exercising with conditions

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MOV History

- In 1980s, operating experience revealed weaknesses in design, qualification, maintenance, personnel training, and IST for MOVs:
  - Davis Besse Feedwater Failure (IN 85-50)
  - Catawba AFW Failure (IN 89-61)
  - Palisades PORV Block Valve Failure (AIT Nov. 1989)
- Research programs by industry and NRC confirmed MOV performance weaknesses
- NRC initiated regulatory action to address these weaknesses

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Past MOV Issues

- Underestimation of required valve thrust or torque from assumptions for differential pressure, valve factors, butterfly valve torque coefficients, and un-wedging
- Overestimation of motor actuator thrust or torque output from assumptions for actuator efficiency, degraded voltage effects, ambient temperature effects, stem friction, and load sensitive behavior
- Potential unpredictability of valve performance under high flow conditions
- Significant variation in MOV performance

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Past MOV Issues
(continued)

- Deficiencies in MOV parts (e.g., torque and limit switches, motor shafts, pinion keys, valve yokes)
- Improper low voltage operation of motor brakes
- Inadequacies in some MOV diagnostic equipment in accurately measuring thrust and torque
- Gearbox and spring pack grease hardening
- Maintenance and training weaknesses
- Inadequate corrective action
- MOV magnesium rotor degradation (remains an issue)

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MOV History - Regulatory Action

- NRC Office of Nuclear Regulatory Research sponsored extensive program by Idaho National Engineering Laboratory on valve performance
- 10 CFR 50.55a revised to supplement ASME Code stroke-time IST provisions with MOV periodic design-basis capability requirement
- Bulletin 85-03 and Generic Letters 89-10, 95-07, and 96-05
- Regulatory Issue Summaries 2000-03 and 2001-15
- Information Notices
- Reviews and inspections of MOV programs at current nuclear power plants
- SRP and inspection procedures updated

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MOV History - NRC-Sponsored INEEL Research

- Valve flow performance
- AC-powered MOV output
- DC-powered MOV output
- Stem friction coefficient
- Actuator efficiency
- Valve aging

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MOV History - INEEL MOV Research Reports

NUREG/CR-5406 (10/1989) - Gate Valve Flow Tests
NUREG/CR-5558 (1/1991) – Gate Valve Flow Tests
NUREG/CR-5720 (6/1992) – MOV Research Update
NUREG/CR-6100 (9/1995) – Gate Valve & Operator
NUREG/CR-6478 (7/1997) – Actuator Motor and Gearbox
NREG/CR-6611 (5/1998) – Pressure Locking
NUREG/CR-6620 (5/1999) – DC-Powered MOVs
NUREG/CR-6750 (10/2001) – Stem Lubricant Performance
NUREG/CR-6806 (9/2002) – Stem Lubricant Aging
NUREG/CR-6807 (3/2003) – Stellite Aging

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MOV History - Bulletin 85-03

- Requested licensees to test high-pressure safety-related MOVs under design-basis DP and flow conditions
- Supplement 1 clarified scope to all MOVs in specified systems and to address potential mispositioning
- Static testing primarily conducted
- Implementation results indicated about 8% of MOVs might not have operated under design-basis conditions
- Results supported development of GL 89-10 to expand scope to all safety-related MOVs

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MOV History - Generic Letter 89-10

- Requested licensees to verify design-basis capability of safety-related MOVs
  - Reviewing MOV design bases,
  - Establishing MOV switch settings
  - Dynamically testing MOVs where practicable
  - Verifying settings every 5 years and following maintenance
  - Improving corrective action and trending MOV problems.
- Licensees requested to complete GL 89-10 in 5 years or 3 RFOs.
- Justified as compliance backfit under 10 CFR 50.109

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MOV History - GL 89-10
(continued)

- NRC staff conducted inspections using TI 2515/109 to evaluate GL 89-10 programs
- NRC closed out GL 89-10 typically through inspections
- GL 89-10 implementation involved several million dollars per plant
- BWR Owners Group indicated acceptable cost/benefit based on numerous MOV deficiencies identified

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MOV History - GL 89-10 Supplements

Supplement 1 (June 13, 1990): Provided results of GL 89-10 workshops in fall 1989

Supplement 2 (Aug. 3, 1990): Allowed additional time for incorporation of Supplement 1 into GL 89-10 programs

Supplement 3 (Oct. 25, 1990): Accelerated review of isolation valves in high pressure coolant injection, reactor core isolation cooling system, and reactor water cleanup system in response to MOV tests

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MOV History - GL 89-10 Supplements (continued)

Supplement 4 (Feb. 12, 1992): Deleted mispositioning from GL 89-10 scope for BWR plants

Supplement 5 (June 28, 1993): Addressed MOV diagnostic equipment accuracy

Supplement 6 (Mar. 8, 1994): Provided results of GL 89-10 workshops including guidance on grouping and pressure locking

Supplement 7 (Jan. 24, 1996): Deleted mispositioning from GL 89-10 scope for PWR plants

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MOV History - Generic Letter 95-07

- Pressure locking of flex wedge gate valve or parallel disc gate valve occurs when pressurized fluid in bonnet prevents valve opening
- Thermal binding of flex wedge or solid wedge gate valve caused by mechanical interference between valve disc and seat
- Requested licensees to address potential pressure locking and thermal binding of power-operated gate valves
- Justified as compliance backfit
- NRC reviewed licensee submittals and prepared SE

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MOV History - Generic Letter 96-05

- Requested licensees to develop programs to periodically verify MOV design-basis capability
- Justified as compliance backfit
- 98 reactor units committed to implement Joint Owners Group (JOG) Program on MOV Periodic Verification
- Callaway, Fort Calhoun, Palisades, and San Onofre 2/3 reviewed separately
- SE prepared based on submittals and commitments
- Sample inspections

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MOV History - RIS 2000-03
Resolution of Generic Safety Issue 158: Performance of Safety-Related Power-Operated Valves Under Design Basis Conditions

- Close out of GSI 158 discussed
- Current regulations provide adequate requirements to ensure verification of POV design-basis capability and no new regulatory requirements are needed
- AOV JOG program with NRC comments
- NRC will monitor licensee activities to ensure that POVs are capable of performing safety-related functions under design-basis conditions

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MOV History - RIS 2001-15 Performance of DC-Powered Motor-Operated Valve Actuators

- Alerts licensees to updated methodology developed by BWROG to evaluate capability of dc-powered MOVs to perform their safety functions
- Notes BWROG recommended schedule for BWR plants to implement methodology
- Indicates that methodology also applicable to dc-powered MOVs in PWR plants

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MOV History - MOV Information Notices

- IN 81-31, Failure of SI Valves to Operate Against DP
- IN 86-02, Failure of Valve Operator Motor During Environmental Qualification Testing
- IN 89-61, Failure of Borg-Warner Gate Valves to Close Against Differential Pressure
- IN 90-21, Potential Failure of Motor-Op. Butterfly Valves
- IN 90-40, Results of NRC-Sponsored MOV Testing
- IN 90-72, Testing of Parallel Disc Gate Valves in Europe
- IN 92-17, NRC Inspections of MOV Programs
- IN 92-23, Results of Validation Testing of MOV Diagnostic Equipment
- IN 92-26, Pressure Locking of FWG valves
- IN 92-83, Thrust Limits for Limitorque Actuators

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MOV History - MOV Information Notices

- IN 93-74, High Temperatures reduce AC motor output
- IN 93-98, Motor Brakes on Actuator Motors
- IN 94-50, Failure of GE Contactors to pull in at voltage
- IN 94-69, Potential Inadequacies in Torque Requirements and Output for Motor-Operated BVs
- IN 95-14, Susceptibility of Containment Sump Valves to Pressure Locking
- IN 95-18, Potential Pressure Locking of Gate Valves
- IN 95-30, LPCI and CS Valve Pressure Locking
- IN 96-08, Thermally Induced PL of HPCI Valve
- IN 96-30, Inaccuracy of Diagnostic Equip. for Motor-Operated BVs
- IN 96-48 and Supplement 1, MOV Performance Issues

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MOV History - MOV Information Notices

- IN 97-07, GL 89-10 Close-out Inspection Issues
- IN 97-16, Preconditioning
- IN 02-26 S2, Additional Flow-Induced Vibration Failures after a Recent Power Uprate
- IN 03-15, Importance of Maintenance Follow-up Issues
- IN 05-23, Vibration-Induced Degradation of Butterfly Valves
- IN 06-03, Motor Starter Failures due to Mechanical-Interlock Binding
- IN 06-15, Vibration-Induced Degradation and Failure of Safety-Related Valves
- IN 06-26, Failure of Magnesium Rotors in Motor-Operated Valve Actuators
- IN 06-29, Potential Common Cause Failure of Motor-Operated Valves as a result of Stem Nut Wear

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MOV History - MOV Information Notices

- IN 08-20, Failures of MOV Actuator Motors with Magnesium Alloy Rotors
- IN 10-03, Failures of MOVs due to Degraded Stem Lubricant
- IN 12-14, Motor-Operated Valve Inoperable Due to Stem-Disc Separation
- IN 13-14, Potential Design Deficiency in Motor-Operated Valve Control Circuitry

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MOV History - Industry Action

- Current nuclear power plants implemented resource-intensive programs in response to GLs 89-10, 95-07, and 96-05
- Electric Power Research Institute test-based valve performance methodology
- Joint Owners Group (JOG) developed MOV dynamic testing program in response to GL 96-05
- Design Certification (DC) and Combined License (COL) Applicants recognize need to address MOV lessons learned in applications

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MOV History - EPRI MOV Performance Prediction Program (PPM)

- Test-based methodology for predicting operating requirements for gate, globe, and butterfly valves described in EPRI TR-103237 (Rev. 2, 1997)
- NRC accepted methodology with conditions in SE and supplement (3/15/96 and 2/20/97)
- PPM conservatism considered in Thrust Uncertainty Method in Addendum 2 (11/98) to topical report and accepted in SE Supplement 3 (9/30/02)
- EPRI provides updated MOV guidance in Application Guide TR-106563 (Vol. 1 and 2)

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MOV History - JOG Program on MOV Periodic Verification

- Risk-informed program to share test information on valve performance for responding to GL 96-05
- 5-year dynamic testing of sample MOVs at each participating plant
- Static and possible dynamic testing based on program results and margin
- Test frequency based on risk and margin
- NRC accepted in SE dated 9/06

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MOV History - ComEd MOV Output Methodology

- In 1990s, ComEd tested motors to evaluate output capability and degraded voltage factors
- ComEd evaluated test data from other sources for actuator performance
- ComEd White Paper 125 (Rev. 3, 2/8/99) provides methodology for sizing motor actuators
- NRC staff accepted use of White Paper 125 during GL 89-10 inspections

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MOV History - BWROG DC MOV Methodology

- Based on research identifying more severe effects on DC MOV output from temperature, voltage, and loading, BWROG developed updated methodology for DC MOV output and stroke time
- BWROG indicated that methodology would be made available to PWR licensees
- NRC discussed BWROG methodology in RIS 2001-15

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MOV History - ASME Activities

- ASME with industry and regulatory participation prepared QME-1-2007 Standard to incorporate MOV lessons learned
- OM Code cases OMN-1 and 11 (MOVs) and OMN-12 (AOVs and HOVs) provide performance-based and risk-informed alternatives to stroke-time testing (conditionally accepted in RG 1.192)
- OM Code Case OMN-1 and OMN-11 have been incorporated into 2009 Edition of ASME OM Code as Mandatory Appendix III

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2015 MOV Event Summary

- OE data (LER, Part 21, Inspection Reports, NOV, etc.) 14 events
  - 5 events due to failed circuitry
  - 3 events due to human performance
  - 3 events due to design weakness
- INPO ICES data review – 45 additional events
  - 22 events due to failed circuitry
  - 13 events due to wear, FME or material fatigue
  - 5 events due to design weakness

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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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10 Year MOV Test Interval

- Question – Can you exceed the exact 10 year MOV test interval due date?
    1) If MOV program follows JOG periodic verification (PV) plan or licensee has its own PV plan, use 50.59 process to determine if you can exceed the 10 year test interval due date
    2) If MOV program is based on ASME OM Code Case OMN-1 or ASME OM Mandatory Appendix III, there is no grace period (unless you have requested the use of ASME OM Code Case OMN-20). You are locked into Inservice Test requirements. To extend past the 10 year test interval date would require a relief request.

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QUESTIONS?

Future Questions

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