

# Inservice Testing (Question 5-9)

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## Inservice Testing Regulatory Requirements and Guidance

- 10 CFR 50.55a for IST requirements
- 10 CFR Part 50, Appendix A, General Design Criteria, and Appendix B, Quality Assurance Criteria
- 10 CFR Part 52 for Design Certification and Combined License (COL) application requirements
- NRC Standard Review Plan (SRP) Section 3.9.6
- Regulatory Guide 1.206 for COL application
- Commission Paper SECY-05-0197 on operational programs

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## ASME Code IST Provisions

- *ASME Code for Operation and Maintenance of Nuclear Power Plants (OM Code)*
  - Section ISTA on general requirements
  - Section ISTB on pump testing
  - Section ISTC on valve testing
  - Section ISTD on dynamic restraints
- 10 CFR 50.55a incorporates by reference the ASME OM Code provisions for IST activities with supplemental requirements and conditions

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## IST Operating Experience

- In 1980s, operating experience at nuclear power plants revealed weaknesses in design, qualification, maintenance, personnel training, and IST for motor-operated valves (MOVs)
- Weaknesses included underestimation of required thrust and torque, overestimation of actuator output, potential unpredictability of valve performance, deficiencies in MOV parts, inadequacies in diagnostic equipment, inadequate corrective action, and magnesium motor rotor degradation
- Some lessons learned applicable to other power-operated valves

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## NRC Valve Research Activities

- NRC sponsored valve research at Idaho National Laboratory
- Research topics included
  - valve flow performance
  - AC- and DC-powered MOV output
  - stem friction coefficient
  - actuator efficiency
  - valve aging
- Research results incorporated into NRC review and inspection practices
- Numerous NUREG/CR reports issued documenting research results

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## NRC Valve 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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## Regulatory Communications

- Generic Letter (GL) 89-10 and supplements on verification of MOV design-basis capability
- GL 95-07 on pressure locking and thermal binding of power-operated gate valves
- GL 96-05 on periodic verification of MOV design-basis capability
- Regulatory Issue Summary (RIS) 2000-03 on performance of safety-related power-operated valves
- RIS 2001-15 on DC-powered MOV performance
- Regulatory Guide 1.192 on ASME OM Code Cases
- Numerous NRC Information Notices

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## MOV Information Notices

- IN 81-31, Failure of Safety Injection Valves to Operate Against Differential Pressure
- 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-Operated Butterfly Valves (BVs)
- 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 Flexible-Wedge Gate valves
- IN 92-83, Thrust Limits for Limitorque Actuators

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- 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 Pressure Locking of HPCI Valve
- IN 96-30, Inaccuracy of Diagnostic Equip. for Motor-Operated BVs
- IN 96-48 and Supplement 1, MOV Performance Issues
- IN 97-07, GL 89-10 Close-out Inspection Issues

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- IN 97-16, Preconditioning
- IN 02-26 Supplement 2, 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
- IN 08-20, Failures of Motor Operated Valve Actuator Motors with Magnesium Alloy Rotors

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## Industry Actions

- Current nuclear power plants implemented significant programs in response to GLs 89-10, 95-07, and 96-05
- EPRI MOV Performance Prediction Methodology, MOV Application Guide, and Technical Repair Guidelines
- Joint Owners Group Program on MOV Periodic Verification based on MOV dynamic testing
- Boiling Water Reactor Owners Group methodology for DC-powered MOV output
- Design Certification and Combined License (COL) applicants addressing valve lessons learned

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## ASME Activities

- Code Cases for ASME OM Code provide performance-based and risk-informed alternatives to OM Code provisions (for example, Code Cases OMN-1 and 11 on MOVs, and OMN-12 on air-operated and hydraulic-operated valves)
- Planned revision to ASME OM Code to replace MOV quarterly stroke-time testing with periodic diagnostic testing
- ASME Standard QME-1-2007, "Qualification of Active Mechanical Equipment Used in Nuclear Power Plants," incorporates valve lessons learned in qualification process

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## Results of NRC and Industry Activities

- U.S. nuclear power plants verified MOV design-basis capability and developed programs to periodically verify MOV capability
- Improvements in standards and guidance for design, qualification, maintenance, personnel training, diagnostic equipment, and IST for power-operated valves
- NRC revised 10 CFR 50.55a to require periodic verification of MOV design-basis capability to supplement ASME IST provisions and revising Reg. Guide 1.100 to address ASME QME-1-2007
- Lessons learned being applied to new reactors

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## Regulatory Requirements for IST Programs in New Reactors

- Design Certification applications required to
  - evaluate design against SRP in effect 6 months before docket date [52.47(a)(9)]
  - address operating experience [52.47(a)(22)]
- COL applications required to
  - provide description of programs and their implementation necessary to ensure that systems and components meet ASME Code per 50.55a [52.79(a)(11)]
  - demonstrate how operating experience incorporated into plant design [52.79(a)(37)]
  - have initial IST program meet ASME Code incorporated in 50.55a 12 months before fuel loading [50.55a(f)(4)(i)]

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## Operational Programs

- Design Certification application may provide general information to allow flexibility by COL applicant in developing plant-specific operational programs
- NRC review of IST and MOV testing programs described in Design Certification application focuses on design aspects and accessibility for IST activities
- COL application needs to provide sufficient information to support NRC decision that operational programs provide reasonable assurance of safe plant operation

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## Examples of Operational Programs

- Inservice Testing
- MOV Testing
- Equipment Qualification
- Preservice Testing
- Containment Leakage Rate Testing

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## Operational Program Description

(SECY-05-0197, Regulatory Guide 1.206,  
and Part 52 Background)

- COL applicants should fully describe operational programs to avoid need for Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC)
- Program should be clearly and sufficiently described in terms of scope and level of detail to allow reasonable assurance finding of acceptability
- Program should be described at functional level and increasing level of detail where implementation choices could materially or negatively affect program effectiveness and acceptability

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## Regulatory Guide 1.206

- RG 1.206 provides guidance for COL applications
- Paragraph C.III.3.9.6 addresses COL applications referencing standard design for functional design, qualification, and IST programs for pumps, valves, and dynamic restraints
- NRC using RG 1.206 to help streamline review process for COL applications

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## SRP Section 3.9.6

- NRC areas of review
  - Functional Design and Qualification of Pumps, Valves, and Dynamic Restraints
  - IST for Pumps, Valves, and Dynamic Restraints
  - Relief Requests and Alternatives to ASME OM Code
  - ITAAC
  - COL Action Items and Certification Requirements and Restrictions
  - Operational Program Description and Implementation
- Incorporates lessons learned from operating experience into acceptance criteria for NRC review of Design Certification and COL applications

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## Review of Operational Programs for New Plants

- Evaluate operational programs as described in Design Certification applications
- Review full description of operational programs in COL applications using applicable SRP sections
- Prepare safety evaluation on NRC review of Design Certification and COL applications
- Provide assistance during NRC inspections of operational programs at nuclear power plant during construction, startup, and operation

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## Inspection of Operational Programs for New Reactors

- Perform inspections of establishment and implementation of operational programs during plant construction and startup
- Monitor performance of operational programs during plant operation in accordance with NRC inspection program
- NRC preparing inspection procedures to provide guidance for future inspections