U.S.NRC

UNITED STATES NUCLEAR REGULATORY COMMISSION

Protecting People and the Environment

Crane Nuclear Technical Seminar

Michael F. Farnan

Mechanical Engineering and Inservice Testing Branch
Division of Engineering
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission

Crane Nuclear Technical Seminar
August 2019

Disclaimer

- This presentation was prepared by staff of the U.S. Nuclear Regulatory Commission (NRC). It may present information that does not currently represent an agreed upon NRC staff position. NRC has neither approved nor disapproved the technical content.

U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

Topics For Discussion

- Mandatory Appendix III
- Mandatory Appendix IV
- Pre-Conditioning
- Anchor Darling Double Disk Gate Valve Part 21 Wedge Pin Failure Update
- NRC Initiative to Update Reactor Oversight Process (ROP) Engineering Inspections – Focused Engineering Inspections (FEI) for Power Operated Valves (POV)

Mandatory Appendix III

Mandatory Appendix III

- Mandatory Appendix III will be required when updating the next 10-Year Inservice Test Interval (IST) to ASME OM Code 2009 Edition or later.
- 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
- NRC perspective on transitioning to Mandatory Appendix III can be found in NUREG/CP-0152 Vol. 8 (ADAMS Accession # ML11223A005)

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. Licensees implementing ASME OM Code, Mandatory Appendix III, "Preservice and Inservice Testing of Active Electric Motor Operated Valve Assemblies in Light-Water Reactor Power Plants," of the 2009 Edition, 2011 Addenda, and 2012 Edition shall comply with the following conditions:

NRC Regulations (cont'd)

A. MOV diagnostic test interval. Licensees shall evaluate the adequacy of the diagnostic test intervals established for MOVs within the scope of ASME OM Code, Appendix III, not later than 5 years or three refueling outages (whichever is longer) from initial implementation of ASME OM Code, Appendix III.

B. MOV testing impact on risk. Licensees shall ensure that the potential increase in core damage frequency and large early release frequency associated with the extension is acceptably small when extending exercise test intervals for high risk MOVs beyond a quarterly frequency. (Regulatory Guide RG-1.174)

NRC Regulations (cont'd)

C. MOV risk categorization. When applying Appendix III to the ASME OM Code, licensees shall categorize MOVs according to their safety significance using the methodology described in ASME OM Code Case OMN–3, "Requirements for Safety Significance Categorization of Components Using Risk Insights for Inservice Testing of LWR Power Plants," subject to the conditions applicable to OMN–3 which are set forth in Regulatory Guide 1.192, or using an MOV risk ranking methodology accepted by the NRC on a plant-specific or industry-wide basis in accordance with the conditions in the applicable safety NRC evaluation.

D. MOV stroke time. When applying Paragraph III–3600, "MOV Exercising Requirements," of Appendix III to the ASME OM Code, licensees shall verify that the stroke time of MOVs specified in plant technical specifications satisfies the assumptions in the plant's safety analyses.

Appendix III Section III-3100

- Design Basis Verification Test
  - A one time test shall be conducted to verify the capability of each MOV to meet its safety-related design basis requirements
  - MOVs that were within the scope of GL 89-10 and GL 96-05, testing and/or engineering analysis performed to close out those generic letter concerns may be used to meet this requirement
  - MOVs outside of GL 89-10 and GL 96-05 scope but within the IST program will require a one time test and/or engineering analysis
  - In both cases it is expected that licensees will have the design basis verification test and/or engineering analysis formally documented for each MOV in the IST program.

Appendix III Section III-3300(c)

- IST program will include a mix of static and dynamic MOV performance testing
- Static Testing:
  - Verifies the actuator settings to insure the MOV will perform its safety function
  - Verifies and trends friction factors in the stem-to-stem nut interface
  - Verifies limit switch settings
  - Verifies running load such as packing forces and motor current
  - Monitor and trend stem nut wear
  - Monitor overall actuator performance

Appendix III Section III-3300(c)

- Dynamic Testing:
  - Verifies the MOV will perform its intended safety function
  - Verifies valve factor
  - Additional dynamic tests may be needed to be performed until the valve factor has reached a plateau
  - Verifies and trends rate of loading (ROL)
  - Periodic dynamic testing may be needed to determine if a valve is susceptible to degradation over a long period of operation (applicable to valves that were not included in the Joint Owners Group (JOG) MOV final program)

Mandatory Appendix IV

Mandatory Appendix IV

- Mandatory Appendix IV will be required when updating the next 10-Year Inservice Test Interval (IST) to ASME OM Code 2017 Edition or later.
- Establishes the requirements for preservice and inservice testing and examination of AOVs
- Maintains existing IST testing requirements for all AOVs
- Adds new requirement for Performance Assessment Test (PAT) for applicable AOVs
- PAT test consists of the measurement and assessment of applicable test parameters. This test is normally performed at ambient conditions without system pressure or flow

Mandatory Appendix IV

- Transitioning to Appendix IV should have a small impact for those plants that implemented the Joint Owners Group (JOG) AOV program issued in late 1990's
- Will require evaluation of current AOV program relative to Appendix IV requirements to identify gaps
- Owner is responsible for the technical basis for applicable AOVs that provide reasonable assurance the pneumatically operated valve is capable of performing its specific function
- Test data analysis and evaluation required. The evaluation must ensure adequate functional margin over the subsequent test interval

Pre-Conditioning

Pre-Conditioning

- Activities performed prior to inservice testing
- Acceptable Pre-Conditioning
  - The alteration, variation, manipulation, or adjustment of the physical condition of a system, structure, or component (SSC) before Technical Specification (TS) surveillance or ASME OM Code testing for the purpose of protecting personnel or equipment or to meet the manufacturer's recommendations. (NRC Inspection Manual 9900)
- Unacceptable Pre-Conditioning
  - The alteration, variation, manipulation, or adjustment of the physical condition of an SSC before or during TS surveillance or ASME OM Code testing that will alter one or more of an SSC's operational parameter which results in acceptable test results. (NRC IM 9900)

Pre-Conditioning

- Five questions to determine if activity is acceptable:
  1. Does the practice performed ensure that the SSC will meet testing acceptance criteria?
  2. Would the SSC have failed the surveillance without the preconditioning?
  3. Does the practice bypass or mask the as-found condition?
  4. Is preventive maintenance routinely performed just before the testing?
  5. Is the preventive maintenance performed only for scheduling convenience?
- If the answer is yes to any of the 5 questions and activity meets the definition of unacceptable preconditioning then the activity is unacceptable preconditioning

Pre-Conditioning

- Examples of acceptable preconditioning activities that would not invalidate an inservice test:
  - Installation of diagnostic test equipment
  - Unavoidable valve movement attributable to the setup and connection of test equipment
  - Electrical disconnection of valve from the power source
  - Installation of jumpers
  - Activities performed to protect personnel or equipment to meet manufacturer's recommendations

Pre-Conditioning

- In each instance of acceptable preconditioning, NRC staff will expect licensee to have available a documented evaluation of the preconditioning activity and a justification for continued confidence in the capability of the IST program to assess the operational readiness of the pump or valve. Generic evaluations may be acceptable as long as the evaluation bounds the conditions of specific activity performed on the SSC.

Pre-Conditioning

- Examples of unacceptable preconditioning activities that would invalidate an inservice test:
  - Lubricating a valve stem of a motor-operated valve
  - Pre-stroking a valve
  - Repetitive testing to achieve acceptable test results without identifying the root cause
  - Correction of a problem in a previous failed test
  - Routine performance of preventive maintenance activities before the inservice test

Pre-Conditioning – Routine Maintenance

- If a preventive maintenance activity such as valve stem lubrication or pump venting periodically occurs prior to testing, the licensee might justify the acceptability of this infrequent preconditioning provided the licensee evaluates the effect of the activity on the overall ability to assess the operational readiness of the component and to trend its degradation in its performance.

Anchor/Darling Update - Background

- Failure of A/D DDGV at Browns Ferry in 2013 revealed that threaded stem-to-wedge connection had not been properly torqued
- Flowserve Part 21 notification February 25, 2013
  - Recommended assessing wedge pin susceptibility to shear and rework the valve if needed
- BWROG developed guidance to address Part 21 to include:
  - Prioritization and Screening Criteria
  - Evaluation Methods
  - Inspection and Diagnostics
  - Repair Methods

Background (cont.)

- NRC staff evaluated 2013 Part 21 and determined the issue would be monitored with no generic communication
- Additional failures occurred at LaSalle Unit 2 and Columbia
- LaSalle event elevated to NRC special inspection
- Information Notice IN 2017-03 (June 2017)
- Flowserve updated Part 21 (July 2017)
- BWROG updated guidance to Rev. 4 (August 2017)
- NRC staff considered need for generic communication due to larger population of failures and limited information readily available to the staff

Progress to Date

- NRC staff held public meetings on guidance and licensee corrective actions
  - Staff requested clarification of guidance (October 2017)
  - NEI provided clarification (November 2017)
- All licensees submitted information (December 2017)
  - Valve population
  - Valve characteristics (susceptible, non susceptible, risk category)
  - Rework status and commitments for future repairs
  - Data Compilation – ADAMS # ML18053A023 & ML18053A904
- NRC staff held public meeting February 15, 2018
  - Staff discussed guidance document, licensee corrective actions, and future plant inspections. Staff has concerns with credit for thread friction and limited effectiveness of diagnostic testing

Progress to Date (cont.)

- NRC staff held public meeting May 16, 2018
  - Staff discussed draft Temporary Instruction (TI)
  - Industry representatives expressed concerns that the draft TI goes above and beyond the regulatory requirements
- NRC staff explained the TI serves two purposes:
  - Evaluate industry progress on addressing Part 21 issue
  - Allow NRC staff to assess the need for further regulatory action
- Industry representative agreed to send NRC staff data from the repairs made to date. Data was received July 13, 2018

U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
Protecting People and the Environment

Staff Assessment of Data

- NRC staff has reviewed the submitted industry data and observed the following:
  - 78 valves reported reworked with 2 valves having sheared pins and 1 valve with pin degraded. Remainder reported no pin damage
  - 22 valves reported stem/wedge joint was found tight and 56 valves reported stem/wedge joint was found loose
  - Collar reported damaged in 5 valves with 2 of 5 having pin sheared
  - 47 valves reworked were size 3 inch (5 total) and 4 inch (42 total). Almost all of the 47 valves had pin margins less than -100%. All 47 valves were found with no pin damage.
  - Valves 6 inch and larger with a valve class greater than 150 tend to have much larger negative pin margins (-300% and greater)
  - 3 valves reported as found diagnostic test anomalies. 1 had a sheared pin while the other 2 valves had loose stem/wedge joint

Staff Assessment of Data (cont.)

- NRC staff preliminary assessment of the industry data:
  - Appears that valves 4 inch and smaller make up the majority of the valve population and do not present a problem. Additional data is needed to complete the assessment
  - Appears that stem/wedge thread friction does play a part in assisting the pin with resisting the force being applied. Additional data is needed to support developing acceptance criteria for crediting stem/wedge thread friction.
  - Data needed to support - actuator capability (motor size, motor curve stall value, overall actuator ratio, motor speed), stem diameter, stem thread diameter, stem thread half angle, stem/wedge material, stem/wedge pitch and lead, wedge pin size, wedge pin material, stem/wedge/wedge pin yield & ultimate stress values, stem/stemnut coefficient of friction, stem/wedge coefficient of friction, shear factor applied, and tested torque & or thrust values

Next Steps

- Public meeting held on 10/10/2018 to discuss the feasibility of forming a working group consisting of NRC staff and industry MOV engineers to evaluate the data and establish acceptance criteria for crediting stem/wedge thread friction, material margins based on component attributes (size, service, material strength, etc.)
  - Criteria could be used for addressing the remainder of the valve population. (e.g., rework/repair, monitor, no rework needed)
- Path forward
  - NRC staff concur on final acceptance criteria and updated industry guidance document?
  - NRC update temporary instruction and conduct inspection?

Next Steps

- Meeting held 7/17/2019 with BWROG Executive Committee
  - Confirmed that industry is evaluating data and developing Revision 5 to guidance document
  - Expect to provide to NRC staff 3Q or 4Q 2019
  - NRC staff stated that TI (or inspections) likely not needed if licensees follow acceptable revised guidance

Anchor/Darling Update - Summary

- Operating Experience identified failures of Anchor/Darling (A/D) Double Disk Gate Valves (DDGVs)
- Significant progress has been made
  - Industry has developed guidance
  - All licensees have submitted information on the affected valves, including commitments for valve repairs
  - Industry provided information on valves repaired through end of spring 2018 refueling outages
  - The NRC staff has drafted an inspection procedure
  - NRC staff and industry MOV engineers are performing more intensive review of the valve repair and test data
  - The NRC staff continues to assess the need for a Generic Communication, but does not plan one at this time

NRC Initiative to Update ROP Engineering Inspections

- SECY-18-0113 “Recommendations for Modifying the Reactor Oversight Process Engineering Inspections” issued 11/13/2018 (ADAMS Accession # ML18441A567)
- Initiative is to improve effectiveness and efficiency of engineering inspections
- Primary focus of inspections remains unchanged
- Inspection sample selection has shifted since the 1990s from verifying compliance with the original plant design bases to inspecting licensee performance in maintaining risk significant equipment

NRC Initiative to Update ROP Engineering Inspections

- Recommended changes include:
  - Perform inspections on a 4 year cycle instead of current 3 year
  - Inspection consolidation and two new types of inspections to be performed during the 4 year cycle, Comprehensive Engineering Team Inspection (CETI) and the Focused Engineering Inspection (FEI)
  - Focusing inspection towards operating experience, aging management, facility changes, and risk
  - NRC staff is evaluating an industry proposal to allow plants to perform a licensee self-assessment in lieu of one FEI during each 4 year cycle

NRC ROP Initiative Summary

- Propose quadrennial inspection cycle, with a CETI or FEI inspection every year at each site. (1 CETI and 3 FEI)
- CETI to incorporate aspects of modifications, 10 CFR 50.59, and design bases assurance inspection with a focus on operating experience, aging management, and changes to the design basis and PRA model
- Development and implementation of new FEIs
- FEIs are intended to verify the licensee's implementation of NRC approved engineering programs (e.g., MOV, AOV, EQ). Topics chosen based on risk, operating experience and potential for engineering challenges.

FEI – MOV/AOV

- FEI for MOV/AOV will evaluate capability
  - Valve/Actuator design and safety function
  - Design basis conditions
  - Uncertainty assumptions applied
  - Diagnostic equipment
  - Weak link evaluations
  - Design basis capability tests
  - Design basis capability basis
- NRC staff is developing training for regional inspectors on implementation of FEI process

Regional Inspector Training

- At the request of regional inspectors, Motor-Operated Valve 3 day training seminar was developed
- The 3 day seminar consists of:
  - History
  - Actuator and Valve design
  - Performance, Design Analysis, and Lessons Learned
  - MOV actuator design and typical control circuitry
  - MOV Diagnostics and Test Systems
  - Preservice and Inservice Testing
  - Operating Experience and Inspection Issues
  - Case Studies, NRC inspection procedures, and recommendations

Regional Inspector Training

- As of October 2018, all four regions have completed the training
- Training for headquarter staff was completed in the first quarter of 2019

QUESTIONS?

Future Questions

Michael.Farnan@nrc.gov

301-415-1486