



U.S. NRC

UNITED STATES NUCLEAR REGULATORY COMMISSION

Protecting People and the Environment

**Industry Response to
Flowserve Part 21 on
Anchor Darling Double Disk Gate Valves and
NRC Staff Next Steps**

Public Meeting

May 16, 2018



Overview

- Operating Experience has 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
- It appears that industry is taking steps to address the issue
- The NRC staff is preparing to inspect licensees' corrective actions
- The NRC staff continues to assess the need for a Generic Communication, but does not plan one at this time



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 (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
 - Commitments for future repairs
 - Public Data Compilations are in ML18053A023 and ML18053A904
- NRC staff held public meeting February 15, 2018
 - Staff discussed guidance document, licensee corrective actions, and future plant inspections



Scope of Meeting

- Discuss the draft Temporary Instruction (TI) developed to inspect and assess industry progress on addressing Flowserve Part 21 issue on A/D DDGV
- Discuss inspection plan and schedule



NRC Temporary Instruction Scope

- Identify
 - Verify licensee properly identified valves population (2 inch valves and larger with a stem-to-disc threaded connection design and an actuator that applies torque to the stem)
- Evaluate
 - Evaluate actuator force for impact on valve integrity
 - Evaluate torque/shear on pin to determine whether valve susceptible
- Review
 - Review history of valve operation and plans for monitoring possible over torque events if licensee does not use maximum torque
 - Review risk categorization
 - Evaluate planned corrective actions



Identify

- Verify licensee has identified the A/D DDGV population
 - Valve size
 - Motor and Actuator type and size
 - Plant system
 - Valve function
 - Normal valve position
 - Valve operational requirements (open, closed, or both, cycles)
 - Stem/Disc connection (threaded or T-head)
 - Stem collar type (pressed on fit or integral)
 - Safety risk category (high, medium, or low)
 - Previous test and/or repair results



Evaluate

- Calculate maximum load stall torque applied
 - Standard industry motor stall torque equation
 - Motor stall torque value obtained from motor curve. If unavailable, motor stall torque estimated value will be 110% of rated motor torque
 - Actual voltage at the motor needs to be considered
- Evaluate maximum test torque applied
 - NRC staff recognizes that a large percentage of actuators have maximum stall torque values that are greater than the capability of the valve components
 - If test max torque is used, evaluate how licensee will manage possible future motor stall events



Evaluate (cont.)

- Considerations for managing possible motor stall events
 - Wedge pin shear capability has been included in the weak link analysis
 - Procedures have been updated as necessary
 - Valve has been modified to lower actuator capability and/or valve components replaced with stronger materials
 - Valve drawings have been updated with Part 21 information regarding pressed fit collars and/or updated to reflect pressed fit collar being replaced with an integral stem
 - Preventive maintenance (PM) activity has been updated to monitor and assess motor control center (MCC) contactor mechanical performance and/or have a periodic contactor replacement strategy



Evaluate (cont.)

- Evaluate applied force
 - Torque, thrust, stem factor, coefficient of friction (COF)
 - If COF is unknown, a value of .08 shall be assumed. This value is based on historical test data
- Calculate stem and wedge thread shear capability
 - ASME B1.1-2003 “Unified Inch Screw Threads (UN and UNR thread form)”
- Compare applied force vs stem and wedge thread shear
- Calculate wedge pin shear capability
- Compare applied force vs wedge pin shear
- Stress values based on BWROG guidance



Evaluate (cont.)

- Evaluate credit for thread resistance
 - BWROG guidance allows reasonable engineering judgement
 - NRC staff notes there is no accepted guidance available regarding how to credit thread friction to resist applied torque
 - NRC staff considers thread resistance should only be used to determine valve operability for the short term and should not be relied upon for a long term fix
 - NRC staff considers 0.1 friction factor as a reasonable value for the short term.
 - NRC staff considers use of higher COF values warrants additional attention until the valve can be reworked (e.g., stem rotation check during each quarterly valve exercise)



Review

- History
 - Review susceptible A/D DDGV maintenance and test history
- Risk
 - Review methodology used to apply risk
 - Review valve risk ranking
- Actuator Capability vs Valve Components
 - Review licensee calculations
 - Calculations must use conservative factors such as applying actual voltage to motor and coefficient of friction on the stem/stem nut interface. Licensees may use actual test data with conservatism for expected variation and measurement uncertainties



Review (cont.)

- Weak link analysis
 - Review valve structural capability and weak link calculations
- Corrective action plan
 - Review adequacy and the timeline to complete repairs. Justification is required for the schedule that exceeds the specifications of the stated valve categories in BWROG guidance
- Reworked Valves
 - A sample will be selected and reviewed to determine if the rework meets Flowserve Part 21 recommendations
- Process
 - Review licensee process to ensure susceptible A/D DDGV provides reasonable assurance that the valves will be able to perform their safety function



NRC Inspection Plans

- NRC draft Temporary Instruction will be finalized following today's public meeting
- NRC staff is developing an inspection sample
 - Initial inspection plan is to select two or three plants per region
 - Evaluation of the first plants inspected will determine if additional inspections are needed
 - Estimated inspection time is 80 hours (2 inspectors for one week)



NRC Next Steps

- Finalize TI (May 2018)
- TI inspections (2018 into 2019)
- Continue to update NRC assessment on need for generic communication



QUESTIONS?

Future Questions

Stewart.Bailey@nrc.gov

301-415-1321

Michael.Farnan@nrc.gov

301-415-1486