Summary of LaSalle SIT exit (the team made it clear to the licensee that info presented was based upon management review)

- Overall assessment provided for each Charter item. A generic issue was discussed for a newly identified design issue. Flowserve is in the process of either updating their original Part 21 issue or issuing a new Part 21 related to reflect the design issue. Specifically, the press-fit collar pre-torque can be overcome for valves set-up with high closed thrust conditions. Additionally, corrective actions to address the Part 21 issue may not have addressed the design issue. For LaSalle's Unit 2 HPCS injection valve, an integral collar was used thus correcting both the Part 21 issue and design issue that was unknown at the time.

- Traditional Enforcement Apparent Violation. Unit 2 HPCS injection valve. 10 CFR 50, Appendix B, Criterion III, "Design Control". No ROP related finding because no performance deficiency was identified. No SL number was exited.

  Since the original valve installation the licensee failed to specify an appropriate thrust closure limit. The licensee failed to identify that the stem press fit collar pre-torque capacity could be overcome and result in the collar sliding up the stem thus loosing pre-torque on subsequent valve strokes. The team's no PD conclusion was based in large part because of the absence of information available to review for a 30 + year old issue and based upon the 1990 Anchor Darling weak-link analysis provided to the licensee that missed identifying the press-fit collar weak link.

- Unresolved Item for other Part 21 valves that have not been inspected. The team could not determine if a violation existed for the Part 21 valves in-service based upon the unknown stem to wedge pre-torque, and valve component condition (i.e. press-fit collar, wedge pin, stem to wedge threaded condition, etc.)

- The Team's assessment is that the Unit 1 HPCS system operability can not be supported. (b)(5) Deliberative Privilege (b)(5) Deliberative Privilege This assessment is based upon the team's review of the valve design and significant operational cycles at thrust conditions that would have been expected to break the wedge pin, loosening the stem to wedge threaded joint, and degraded the integrity of the wedge threads beyond their design capacity. Due to the uncertainty in the known degradation mechanism it is not possible to predict with any confidence when failure could occur. Not have a defined level of certainty (or confidence) that the (b)(5) Deliber injection valve will not fail on the next valve stroke or next several strokes provides the team with enough doubt to reach have their conclusion.

The licensee's Operability Evaluation concluded from an historical thrust perspective the following:

> Previous thrusts experienced by the 1E22-F004 have been historically lower than those seen by the 2E22-F004 by approximately 5 to 10% on each test based on a review of work/operating history of the valves

This appeared to be based on the measured thrust on the Unit 1 valve compared to the measured thrust on the Unit 2 valve. This evaluation did not take into account the number of cycles the valves would see at each measured thrust. Taking this into account, a review done by the team determined the thrust seen on the Unit 2 valve was higher, but only by about 4%.

(b)(5) Deliberative Privilege

(b)(4)

Unit 1 Data	Notes	Unit 2 Dat
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ta	Notes
(b)(5) Deliberative Privilege	

(b)(5) Deliberative Privilege

The information available on the number of valve stroke cycles is readily available only for the last nine refueling outages for each unit. The number of valve cycles for nine outages for U1 is 93 cycles, and the average is 10.333 cycles per outage. Extrapolating this information to account for five additional refueling outages (assumed outages since new valve stem installation in 1987) the total number of cycles would increase to 145 cycles. This total number of cycles does not account for one known thermal cycle (actual system demand). If it is assumed that the thermal cycle only cycled the valve once, the total cycles for U1 would increase to 146 cycles. This number does not include cycles during a long outage between 1998 and 1999 for which no information is available.

A similar assessment is performed for the U2 valve. The number of valve cycles for nine outages for U2 is 86 cycles, and the average cycles per outage is 9.555. Extrapolating this information to account for six additional refueling outages (assumed outages since U2 startup) the total number of cycles would increase to 143 cycles. This total number of cycles does not account for two known thermal cycles. If it is assumed that a thermal cycle only cycled the valve once, the total cycles for U2 would increase to 145 cycles. This number does not include cycles during a long outage between 1998 and 1999 for which limited information is available.

Therefore, based on known operational cycles, and extrapolating the data for the unknown history of the valves, it can be assumed that the U1 valve has cycled 1 more time than the U2 valve during operation of the units. However, since U2 was subjected to pre-operational testing, U2 could have more cycles than U1. The licensee, through anecdotal data, assumes the U2 valve was cycled about 40-50 times during pre-operational testing. Using the lower end of the anecdotal data, the U2 valve may have had 39 additional cycles compared to the U1 valve.

A similar assessment was performed by the licensee, and they concluded the U2 valve could have as much as 51 additional cycles compared to the U1 valve. The differences come from manipulation of the data used to develop the averages, and the number of cycles extrapolated for outages for which there is no available information.

It is important to note that the number of valve cycles during an outage could vary from 1-20 cycles. Therefore, the uncertainty of the average can be significant with only nine data points to compare the average to. Applying a rough uncertainty, the final number of total cycles could be off by 7-10 valve cycles. Using this information, in addition to the fact that only anecdotal data exists for the pre-operational cycles of the U2 valve (b)(5) Deliberative Privilege

(b)(5) Deliberative Privilege

To summarize, the difference in valve cycles between U1 (since 1987) and U2 (since unit startup in about 1984) is not significant, or within the margin of error. The only significant difference in valve cycles between the units can be attributed to pre-operational testing. Since only anecdotal data exists for pre-operational testing, there is no certainty associated with how many additional cycles the U2 valve had over the U1 valve. This information, coupled with the fact that remaining valve cycles cannot be predicted given the degraded condition of the valve,

(b)(5) Deliberative Privilege

Communication Plan
June 1, 2017

Goals

This communication plan serves as a reference document as information is discovered throughout the LIC-504 process. Significant information, references, observations and messages should be included in this plan.

Communication Team

Region III, NRR (DPR, DE, DIRS), NRO (DCIP), OPA

Timeline

- Region 3 exit for the LaSalle SIT – June 16, 2017
- Issuance of the IN – Expected delivery of the draft is June 12 for comment, with issuance June 16
- Public Meeting – as early as June 19, 2017

Key Messages

- Anchor Darling valves have been found to be susceptible to wedge pin failure, including simple unthreading of the stem and wedge due to inadequate torqueing of a critical part during assembly resulting in valve failure.

- The safety significance depends on the size of the valve as well as its function. Based on conservative input and failure probability, it is reasonable to conclude that the increase in CDF is less than 1E-5, which is within the bounds of RG 1.174 for small changes in risk.

- Approximately 26 valves have been inspected. Although the full population of valves within the scope of the Part 21s was not known, it is believed that only a small portion of the in-service valves have been inspected. There have been valve operation indications.

- The NRC is working closely with industry throughout the process to apply lessons learned that will ensure the best possible outcomes. The NRC has concerns with the use of stem rotation checks to demonstrate valve functionality and the use of motor operated valve diagnostic testing (e.g., stem strain measurement traces) to demonstrate valve functionality.

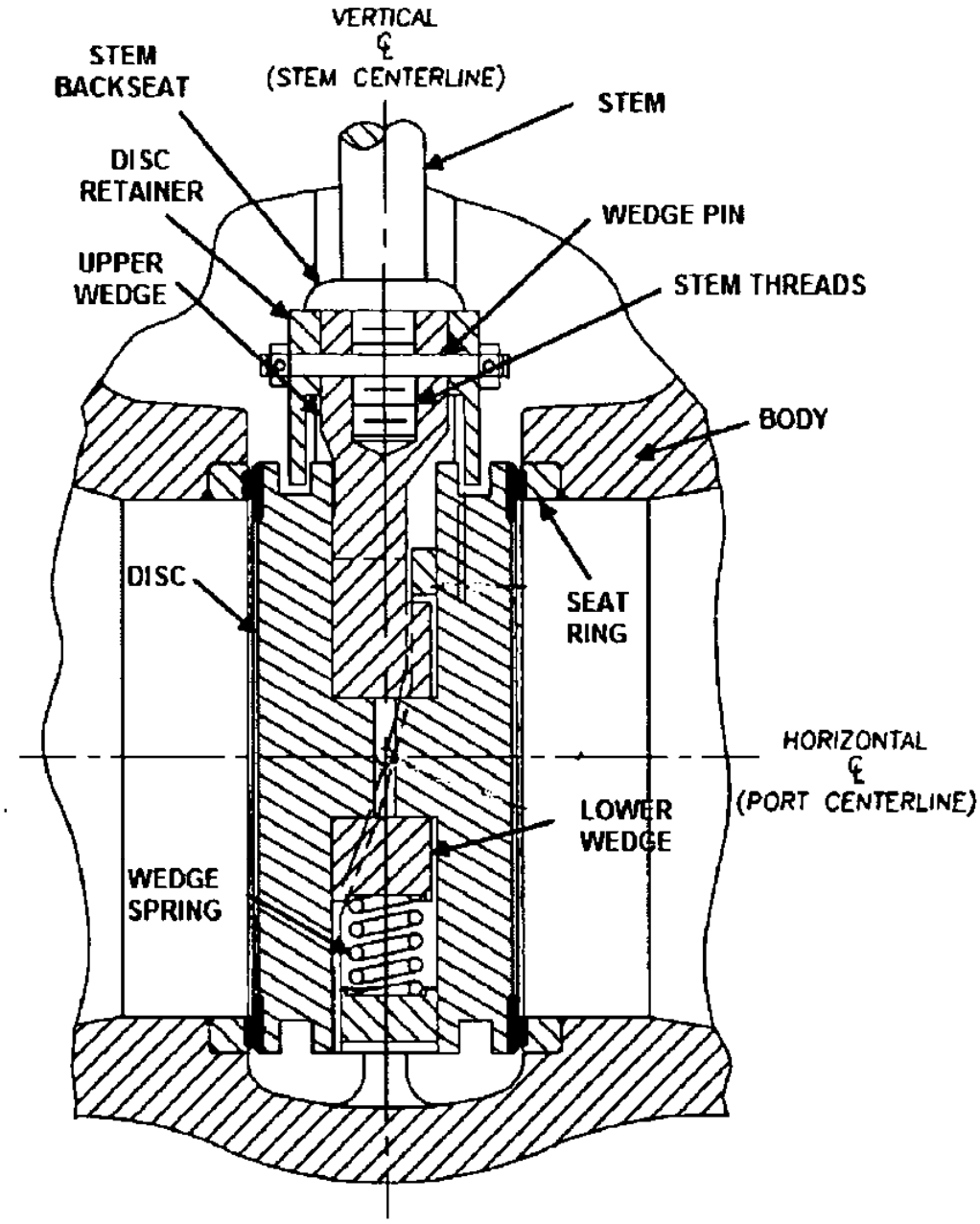
- The NRC has concluded that U.S. nuclear facilities are safe and that they do not pose an undue risk to the public health and safety.

Background

These valves are used on numerous plants, and there has been recent operating experience. On February 11, 2017, the LaSalle Unit 2 HPCS injection valve stem was found to be separated from the upper wedge/disc assembly during a fill and vent activity[1]. Prior to the failure, the valve

[1] See LER 50-374/2017-003-00, "High Pressure Core Spray System Inoperable due to Injection Valve Stem-Disc Separation" (ADAMS ML17102B424).

had successfully passed a local leak rate test where the valve had cycled successfully several times. Valve disassembly and inspection revealed the wedge pin had sheared and the valve stem threads were damaged. This valve was an Anchor/Darling 12 inch Double Disc Gate Valve (ADDDGV) and was included in those valves associated with the Flowserve and Browns Ferry Part 21 reports submitted in 2013 (ADAMS ML13008A321 and ML13064A012). The licensee was addressing the Part 21 reports by using industry guidance provided by the Boiling Water Reactor Owners Group (BWROG) prior to the failure.



On February 11, 2017, the LaSalle Unit 2 HPCS injection valve stem was found to be separated from the upper wedge/disc assembly during a fill and vent activity. Prior to the failure, the valve had successfully passed a local leak rate test where the valve had cycled successfully several times. Valve disassembly and inspection revealed the wedge pin had sheared and the valve stem threads were damaged. This valve was an Anchor/Darling 12 inch Double Disc Gate Valve (ADDDGV) and was included in those valves associated with the Flowserve and Browns Ferry Part 21 reports submitted in 2013 (ADAMS ML13008A321 and ML13064A012). The licensee was addressing the Part 21 reports by using industry guidance provided by the Boiling Water Reactor Owners Group (BWROG) prior to the failure. Following the identification of the separation, the licensee redesigned and repaired the failed Unit 2 HPCS Injection valve.

[redacted]

(b)(4)

A December 2016 Update to the Boiling Water Reactor Owners Group (BWROG) Guidance (BWROG-TP-13-006, "Recommendations to Resolve Flowserve 10 CFR Part 21 Notification Affecting Anchor Darling Double Disc Gate Valve Wedge Pin Failures,") associated with the Part 21 Reports, documented that another utility disassembled and inspected similar valves associated with the Part 21 Report and identified that 24 of the 26 valves stems and upper wedges were not properly torqued prior to installation. As a result, the stem could be unthreaded from the upper wedge by hand after the wedge pin was removed. None of these inspected valves were noted to have broken or sheared wedge pins.

On February 11, 2017, the Unit 2 high pressure core spray (HPCS) injection valve stem was found to be separated from the upper wedge/disc assembly during a fill and vent activity.

The BWROG issued Revision 2 to BWROG-TP-13-006, "Recommendations to Resolve Flowserve 10 CFR Part 21 Notification Affecting Anchor Darling Double Disc Gate Valve Wedge

Pin Failures," last week. The updated revision incorporates lessons learned from the LaSalle valve failure and provides recommendations for (1) enhanced valve testing methods for stem rotation checks (intended to detect ratcheting behavior) and (2) an accelerated schedule for susceptible valve repair/replacement (e.g., medium and high risk significant valves with a safety function to cycle multiple times should be repaired/replaced within one operating cycle or 2 years).

(b)(4)

The PWROG had not taken any actions to date and does not have a recommended schedule for action on the Part 21s, but will be having a phone call 5/19 to initiate the process to address this concern as an "emergent issue".

Flowserve believes operating experience is consistent with the failure analysis supporting their previous Part 21 and does not plan to take any further action.

The BWROG performed a survey of their members in support of the Revision 2 update to BWROG-TP-13-006. This survey identified the following:

- Duke has dissembled more than 23 valves and found that the stem-disc connection was not torqued to the required preload, but that no wedge pins or stem threads were damaged.
- Diablo Canyon is inspecting valves within the Part 21 scope during an ongoing outage and have found two valves with anomalous indications. Both of these valves will be disassembled and inspected.

NRC is questioning whether the use of the MOV diagnostic testing (i.e., stem strain trace measurements) and the stem rotation deflection check reliably demonstrate that wedge pins

remain intact, that prior over-torqueing did not occur, or that stem/wedge thread degradation has not already occurred.

The NRC is gathering information to support developing a path forward, including a call on May 16, 2017. No final decisions have been made with regard to this issue.

Questions and Answers

Q. What issue was reported in the Part 21 report?

A.

Q. Have these valves failed before? What was the consequence?

A.

Q. Are the plants really safe?

A. The NRC has concluded that U.S. nuclear facilities are safe and that they do not pose an undue risk to the public health and safety.

Q. Can FLEX equipment be used to mitigate failure?

A.

Q. Does this impact other types of valves?

A.

Contacts: Scott Burnell, OPA
Greg Bowman, DPR

LIC-504 Assessment – LaSalle Motor Operated Valve Issue

June 1, 2017
10:00 – 11:00 am (eastern)

Purpose: Continue discussion of LIC-504 process to address generic implications arising from LaSalle special inspection. Where appropriate, make decisions on the following:

- Continue to refine potential decision options
  - Schedule for completing IN
  - Identify subsequent follow-up activities (e.g., additional generic communications, inspection activities)
- Discuss planning for Follow-up Public Meeting

Agenda

Introductions/Roll Call – NRR/DE	5 minutes
Status Updates	
• Update on Special Inspection – Region III	10 minutes
• Interactions with Owners Groups – NRR/DPR	1 minutes
• Interactions with Flowserve – NRO/DCIP	1 minutes
• Interactions with INPO – NRR/DIRS	1 minutes
• Interactions with NEI – NRR/DPR	2 minutes
• Risk Assessment – NRR/DRA	10 minutes
– Risk assessment for degraded valves	
– Impact on FLEX equipment	
Review/Re-affirm Immediate Safety Screening – NRR/DE	5 minutes
LIC-504 Decision Options –NRR/DE, All	15 minutes
• Prioritization for IN issuance	
• Planning for public meeting (schedule, agenda)	
• Follow-on Activities (Bulletin, TI, etc.)	
Communication Plan – NRR/DPR	5 minutes
Summarize Actions – NRR/DE	5 minutes
• Review actions from previous meeting	
• Identify new actions	
• Next meetings - weeks of June 12 and 26	

LIC-504 Assessment – Anchor/Darling Double Disc Gate Valves

Scope: The HQ (NRR led) LIC-504 assessment is addressing generic implications arising from LaSalle Special Inspection, as appropriate. Follow-up and decision-making for LaSalle-specific issues will continue under the Region III inspection and enforcement programs and are outside the scope of the HQ LIC-504 process.

> ***Caution**: If at any time an immediate shutdown of a plant is required, LIC-106, "Issuance of Safety Orders" or the Enforcement Manual Process should be entered. The LIC-504 process should not be permitted to interfere with taking necessary and timely action. LIC-504 may be suspended or curtailed at that time by cognizant management.*

LIC-504 Risk Screening Questions:

a. Is immediate regulatory action required?
   - Defense in depth significantly degraded (multiple barriers significantly degraded, functional redundancy or diversity is significantly compromised)
   - Significant loss of safety margin
     Risk impact is high (e.g., CDF >1E-03, LERF > 1E-04, ICCDP > 5E-05, ICLERP > 5E-06)

   Preliminary Assessment

   1. Anchor Darling Double Disc Gate Valves (DDGVs) are used in safety-related and risk-significant applications at over 40 plant sites. These valves are used in both PWR and BWR plant applications, including emergency core cooling, residual heat removal, and service water systems.
   2. The under-torqued stem condition described in the TVA and Flowserve Part 21 reports may have existed since initial plant construction.
   3. Although the under-torqued stem condition can lead to valve failure, the staff has identified that only a small portion of the in-service valves have failed due to wedge pin shearing (the estimated failure rate based on operating experience for A/D DDGVs is approximately 1E-03/year, slightly worse than the non-A/D valve population).
   4. Limiting the shear stress applied to the wedge pin by either (1) the use of a motor actuator incapable of generating sufficient torque, or (2) by valve setup (e.g., setting of torque switches at a low enough value) may prevent wedge pin and subsequent failure of valve.
   5. Operating experience from Duke disassembly and inspection of more than 23 valves indicated that all but two valves were untorqued. However, none of the under-torqued valves had a sheared wedge pin; stem or disc damage; or was in a failed condition prior to disassembly.
   6. A risk assessment conducted for 11 plants using conservative assumptions indicates that the increase in CDF associated with the degraded valve conditions constitutes a small increase in CDF (approximately less than 1E-05/yr).
   7. The staff is not aware of any other information at this time that would require immediate regulatory action

Therefore, the preliminary conclusion is that while reliability of the affected valves may be degraded, the condition identified in the Part 21 notifications does not necessarily lead to loss of valve function.

Open questions that may impact safety assessment:

- Is the description in the Part 21 notice adequate (e.g., does it accurately describe the condition adverse to quality)
  Total population of affected valves and safety functions
- Safety impact associated with normally open valves with a safety function to close (e.g., containment isolation). Note that the failure at Browns Ferry was identified by the failure of disc retaining clip (due to stem rotation) preventing full closure of the valve resulting in a failed LLRT.
- Risk impact of potential valve reliability degradation (e.g., develop insights to gain a better understanding of risk implications of degraded valve reliability)
- Can FLEX equipment be used to mitigate valve failure during an accident (e.g., does valve failure preclude a flow path needed for FLEX equipment)

b. Is the issue clearly of low safety significance?
   - Delta CCDP < 1E-07 and minimal degradation in of defense in depth or safety margin.

   Based on MD 8.3 assessment (i.e., CCDP of 2.5E-05 for LaSalle Unit 2 failed HPCS valve) and potential for a large number of ECCS valves to be affected at multiple plant sites, this does not appear to be an issue of low safety significance.

LIC-504 Provides Two Approaches for Evaluation:

1. Appendix B – Standard Approach
2. Appendix C – Integrated risk-informed Decision-Making Process

Both options consider five principles of risk-informed regulation:

Compliance with existing regulations
- Maintenance of adequate safety margins
  Maintenance adequate defense in depth
- Demonstration of acceptable levels of risk
- Implementation of defined performance measurement strategies

The detailed Appendix C should be used when there is a:

1. Need for highly deliberative process (multiple technical disciplines, large uncertainty, unintended consequences)
2. Need for structured assessment of risk, defense-in-depth, safety margins (structured assessment of five key principles of integrated decision-making is needed

Appendix B LIC-504 Process – Standard Approach

a) Define LIC-504 Assessment Team

a. Decision Authority: NRR ET
b. Management Lead: NRR/DE
c. Project Manager: NRR/DPR (Benney/Wilkins)
d. Technical Lead:
e. Team Members
    i. NRR/DE
    ii. NRR/DIRS
    iii. NRR/DSS
    iv. NRR/DRA
    v. NRO/DCIP
    vi. NRR/DPR
    vii. Region III

b) Characterize the Emergent Issue

The emergent issue is the potential need for generic industry actions as a result of the Anchor/Darling Double Disc Gate Valve failures associated with improperly torqued stem-disc connections.

Note, the immediate issues associated with LaSalle Units 1 and 2 are being addressed by the Region III Special Inspection Team and are outside the scope of the HQ LIC-504 assessment. However, the results obtained from the SI will inform the HQ LIC-504 process related to the broader generic implications for the industry.

c) Define Decision Options

(b)(5) Deliberative Privilege

Notes:

1. Define each decision option (e.g., shut down plant immediately or shut down in specified time period)
2. What analytical tools are available (e.g., risk analysis tools or engineering models) – may be quantitative or qualitative

3. Identify potential impact on the principles of risk-informed decision-making or other factors being analyzed or evaluated to differentiate the options.
4. Define the basis or standard for accepting or rejecting each decision option.
5. Compare the options and justify the option that is being recommended for implementation.

d) Perform Assessment of each Option

Need to consider five principles of risk-informed regulation:

- Compliance with existing regulations
- Maintenance of adequate safety margins
- Maintenance adequate defense in depth
  Demonstration of acceptable levels of risk
- Implementation of defined performance measurement strategies

e) Integrate Assessment Results including Performance Monitoring Strategies

To be developed

f) Communicate Assessment and Recommendations to Decision Authority

To be developed

g) Document the Decision, including any performance monitoring

To be developed

h) Communicate the Decision

Communication Plan under development

Generic Communications (MD 8.18)

Bulletin (BL)

- A BL is used to request licensee actions and/or information to address significant issues regarding matters of safety, security, safeguards, or environmental significance that also have great urgency. A BL requires a written response. The compensatory actions requested should be commensurate with the urgency of the issue being addressed.
- A BL may NOT request long-term actions or require actions or commitments.

Generic Letter (GL)

- A GL addresses either an emergent or routine technical issue with generic applicability for which NRC staff and stakeholders have interacted. A GL may also be issued without extensive prior interaction between the NRC and stakeholders when the NRC has determined a risk-significant compliance matter should be brought promptly to the attention of licensees.
- A GL may request information and/or compensatory actions and require a written response from licensees regarding matters of safety, security, safeguards, or environmental significance.
- A GL may NOT request long-term actions or require actions or commitments

Regulatory Issue Summary

- A RIS is used to communicate with stakeholders on a broad range of matters.
- A RIS may—
  - Communicate previous NRC endorsement of an industry-developed resolution of a matter on which the staff has interacted with the industry.
  - Communicate previous NRC endorsement of industry guidance on technical or regulatory matters.
  - Provide the status of staff interaction with the nuclear industry on a matter.
  - Request the voluntary submittal of information which will assist the NRC in the performance of its functions.
- A RIS may NOT—
  - Provide guidance for the implementation of rules and regulations,
  - Provide guidance to NRC staff on regulatory or technical matters,
  - Require a response, commitments, or action, or
  - Be used in lieu of other established agency products

Information Notice

- An IN communicates recently identified operating experience to the nuclear industry. The results of recently completed research that may affect addressees may also be communicated in an IN. Addressees are expected to review the information for applicability to their facilities or operations and consider actions, as appropriate, to avoid similar problems.
- An IN may NOT—
  - Convey or imply requirements,
  - Transmit interpretations of regulations, or
  - Request information or action from addressees.

Criteria for Identifying Susceptible Valves

Background on Anchor/Darling Double Disc Gate Valves

The valve key components are the body, the seats, the disk or wedge assembly, stem, and in some cases a stem disk retainer pin and retainer clips. The valve body accepts the stem wedge assembly which lowers into the body. Valve seats are part of the valve body and this is where the sealing of the flow medium is done. The stem is attached to the disk/wedge assembly by one of two methods:

- The stem is screwed into the wedge to a recommended torque which is greater than the capability of the actuator but less than the structural limits of the components. Once torqued, a hole is drilled for the retainer pin and retainer clips. In essence, the pin acts like a lock washer. If torqued properly, the actuator force will not move the stem. If the stem is not torqued properly and pinned at the improper torque, the actuator, if large enough, can supply enough torque which would now be applied to the pin. The pin typically is the weak link.

- The other method for stem attachment to the wedge is a T-Head configuration. The wedge assembly has a T-hear design that would match up with a T-Head stem. This design does not have a pin and would not be vulnerable to this type of separation.

Anchor Darling double disc gate valves are used in both BWR and PWR plants. The Flowserve Part 21 identifies over 40 affected nuclear plant sites.

- *Region III has surveyed licensees in their Region and identified a population of 88 valves (ranging from 4 valves for the Quad Cities site to 28 at DC Cook). Some sites have either fully inspected the valves ((Perry) or performed a wedge pin analysis (Dresden)*

Potential Considerations for Identifying Susceptible Valves

- Flowserve identified the following valve characteristics that increase susceptibility to wedge pin failure:
  - Double-Disc Gate valves with threaded stem to upper wedge connections.
  - Valves with electric motor actuators which produce high output torques are the most susceptible to failure (valves which were assembled with stem torques that exceed the operating torque are not candidates for failure).

- In addition, with the following characteristics may place affected valves in a high priority category for follow-up:
  - Performs a safety-related function
  - Valves with an open safety position or are required to operate multiple times during a design basis accident

- Valves that incorporate a press fit stem collar vice an integral stem collar (the collar makes contact with the disc assembly and supports the torqueing process).
- Valves with abnormal diagnostic testing results (however, while test results may be useful in identifying potential degradation, they may not be sufficient to prove operability)

- Previous history with stem over-torqueing
  - The upgrading of the sizing and setting of the motor actuators to correct inadequacies in the original design and qualification of MOVs identified in the 1980s might have resulted in the original stem-wedge assembly torque or threaded connection capability being exceeded. Application issues (such as pressure/locking or vibration) might have resulted in the assembly torque or thread capability of the stem-disc connection being exceeded by the motor actuator

- High speed valves have to account for motor inertia after the power is removed via torque switch or limit switch. Setting a motor to stop on limit for a high speed valve is a challenging adjustment and must balance correctly positioning the valve without overstressing valve components.

- BWROG TP17-1-112, "Recommendations to Resolve Flowserve 10CFR Part 21 Notification Affecting Anchor Darling Double Disc Gate Valve Wedge Pin Failures (Revision 2)" provides a prioritization scheme based on:
  - Operating history (e.g., flow induced vibration, significant over torque)
  - Open safety-related design basis torque requirement (which could lead to unthreading)
  - Evidence of stem disc separation based on valve diagnostics
  - Recirc discharge valves (BWR-5 and -6) where plant has not complied with SIL-032, -528, -620

Information Needs/Active Questions

Information needed to assess options:

- **What population of valves are vulnerable to failure? Identification of locations where Anchor/Darling used in the fleet and supported safety functions**

  NRR/DIRS, NRR/DRA, and RES supporting evaluation

- **What have other utilities who have performed disassembly and inspection of the affected valves found?**

  Some feedback obtained from BWROG/PWROG call and from Region III survey. Duke Power, First Energy (Perry), PG&E (Diablo Canyon)

- **Risk impact of potential generic issue?**

  NRR/DRA evaluating risk impact

- **Is the guidance developed in response to the Part 21 notifications (e.g., BWR topical report BWROG-TP-13-006, "Recommendations to Resolve Flowserve 10 CFR Part 21 Notification Affecting Anchor Darling double Disc Gate Valve Wedge Pin Failures.") adequate to address the issue and can it be reasonably implemented by licensees?**

  Still under evaluation?

- **What actions were taken by the PWROG in response to the Part 21? What other actions have been taken by PWR plants in general in response to this issue?**

  PWROG plans to issue an owners group letter to their members notifying them of the issues at LaSalle, providing background, and remind licensees that this is a licensee issue that should be included in their corrective action program.

- **Did Exelon implement the same corrective actions for the Part 21 at their other facilities or were the actions taken at LaSalle unique?**

- **What actions were taken by other licensees?**

  Have some information from Duke Power (inspected at least 23 valves, most untorqued, some with calculated torque capability in excess of wedge pin capability -no evidence of damage of valves); Diablo Canyon, and Perry.

Still need more specific information from these inspections results (e.g., Duke margin analysis)?

- **Accessibility of MOV's, ability to test on-line? Would be relevant to the time required to inspect/repair/replace valves.**

- **What monitoring can be used to ensure that the safety implications of the issue do not change over time?**

  Continue to monitor operating experience to ensure that Agency actions effectively resolve issues.

  A review of operating experience conducted by INL indicates that the failure rate for Anchor Darling valves is slightly higher (by a factor of ~ 2.5x) than the general population of motor operated valves. Continued monitoring of performance of these valves may provide an indication of the effectiveness of actions taken under LIC-504.

LaSalle Failure Analysis Farnan Comments
6/5/2017

I believe that the opening statement of the conclusions section is correct: **"The failure of the valve 2E22-F004 stem-to-wedge connection was due to multiple closing high load cycles (with both axial thrust and torque components) which caused loosening and eventual shear failure of the wedge pin, followed by wear and shear failure of the threads. The loosening and shear failure were caused by an insufficient capacity of the shrink fit stem collar for the 2E22-F004 application, which was routinely subjected to loads exceeding 200 kips."** With that said, this further solidifies my position that the sister valve in Unit 1 is heading down the same failure path. Unit 1 valve has been subjected to the same forces of > 200 kips each time it is stroked.

Comments on the analysis report:

1) Section 3.2 "As-Found Failure Condition" – Was it ever explained why it took so much force to get the double disc wedge assembly out of the seat? I was always under the belief that the Double Disc wedge design was such that unwedging forces would be the weight of the two discs.
2) Section 4.2 "Monitoring and OE" – In this section there is a discussion on the diagnostic test performed on the failed Unit 2 in 2015. The discussion notes that anomalous traces found in 2015 would have failed multiple criterion based on Kalsi Engineering May 15, 2017 letter. This criterion assessment was developed after the failed valve event. What gets lost in this discussion is that Kalsi Engineering assessed the diagnostic test data and the actions taken by the Exelon MOV engineer in a letter dated April 29, 2017. In that letter, Kalsi noted that there was anomalous behavior of the as-found and as left thrust and torque traces which would warrant additional investigation. Kalsi conclusion was that the MOV engineer took reasonable steps to investigate the anomalous behavior identified in the test data.
3) Section 6.1 "Collar Slip" – This section devotes a long discussion on the shrunk fit stem collar. The discussion presents several possible variables such as clearances of the collar and stem fit, friction factors, and the capacity of the collar to resist movement after pre-load. The end result was the collar lost its pre-load due to the actuator capability. This could explain why there were so many disassembled valves that found to have no pre-load and a gap between the collar and the wedge.
4) Table 7.1 "2E22-F004 Failure Mechanism Support/Refute Evaluations" row H – Why is Unit 1 any different? Past diagnostic data show that the valve is set to operate with closing forces exceeding 200 kips.
5) The early days of diagnostic testing, the files note that MOVATS testing was completed. I know that the MOVATS testing used a method called "Open vs. Close" testing. This method would calibrate the torque switch assembly. The torque switch operates in a rotational rocker motion via a gear set attached to the spring pack. When the spring pack pushes one direction, the torque switch rotates until the contacts open. Reversing the spring pack operation, the torque switch rotates the opposite direction until the other set of contacts open. The calibration of the torque switch in the Open vs. Closed balances the rotation between open and closed. Once balanced, the actuator was

tested using a load cell attached to the top of the actuator. The load cell would then capture the force used to open the valve with a preset torque switch value. Once the force meets the design of the valve, the torque switch setting is noted and the close torque switch is now set at that value. This was used because there was no easier way to measure closing force. However, this method was later debunked in that errors could be as high as 50%. This discovery had many industry folks looking for other test equipment. I am assuming that LaSalle testing completed in 1987 used this type of testing. What is lost here is that nowhere in the discussion is there any assumptions being made that the early captured data could have been much higher than the final as left value.

Agency Mission Meeting
June 7, 2017

OEDO/AO

Non Responsive

RI

Non Responsive

RII

Non Responsive

RIII

Non Responsive

- Discussed special inspection at LaSalle.

Non Responsive

OIP

Non Responsive

OCHCO

Non Responsive

NRO

Non Responsive

ACRS

Non Responsive

OI

Non Responsive

SBCR

Non Responsive

RES

Non Responsive

NRR

- NRR expressed positive engagement and communications with RIII on LaSalle and the Anchor-Darling double disc gate valve issue. NRR expects to issue an IN on this topic around June 16, which is a very fast timeframe for issuing a generic communication. **[Example of agility].**

Non Responsive

OCIO

Non Responsive

NMSS

Non Responsive

NSIR

Non Responsive

OCFO

Non Responsive

DEDM

Non Responsive

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Protecting People and the Environment

Operating Experience
Spring 2017 Counterparts Briefing

June 7, 2017

Stephen J. Pannier, NRR/DIRS

U.S.NRC
UNITED STATES NUCLEAR REGULATORY COMMISSION
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Outline

- Recent OpE on Anchor Darling Double Disc Gate Valve Failures
- OpE Data Analysis Tool (ODAT) Update
- Overview of Recent OpE COMMs

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Anchor Darling Valve Failures

- Anchor/Darling Double Disc Gate Valves (DDGV) widely used in safety systems in the U.S. industry
- 10 CFR Part 21 reports in 2013, based on a stem to disc separation event at Browns Ferry 1
  - Inadequate torqueing of the stem-upper wedge assembly on valves larger than 2 inches in diameter during assembly
  - Allows excess rotation of the disc assembly during valve operation
  - Can lead to failure of wedge pin, deterioration of stem-wedge connection, and eventually stem-disc separation
- BWROG issued a Topical Report detailing corrective and preventive actions

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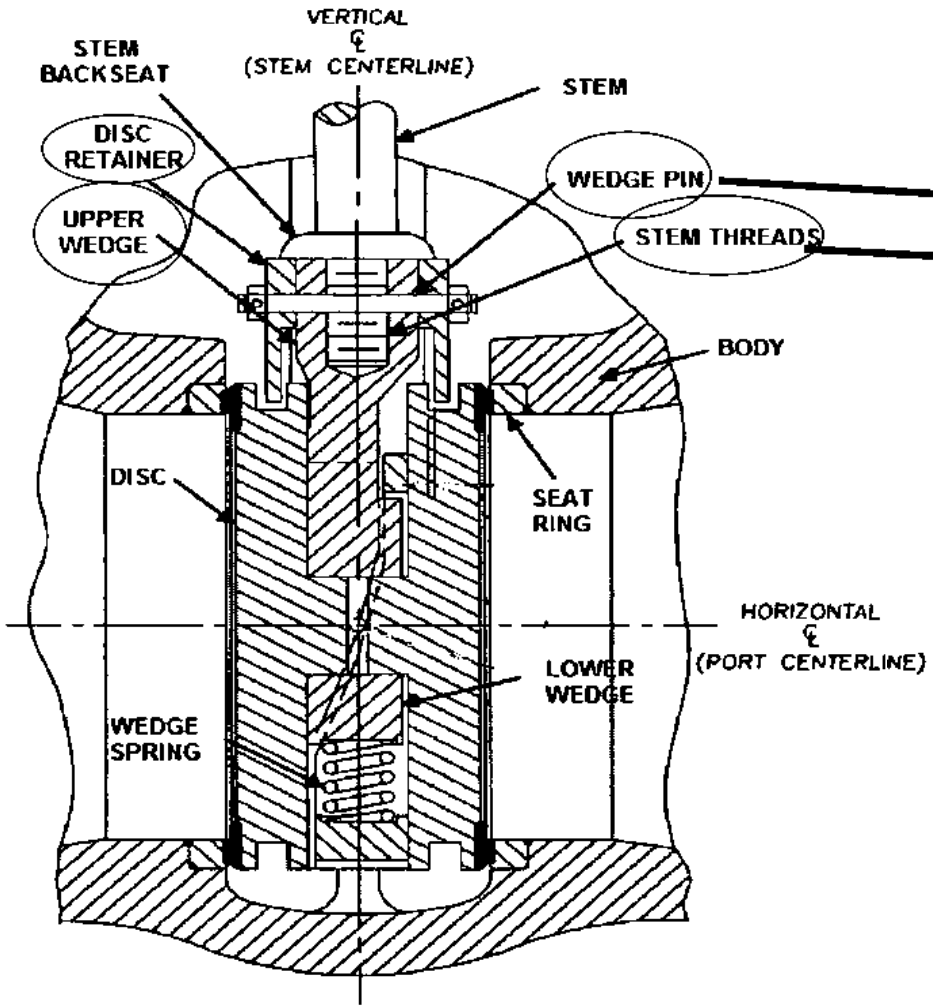
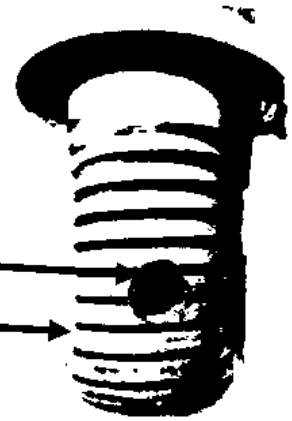
Anchor Darling DDGV Internals





- The stem-to-upper wedge threaded connection is torqued into the upper wedge, and then the anti-rotation (wedge) pin is inserted
- If operating torque exceeds stem torque, the stem can loosen during valve opening, eventually leading to wedge pin failure

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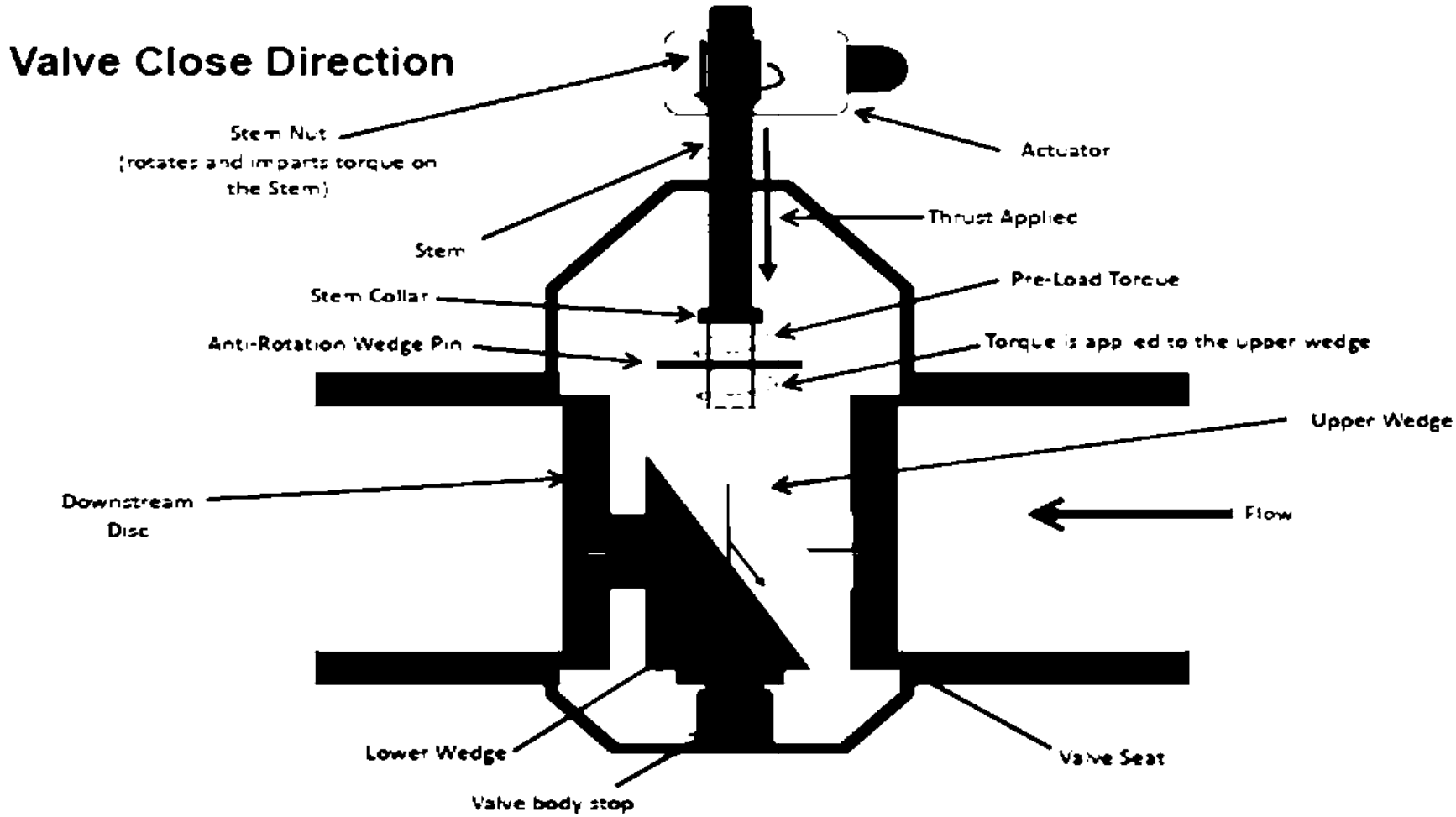
Simplified Operation Diagram – Close



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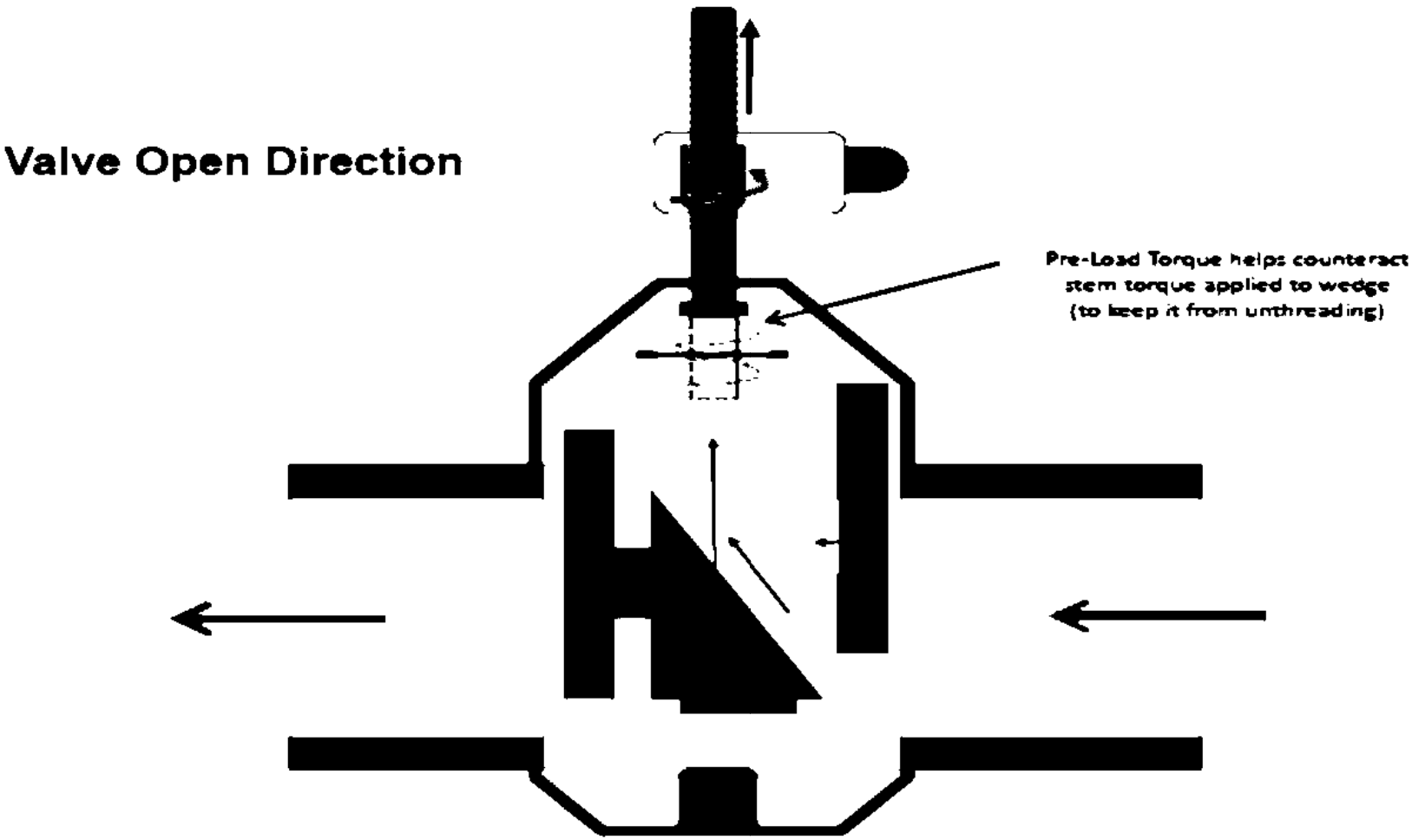
Simplified Operation Diagram – Open



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LaSalle 2 – HPCS Injection Valve Failure – Stem-Disc Separation

- February 11, 2017, the HPCS Pump Discharge Valve failed during routine outage maintenance
  - Flowserve-Anchor/Darling 12-inch double disc gate valve
  - Stem-disc separation when attempting to open the valve
- Shearing of the anti-rotation pin ("wedge pin") resulted in failure
- Previous operating experience led to vendor/industry guidance for flagging potential valve degradation

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LaSalle HPCS Valve Images

(b)(4)

BWROG PROPRIETARY

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Event Response

- **Licensee/Industry Response:**
  - Licensee conducting a root cause investigation
  - BWROG issued a Topical Report to account for LaSalle experience, but is not endorsed by NRC
- **NRC Response:**
  - Ongoing NRC reactive inspection (began 4/24/17)
  - Questions about current and past operability of installed valves
  - All sites evaluate response to 2013 Part 21 reports
  - Issued OpE COMM and updated IOEB SharePoint site with the latest information
  - Determine need for additional industry communication (Information Notice)

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Inspection Considerations

- **Licensee Susceptibility and Response to Previous OpE**
  - Does your licensee have Anchor Darling double disc gate valves installed that are >2" in diameter?
  - Was action taken on the 2013 Part 21 reports?

- **Awareness of LaSalle Event and Related Industry Actions**
  - If your licensee has susceptible Anchor Darling valves installed, are they aware of the LaSalle event?
  - Are they aware that Rev 2 of the Topical Report is in the process of being issued, but is not endorsed?

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Update – OpE Data Analysis Tool (ODAT)

- **OpE SharePoint Site (**Open with Chrome Browser) http://fusion.nrc.gov/nrr/team/dirs/ioeb/odat/index.html
- **Uses INPO ICES data tables to create visualizations of component failures and failure causes.**
- **IOEB staff investigating how to make ODAT an inspection planning tool. Examples:**
  - Inform inspection plans using trends in failures/failure causes
  - Develop site Dashboards
- **IOEB will advertise and organize online seminars**
  - To further demonstrate ODAT capabilities
  - To gather inspector/regional input on additional uses of ODAT

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Recent OpE COMMunications

Non Responsive

LaSalle – Anchor Darling Valves

Non Responsive

Special Inspection

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Backup Slides

LIC-504 Assessment – LaSalle Motor Operated Valve Issue

June 8, 2017
3:00 – 4:00 pm (eastern)

Purpose: Continue discussion of LIC-504 process to address generic implications arising from LaSalle special inspection. Focus areas for discussion will be:

- Status of IN development process (target completion 6/16)
- Discuss planning for Follow-up Public Meeting

Agenda

Introductions/Roll Call – NRR/DE	5 minutes
Status Updates	
• Update on Special Inspection – Region III MPR Evaluation – Columbia Inspection experience	10 minutes
• Interactions with Owners Groups – NRR/DPR	1 minutes
• Interactions with Flowserve – NRO/DCIP	1 minutes
• Interactions with INPO – NRR/DIRS	1 minutes
• Interactions with NEI – NRR/DPR	1 minutes
• Risk Assessment – NRR/DRA	1 minutes
Review/Re-affirm Immediate Safety Screening – NRR/DE	5 minutes
LIC-504 Decision Options – NRR/DE, All	20 minutes
• Status of IN development (see attached schedule) • Planning for public meeting (schedule, agenda)	
Communication Plan – NRR/DPR	5 minutes
Summarize Actions – NRR/DE	10 minutes
• Review actions from previous meeting • Identify new actions • Next meeting(s)	

Information Notice (IN) Schedule: Anchor/Darling Double Disc Gate Valve Wedge Pin Shearing

Time (days)	Description	Scheduled	Completed
T=0	PGCB receives and reviews IN	COB June 1	COB June 1
T=1	PGCB PM adds IN into ADAMS, AA/LA review, and sends to QTE. DIRS technical lead responds to PM comments	June 2	June 2
T=2	QTE provides comments	June 5	June 5
T=3	**In parallel:** Request Licensee Comments Request comments and requests to be on concurrence from: Regions, NRO, NRR/DRA, NRR/DSS, NRR/DE, NRR/DLR, NRR/DORL/PM (2 day turn-around request). Confirm RES, NMSS, and NSIR do not want to be on concurrence.	Request June 5 Receive June 7	Requested June 5 Received June 7
T=6	DIRS technical lead addresses comments	June 9	
T=7	LA concurrence and IN number obtained	June 12	
T=8	Parallel NRR/DIRS, DRA, DSS, DE, DPR, DLR; and NRO concurrence (2 days).	Request June 13 Receive June 15	
T=10	Get signatures from NRO (McGinty) and NRR (Lund) and provide to LA to Issue IN	June 16	

Anchor Darling MOV Public Meeting
Planning Considerations

Objectives:

- Understand industry actions in response to recent anchor darling valve operating experience
- Determine what further NRC regulatory action is needed

Schedule/Logistics:

- Schedule as soon as practical
- Provide sufficient lead time for industry stakeholders to address key questions
- Location – HQ, with teleconference/webinar capability
- Key participants
  - NRC HQ (NRR, NRO)
  - NRC Region III (other Regions?)
  - NEI
  - PWROG/BWROG
  - Flowserve

Key Questions:

- Characteristics of Anchor Darling double disc gate valve population?
  - Number in service in safety-related or risk-significant functions?

- What industry actions have been taken in response to Part 21 issue?
  - Failure evaluations?
  - Inspections?
  - Repairs/modifications?
  - Schedule for future actions?

- What corrective actions are needed to address degraded condition?

- What factors increase susceptibility to valve failure?

- What testing procedures can be used to identify degraded condition or incipient failure?

- Adequacy of available information on valve degradation (e.g., Part 21s, guidance documents)

- Other?

LIC-504 Assessment – Anchor/Darling Double Disc Gate Valves

Scope: The HQ (NRR led) LIC-504 assessment is addressing generic implications arising from LaSalle Special Inspection, as appropriate. Follow-up and decision-making for LaSalle-specific issues will continue under the Region III inspection and enforcement programs and are outside the scope of the HQ LIC-504 process.

> ***Caution**: If at any time an immediate shutdown of a plant is required, LIC-106, "Issuance of Safety Orders" or the Enforcement Manual Process should be entered. The LIC-504 process should not be permitted to interfere with taking necessary and timely action. LIC-504 may be suspended or curtailed at that time by cognizant management.*

LIC-504 Risk Screening Questions:

a. Is immediate regulatory action required?
   - Defense in depth significantly degraded (multiple barriers significantly degraded, functional redundancy or diversity is significantly compromised)
   - Significant loss of safety margin
   - Risk impact is high (e.g., CDF >1E-03, LERF > 1E-04, ICCDP > 5E-05, ICLERP > 5E-06)

   Preliminary Assessment

   1. Anchor Darling Double Disc Gate Valves (DDGVs) are used in safety-related and risk-significant applications at over 40 plant sites. These valves are used in both PWR and BWR plant applications, including emergency core cooling, residual heat removal, and service water systems.
   2. The under-torqued stem condition described in the TVA and Flowserve Part 21 reports may have existed since initial plant construction.
   3. Although the under-torqued stem condition can lead to valve failure, the staff has identified that only a small portion of the in-service valves have failed due to wedge pin shearing (the estimated failure rate based on operating experience for A/D DDGVs is approximately 1E-03/year, slightly worse than the non-A/D valve population).
   4. Limiting the shear stress applied to the wedge pin by either (1) the use of a motor actuator incapable of generating sufficient torque, or (2) by valve setup (e.g., setting of torque switches at a low enough value) may prevent wedge pin and subsequent failure of valve.
   5. Operating experience from Duke disassembly and inspection of more than 23 valves indicated that all but two valves were untorqued. However, none of the under-torqued valves had a sheared wedge pin; stem or disc damage; or was in a failed condition prior to disassembly.

6. A risk assessment conducted for 11 plants using conservative assumptions indicates that the increase in CDF associated with the degraded valve conditions constitutes a small increase in CDF (approximately less than 1E-05/yr).
7. The staff is not aware of any other information at this time that would require immediate regulatory action

Therefore, the preliminary conclusion is that while reliability of the affected valves may be degraded, the condition identified in the Part 21 notifications does not necessarily lead to loss of valve function.

Open questions that may impact safety assessment:

- Is the description in the Part 21 notice adequate (e.g., does it accurately describe the condition adverse to quality)
  Total population of affected valves and safety functions
  Safety impact associated with normally open valves with a safety function to close (e.g., containment isolation). Note that the failure at Browns Ferry was identified by the failure of disc retaining clip (due to stem rotation) preventing full closure of the valve resulting in a failed LLRT.
- Risk impact of potential valve reliability degradation (e.g., develop insights to gain a better understanding of risk implications of degraded valve reliability)
- Can FLEX equipment be used to mitigate valve failure during an accident (e.g., does valve failure preclude a flow path needed for FLEX equipment)

b. Is the issue clearly of low safety significance?
   - Delta CCDP < 1E-07 and minimal degradation in of defense in depth or safety margin.

   Based on MD 8.3 assessment (i.e., CCDP of 2.5E-05 for LaSalle Unit 2 failed HPCS valve) and potential for a large number of ECCS valves to be affected at multiple plant sites, this does not appear to be an issue of low safety significance.

LIC-504 Provides Two Approaches for Evaluation:

1. Appendix B – Standard Approach
2. Appendix C – Integrated risk-informed Decision-Making Process

Both options consider five principles of risk-informed regulation:

- Compliance with existing regulations
- Maintenance of adequate safety margins
  Maintenance adequate defense in depth
- Demonstration of acceptable levels of risk
  Implementation of defined performance measurement strategies

The detailed Appendix C should be used when there is a:

1. Need for highly deliberative process (multiple technical disciplines, large uncertainty, unintended consequences)

2. Need for structured assessment of risk, defense-in-depth, safety margins (structured assessment of five key principles of integrated decision-making is needed

Appendix B LIC-504 Process – Standard Approach

a) Define LIC-504 Assessment Team

a. Decision Authority: NRR ET
b. Management Lead: NRR/DE
c. Project Manager: NRR/DPR (Benney/Wilkins)
d. Technical Lead:
e. Team Members
    i. NRR/DE
    ii. NRR/DIRS
    iii. NRR/DSS
    iv. NRR/DRA
    v. NRO/DCIP
    vi. NRR/DPR
    vii. Region III

b) Characterize the Emergent Issue

The emergent issue is the potential need for generic industry actions as a result of the Anchor/Darling Double Disc Gate Valve failures associated with improperly torqued stem-disc connections.

Note, the immediate issues associated with LaSalle Units 1 and 2 are being addressed by the Region III Special Inspection Team and are outside the scope of the HQ LIC-504 assessment. However, the results obtained from the SI will inform the HQ LIC-504 process related to the broader generic implications for the industry.

c) Define Decision Options

(b)(5) Deliberative Privilege

Notes:

1. Define each decision option (e.g., shut down plant immediately or shut down in specified time period)
2. What analytical tools are available (e.g., risk analysis tools or engineering models) – may be quantitative or qualitative

3. Identify potential impact on the principles of risk-informed decision-making or other factors being analyzed or evaluated to differentiate the options.
4. Define the basis or standard for accepting or rejecting each decision option.
5. Compare the options and justify the option that is being recommended for implementation.

d) Perform Assessment of each Option

Need to consider five principles of risk-informed regulation:

- Compliance with existing regulations
- Maintenance of adequate safety margins
- Maintenance adequate defense in depth
  Demonstration of acceptable levels of risk
- Implementation of defined performance measurement strategies

e) Integrate Assessment Results including Performance Monitoring Strategies

To be developed

f) Communicate Assessment and Recommendations to Decision Authority

To be developed

g) Document the Decision, including any performance monitoring

To be developed

h) Communicate the Decision

Communication Plan under development

Generic Communications (MD 8.18)

Bulletin (BL)

- A BL is used to request licensee actions and/or information to address significant issues regarding matters of safety, security, safeguards, or environmental significance that also have great urgency. A BL requires a written response. The compensatory actions requested should be commensurate with the urgency of the issue being addressed.
- A BL may NOT request long-term actions or require actions or commitments.

Generic Letter (GL)

- A GL addresses either an emergent or routine technical issue with generic applicability for which NRC staff and stakeholders have interacted. A GL may also be issued without extensive prior interaction between the NRC and stakeholders when the NRC has determined a risk-significant compliance matter should be brought promptly to the attention of licensees.
- A GL may request information and/or compensatory actions and require a written response from licensees regarding matters of safety, security, safeguards, or environmental significance.
- A GL may NOT request long-term actions or require actions or commitments

Regulatory Issue Summary

- A RIS is used to communicate with stakeholders on a broad range of matters.
- A RIS may—
  - Communicate previous NRC endorsement of an industry-developed resolution of a matter on which the staff has interacted with the industry.
  - Communicate previous NRC endorsement of industry guidance on technical or regulatory matters.
  - Provide the status of staff interaction with the nuclear industry on a matter.
  - Request the voluntary submittal of information which will assist the NRC in the performance of its functions.
- A RIS may NOT—
  - Provide guidance for the implementation of rules and regulations,
  - Provide guidance to NRC staff on regulatory or technical matters,
  - Require a response, commitments, or action, or
  - Be used in lieu of other established agency products

Information Notice

- An IN communicates recently identified operating experience to the nuclear industry. The results of recently completed research that may affect addressees may also be communicated in an IN. Addressees are expected to review the information for applicability to their facilities or operations and consider actions, as appropriate, to avoid similar problems.
- An IN may NOT—
  - Convey or imply requirements,
  - Transmit interpretations of regulations, or
  - Request information or action from addressees.

Criteria for Identifying Susceptible Valves

Background on Anchor/Darling Double Disc Gate Valves

The valve key components are the body, the seats, the disk or wedge assembly, stem, and in some cases a stem disk retainer pin and retainer clips. The valve body accepts the stem wedge assembly which lowers into the body. Valve seats are part of the valve body and this is where the sealing of the flow medium is done. The stem is attached to the disk/wedge assembly by one of two methods:

- The stem is screwed into the wedge to a recommended torque which is greater than the capability of the actuator but less than the structural limits of the components. Once torqued, a hole is drilled for the retainer pin and retainer clips. In essence, the pin acts like a lock washer. If torqued properly, the actuator force will not move the stem. If the stem is not torqued properly and pinned at the improper torque, the actuator, if large enough, can supply enough torque which would now be applied to the pin. The pin typically is the weak link.

- The other method for stem attachment to the wedge is a T-Head configuration. The wedge assembly has a T-hear design that would match up with a T-Head stem. This design does not have a pin and would not be vulnerable to this type of separation.

Anchor Darling double disc gate valves are used in both BWR and PWR plants. The Flowserve Part 21 identifies over 40 affected nuclear plant sites.

- *Region III has surveyed licensees in their Region and identified a population of 88 valves (ranging from 4 valves for the Quad Cities site to 28 at DC Cook). Some sites have either fully inspected the valves ((Perry) or performed a wedge pin analysis (Dresden)*

Potential Considerations for Identifying Susceptible Valves

- Flowserve identified the following valve characteristics that increase susceptibility to wedge pin failure:
  - Double-Disc Gate valves with threaded stem to upper wedge connections.
  - Valves with electric motor actuators which produce high output torques are the most susceptible to failure (valves which were assembled with stem torques that exceed the operating torque are not candidates for failure).

- In addition, with the following characteristics may place affected valves in a high priority category for follow-up:
  - Performs a safety-related function
    Valves with an open safety position or are required to operate multiple times during a design basis accident

- Valves that incorporate a press fit stem collar vice an integral stem collar (the collar makes contact with the disc assembly and supports the torqueing process).
- Valves with abnormal diagnostic testing results (however, while test results may be useful in identifying potential degradation, they may not be sufficient to prove operability)

- Previous history with stem over-torqueing
  - The upgrading of the sizing and setting of the motor actuators to correct inadequacies in the original design and qualification of MOVs identified in the 1980s might have resulted in the original stem-wedge assembly torque or threaded connection capability being exceeded. Application issues (such as pressure/locking or vibration) might have resulted in the assembly torque or thread capability of the stem-disc connection being exceeded by the motor actuator

- High speed valves have to account for motor inertia after the power is removed via torque switch or limit switch. Setting a motor to stop on limit for a high speed valve is a challenging adjustment and must balance correctly positioning the valve without overstressing valve components.

- BWROG TP17-1-112, "Recommendations to Resolve Flowserve 10CFR Part 21 Notification Affecting Anchor Darling Double Disc Gate Valve Wedge Pin Failures (Revision 2)" provides a prioritization scheme based on:
  - Operating history (e.g., flow induced vibration, significant over torque)
  - Open safety-related design basis torque requirement (which could lead to unthreading)
  - Evidence of stem disc separation based on valve diagnostics
  - Recirc discharge valves (BWR-5 and -6) where plant has not complied with SIL-032, -528, -620

Information Needs/Active Questions

Information needed to assess options:

- **What population of valves are vulnerable to failure? Identification of locations where Anchor/Darling used in the fleet and supported safety functions**

  NRR/DIRS, NRR/DRA, and RES supporting evaluation

- **What have other utilities who have performed disassembly and inspection of the affected valves found?**

  Some feedback obtained from BWROG/PWROG call and from Region III survey. Duke Power, First Energy (Perry), PG&E (Diablo Canyon)

- **Risk impact of potential generic issue?**

  NRR/DRA evaluating risk impact

- **Is the guidance developed in response to the Part 21 notifications (e.g., BWR topical report BWROG-TP-13-006, "Recommendations to Resolve Flowserve 10 CFR Part 21 Notification Affecting Anchor Darling double Disc Gate Valve Wedge Pin Failures.") adequate to address the issue and can it be reasonably implemented by licensees?**

  Still under evaluation?

- **What actions were taken by the PWROG in response to the Part 21? What other actions have been taken by PWR plants in general in response to this issue?**

  PWROG plans to issue an owners group letter to their members notifying them of the issues at LaSalle, providing background, and remind licensees that this is a licensee issue that should be included in their corrective action program.

- **Did Exelon implement the same corrective actions for the Part 21 at their other facilities or were the actions taken at LaSalle unique?**

- **What actions were taken by other licensees?**

  Have some information from Duke Power (inspected at least 23 valves, most untorqued, some with calculated torque capability in excess of wedge pin capability -no evidence of damage of valves); Diablo Canyon, and Perry.

Still need more specific information from these inspections results (e.g., Duke margin analysis)?

- **Accessibility of MOV's, ability to test on-line? Would be relevant to the time required to inspect/repair/replace valves.**

- **What monitoring can be used to ensure that the safety implications of the issue do not change over time?**

  Continue to monitor operating experience to ensure that Agency actions effectively resolve issues.

  A review of operating experience conducted by INL indicates that the failure rate for Anchor Darling valves is slightly higher (by a factor of ~ 2.5x) than the general population of motor operated valves. Continued monitoring of performance of these valves may provide an indication of the effectiveness of actions taken under LIC-504.

LaSalle SIT Operability Assessment

PRESENTER: MARK JEFFERS, RIII ENGINEERING BRANCH CHIEF

DATE: JUNE 13, 2017

Overview

- Background
- Problem
- Licensee's Assessment of Operability
- SIT's evaluation of Operability
- Response to Key Questions
- Recommendation / Decision Point
- Conclusion

[redacted]

Background

Unit 2 HPCS injection valve failed during surveillance testing during February outage.

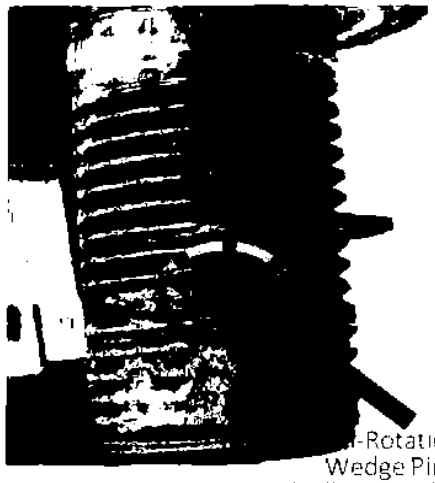
Licensee failure analysis confirmed a design flaw (vendor is expected to update Part 21).

Exited with the licensee on Friday June 9, 2017.

- One apparent violation, 10 CFR 50 Appendix B, Criterion III, "Design Control"
- One Unresolved Issue, Unit 1 HPCS Operability

Some of the Key Messages Included:

- Licensee had no intention of reporting this issue without NRC initiating the action.
- Lack of technical rigor in the operability evaluation.
- The analysis demonstrates that it is not a question of "if" the valve is going to fail, but "when" the valve will fail.



-Rotation Wedge Pin (still inserted but sheared)

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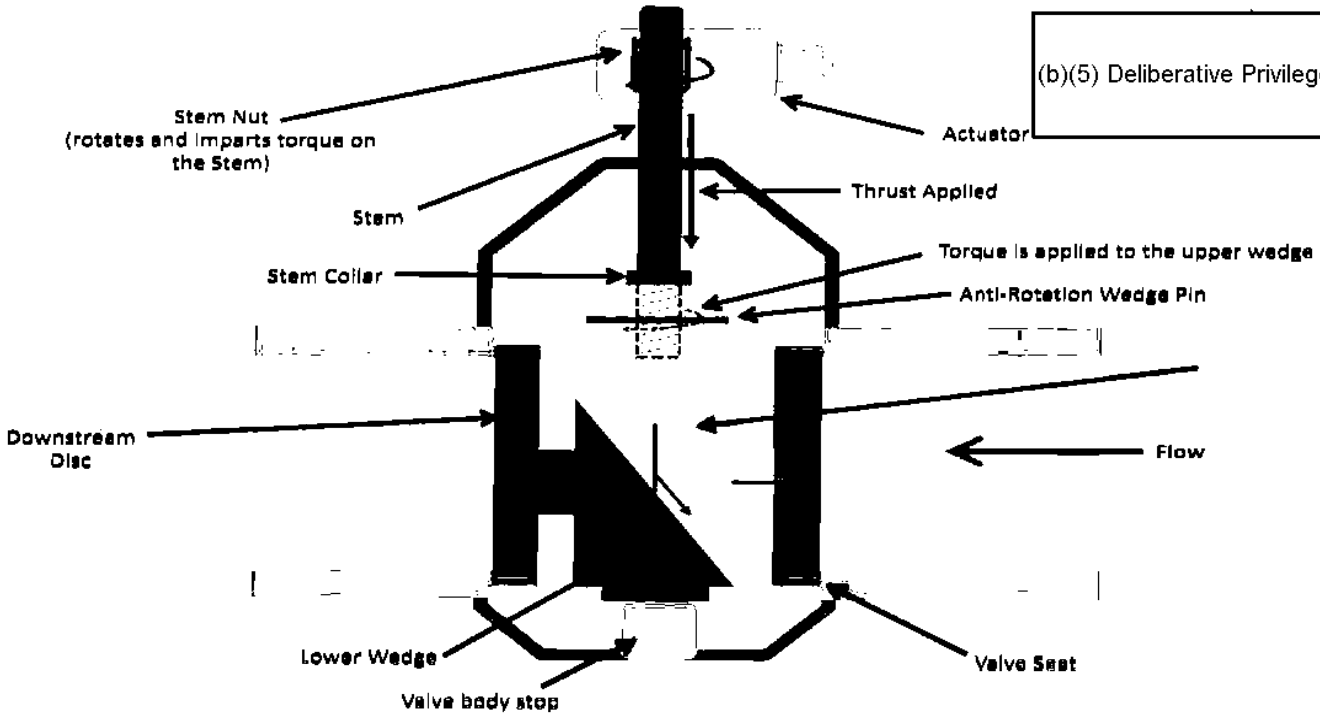
Background

(b)(5) Deliberative Privilege

Simplified Operation Diagram

(b)(5) Deliberative Privilege



[redacted]

Problem

Without physical examination of the valve, the site lacks methods to reliably understand the current condition of the component.

Failure analysis performed by the licensee and independently identified by the SIT demonstrate that the Unit 1 HPCS injection valve has a design flaw which will lead to stem-to-disc separation

Due to the failure mechanism and previous operating experience, the site does not have the ability to predict when failure will occur.

[redacted]

Licensee's Assessment of Operability

- Licensee claims they are able to detect degradation prior to failure.
  - Stem Rotation Checks
  - Diagnostic Traces
- Operating Experience provided by Duke and Columbia.
- History of the Unit 1 valve.
  - Number of cycles stroked.
  - Amount of thrust being exerted on the valve stem.

[redacted]

SIT Evaluation of Operability

(b)(5) Deliberative Privilege

Key Questions

(b)(5) Deliberative Privilege

Key Questions

(b)(5) Deliberative Privilege

[redacted]

Key Questions

(b)(5) Deliberative Privilege

[redacted]

Key Questions

(b)(5) Deliberative Privilege

[redacted]

Summary

(b)(5) Deliberative Privilege

[redacted]

Recommendation

(b)(5) Deliberative Privilege

DECISION POINT.

Identify next steps.
Identify action items/owners.
Identify anticipated timeline.

[redacted]

Conclusion

(b)(5) Deliberative Privilege

Withheld pursuant to exemption

(b)(4)

of the Freedom of Information and Privacy Act

Withheld pursuant to exemption

(b)(4)

of the Freedom of Information and Privacy Act

Withheld pursuant to exemption

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of the Freedom of Information and Privacy Act

LaSalle SIT Operability Assessment

PRESENTER: MARK JEFFERS, RIII ENGINEERING BRANCH CHIEF

DATE: JUNE 13, 2017

Overview

Background

Problem

Licensee's Assessment of Operability

SIT's evaluation of Operability

Response to Key Questions

Recommendation

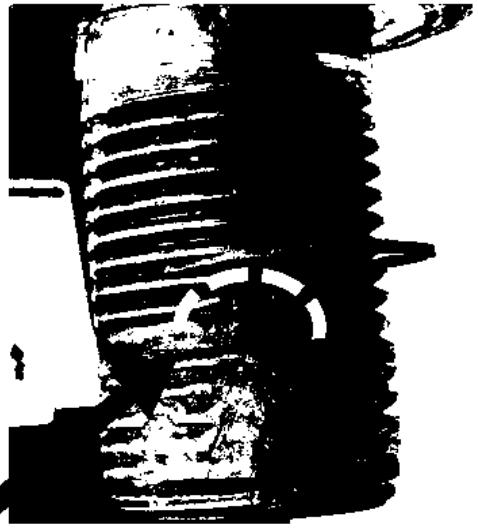
Background

Unit 2 HPCS injection valve failed during surveillance testing during February outage.

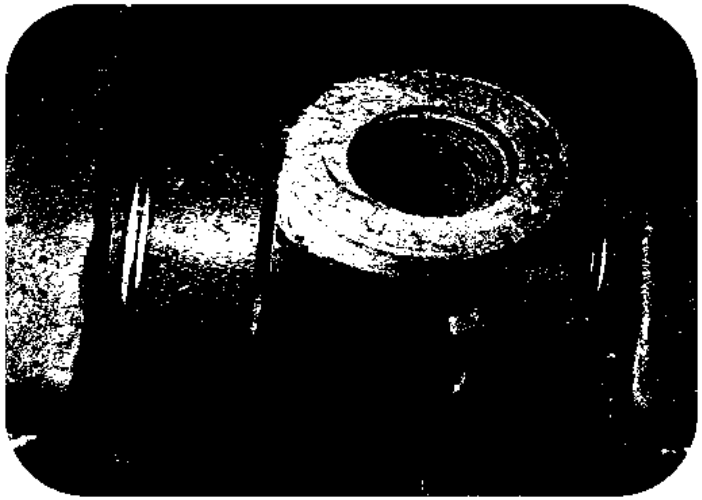
Licensee failure analysis confirmed a design flaw (vendor is expected to update Part 21).

Exited with the licensee on Friday June 9, 2017.

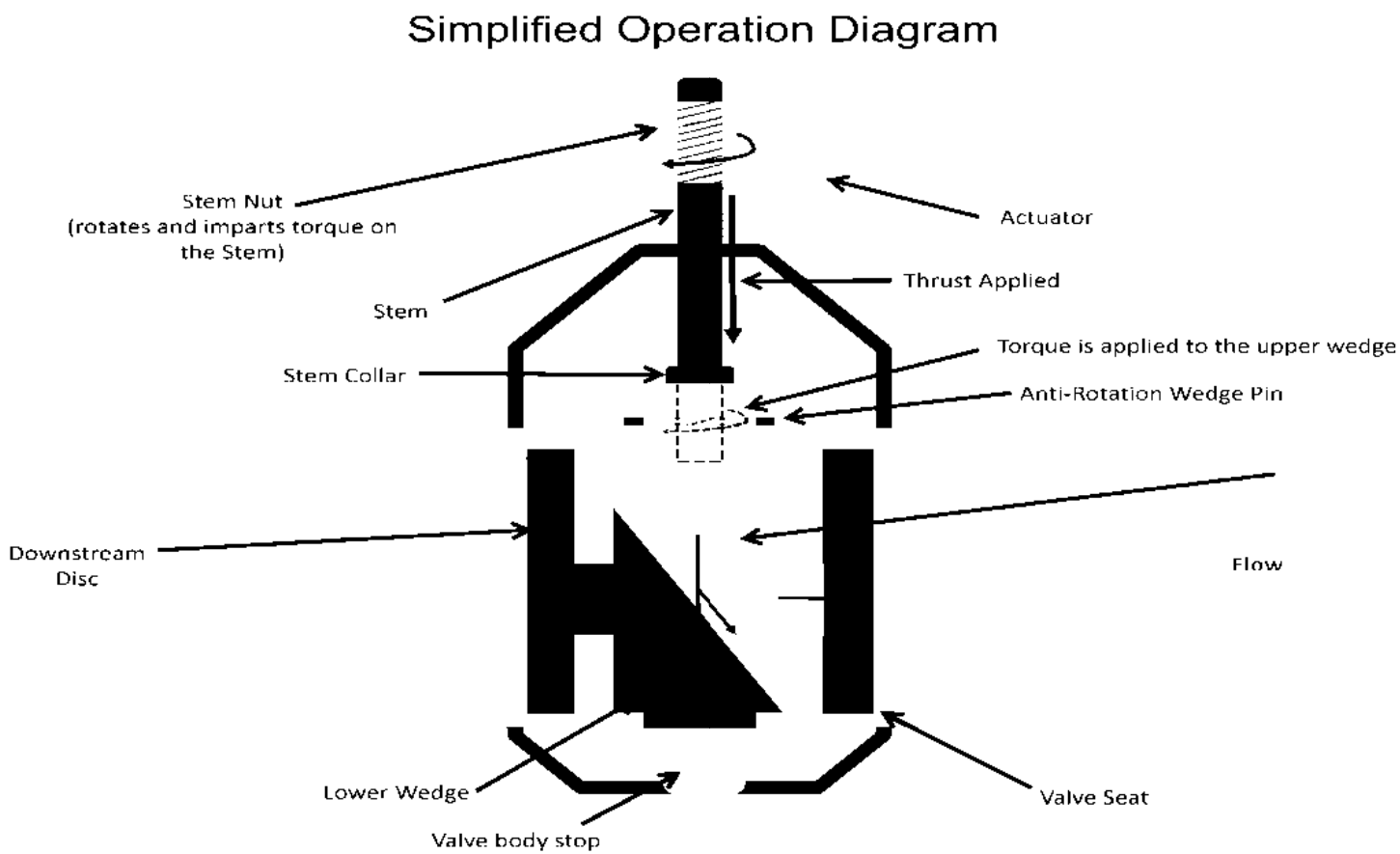
- One apparent violation, 10 CFR 50 Appendix B, Criterion III, "Design Control"
- One Unresolved Issue, Unit 1 HPCS Operability



Anti-Rotation Wedge Pin (still inserted but sheared)



Background


Simplified Operation Diagram
Stem Nut
(rotates and imparts torque on the Stem)
Actuator
Stem
Thrust Applied
Stem Collar
Torque is applied to the upper wedge
Anti-Rotation Wedge Pin
Downstream Disc
Flow
Lower Wedge
Valve Seat
Valve body stop

Problem

Without physical examination of the valve, the site lacks methods to reliably understand the current condition of the component.

Failure analysis performed by the licensee and independently identified by the SIT demonstrate that the Unit 1 HPCS injection valve has a design flaw which will lead to stem-to-disc separation

Due to the failure mechanism and previous operating experience, the site does not have the ability to predict when failure will occur.

Licensee's Assessment of Operability

Licensee claims they are able to detect degradation prior to failure.

- Stem Rotation Checks
- Diagnostic Traces

Operating Experience provided by Duke and Columbia.

History of the Unit 1 valve.

- Number of cycles stroked.
- Amount of thrust being exerted on the valve stem.

SIT Evaluation of Operability

Stem rotation checks and MOV diagnostic data have not been demonstrated to identify stem degradation.

Initial MOVATS testing identified potential for plastic deformation of the wedge pin in 1987; therefore, valve susceptible to 30 years of thread degradation.

Columbia opex identified broken wedge pin and loose threaded connection on the similar valve (HPCS injection valve).

The difference in cycles between the Unit 1 valve and the Unit 2 valve is within the margin of error.

Thrusts being applied to the Unit 1 valve are sufficient to shear the pin and degrade the threaded connection.

Licensee could not benchmark their operability methodology.

Failure analysis performed for the Unit 2 valve identifies a design issue in the valve itself. Therefore, this design flaw and the operating history of the valve will lead to failure.

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Agency Mission Meeting
June 14, 2017

OEDO

Non-Responsive Record

RI

Non-Responsive Record

RII

Non-Responsive Record

RIII

Non-Responsive Record

- Provided an update on the LaSalle SIT; not yet aligned internally but another meeting is scheduled for tomorrow.

RIV

Non-Responsive Record

OIP

Non-Responsive Record

OCHCO

Non-Responsive Record

NRO

Non-Responsive Record

ACRS

Non-Responsive Record

OI

Non-Responsive Record

SBCR

Non-Responsive Record

RES

Non-Responsive Record

NRR

- On the topic of LaSalle, NRR reached out to NEI for awareness on industry's actions on the anchor darling gate valve issue; NRR's operating experience staff is continuing to search for related experience

OCIO

Non-Responsive Record

NMSS

Non-Responsive Record

NSIR

Non-Responsive Record

OCFO

Non-Responsive Record

OGC

Non-Responsive Record

LIC-504 Assessment – LaSalle Motor Operated Valve Issue

June 14, 2017
3:00 – 4:00 pm (eastern)

Purpose: Continue discussion of LIC-504 process to address generic implications arising from LaSalle special inspection. Focus areas for discussion will be:

- Status of IN development process (target completion 6/16)
- Discuss planning for Follow-up Public Meeting

Agenda

Introductions/Roll Call – NRR/DE	5 minutes
Status Updates	
• Update on Special Inspection – Region III Exit meeting	5 minutes
• Interactions with Owners Groups – NRR/DPR	1 minutes
• Interactions with Flowserve – NRO/DCIP	1 minutes
• Interactions with INPO – NRR/DIRS	1 minutes
• Interactions with NEI – NRR/DPR	1 minutes
• Risk Assessment – NRR/DRA	1 minutes
Review/Re-affirm Immediate Safety Screening – NRR/DE	5 minutes
LIC-504 Decision Options – NRR/DE, All	25 minutes
• Status of IN development (see attached schedule)	
• Planning for public meeting (schedule, agenda)	
Communication Plan – NRR/DPR	5 minutes
Summarize Actions – NRR/DE	10 minutes
• Review actions from previous meeting	
• Identify new actions	
• Next meeting(s)	

Information Notice (IN) Schedule: Anchor/Darling Double Disc Gate Valve Wedge Pin Shearing

Time (days)	Description	Scheduled	Completed
T=0	PGCB receives and reviews IN	COB June 1	COB June 1
T=1	PGCB PM adds IN into ADAMS, AA/LA review, and sends to QTE. DIRS technical lead responds to PM comments	June 2	June 2
T=2	QTE provides comments	June 5	June 5
T=3	**In parallel:** Request Licensee Comments Request comments and requests to be on concurrence from: Regions, NRO, NRR/DRA, NRR/DSS, NRR/DE, NRR/DLR, NRR/DORL/PM (2 day turn-around request). Confirm RES, NMSS, and NSIR do not want to be on concurrence.	Request June 5 Receive June 7	Requested June 5 Received June 7
T=6	DIRS technical lead addresses comments	June 9	
T=7	LA concurrence and IN number obtained	June 12	
T=8	Parallel NRR/DIRS, DRA, DSS, DE, DPR, DLR; and NRO concurrence (2 days).	Request June 13 Receive June 15	
T=10	Get signatures from NRO (McGinty) and NRR (Lund) and provide to LA to Issue IN	June 16	

Anchor Darling MOV Public Meeting
Planning Considerations

Objectives:

- Understand industry plans and actions in response to recent anchor darling valve operating experience
- Obtain sufficient information to better inform additional NRC regulatory actions

Schedule/Logistics:

- Schedule as soon as practical (balancing industry lead time needed to address key questions with immediate information needs)
- Location – HQ, with teleconference/webinar capability
- Key participants
  - NRC HQ (NRR, NRO)
    NRC Region III (other Regions?)
  - NEI
  - PWROG/BWROG
  - Flowserve

Key Questions:

- Characterization of the population of Anchor/Darling Double Disc Gate Valves (DDGVs) with threaded stem-disc connections in nuclear service
  - Total number in service
  - Distribution of population in following sub-categories:
    - Safety-related applications
    - Non safety-related, high safety significance applications
    - Normally closed valves with open safety function
    - Valves with fast closure function or torque switch cutoff on closing
    - Valves required to cycle multiple times during a design basis accident
    - Valves with actuator force that exceeds valve capability
    - Valves subject to design basis accident forces significantly greater than forces during routine testing conditions

    Operating experience (number of failures, causes, characteristics of failed valves)

- What valve characteristics or operating conditions increase susceptibility to wedge pin failure and subsequent stem disc separation failure?
  - How should these valve characteristics/conditions be used to prioritize resolution of issues for Anchor/Darling DDGVs.

- What corrective actions are needed to resolve the Anchor/Darling DDGV pre-torqueing and design issues?

- What industry actions have been performed (or are planned) in response to the recent Anchor/Darling DDGV issues?
  - Failure evaluations
  - Inspections
  - Repairs/modifications
  - Schedule for future actions?

- What testing or inspection (if any) procedures can be used to identify degraded condition or incipient failure without valve disassembly?

- Industry plans and schedule for updating Anchor/Darling DDGV guidance documents (e.g., Part 21s, BWROG guidance)

- Has the extent of condition been evaluated for other valve or actuator types (e.g., Anchor/Darling DDGVs with T connection, other supplier valves with threaded stem-disc connection)?

Category: This is a Category 2 meeting. The public is invited to participate in this meeting by discussing regulatory issues with the Nuclear Regulatory Commission (NRC) at designated points identified on the agenda.

Purpose: The Nuclear Regulatory Commission (NRC) will meet with industry to discuss its response to the Flowserve Part 21 notification and recent operating experience. The purpose is to solicit input from industry on recent actions taken with regard to the Flowserve Part 21 notification as a result of the valve failure at LaSalle County Nuclear Generating Station, Unit 2.

Agenda

Administrative, Introductions, and Opening Remarks	5 minutes	All
Review of LaSalle Event/Preliminary Observations	10 minutes	NRC
Discussion of recent observations related to Anchor/Darling Double Disc Gate Valves	10 minutes	NRC
Discussion of industry actions in response to the Flowserve Part 21 notification (ADAMS Accession No. ML13064A012).	2 hours?	PWROG BWROG NEI Flowserve INPO
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Industry Perspectives	1 hour?	PWROG BWROG NEI Flowserve INPO
Next steps and closing remarks	15 minutes	All
Opportunity for Public Comment	15 minutes	
Adjournment	5 minutes	

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LIC-504 Assessment – Anchor/Darling Double Disc Gate Valves

Scope: The HQ (NRR led) LIC-504 assessment is addressing generic implications arising from LaSalle Special Inspection, as appropriate. Follow-up and decision-making for LaSalle-specific issues will continue under the Region III inspection and enforcement programs and are outside the scope of the HQ LIC-504 process.

***Caution**: If at any time an immediate shutdown of a plant is required, LIC-106, "Issuance of Safety Orders" or the Enforcement Manual Process should be entered. The LIC-504 process should not be permitted to interfere with taking necessary and timely action. LIC-504 may be suspended or curtailed at that time by cognizant management.*

LIC-504 Risk Screening Questions:

a. Is immediate regulatory action required?

Defense in depth significantly degraded (multiple barriers significantly degraded, functional redundancy or diversity is significantly compromised)

- Significant loss of safety margin
- Risk impact is high (e.g., CDF >1E-03, LERF > 1E-04, ICCDP > 5E-05, ICLERP > 5E-06)

Preliminary Assessment

1. Anchor Darling Double Disc Gate Valves (DDGVs) are used in safety-related and risk-significant applications at over 40 plant sites. These valves are used in both PWR and BWR plant applications, including emergency core cooling, residual heat removal, and service water systems.
2. The under-torqued stem condition described in the TVA and Flowserve Part 21 reports may have existed since initial plant construction. In addition, for valves with a press fit stem collar, slippage of the collar (due to operating forces greater than the resistance from the collar) can result in loss of stem pre-torque.
3. Although the under-torqued stem condition can lead to wedge pin shearing and eventual valve failure, the staff has identified that only a small portion of the in-service valves have failed due to wedge pin shearing. Based on a data analysis conducted by INL, the estimated failure rate based on operating experience for A/D DDGVs is approximately 1E-03/year, slightly worse than the non-A/D valve population (note that this estimate pools all anchor darling valves regardless of size and includes all failure modes).
4. Limiting the shear stress applied to the wedge pin by either (1) the use of a motor actuator incapable of generating sufficient torque, or (2) by valve setup (e.g., setting of torque switches at a low enough value) may prevent wedge pin and subsequent failure of valve.
5. Failure of wedge pin does not immediately lead to valve failure. Based on operating experience, there appears to be a latency period (in some cases of several decades) following wedge pin failure before gross failure of the valve occurs.
6. Operating experience from Duke disassembly and inspection of more than 23 valves indicated that all but two valves were untorqued. However, none of the under-

torqued valves had a sheared wedge pin; stem or disc damage; or was in a failed condition prior to disassembly. This operating experience was associated with smaller sized anchor darling valves.

7. A risk assessment conducted for 11 plants using conservative assumptions (e.g., increase in failure rate of all MOVs by a factor of ~11) indicates that the increase in CDF associated with the degraded valve conditions constitutes a small increase in CDF (approximately less than 1E-05/yr).

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Open questions that may impact safety assessment:

The current Flowserve Part 21 does not adequately describe slippage of a press fit collar as a contributing cause to loss of stem pre-torque. Therefore, actions to specifically address the current Part 21 stem pre-torque issue may not eliminate the issue if stem collar issue is not corrected

- Information on the total population of affected valves is needed to place failure operating experience into proper context (e.g., to help identify sub-populations of valves that may have increased vulnerability to failure)
- Increased susceptibility of larger anchor darling valves to failure compared to smaller sized valves?
- Safety impact associated with normally open valves with a safety function to close (e.g., containment isolation). Note that one of the failures at Browns Ferry was identified by the failure of disc retaining clip (due to stem rotation) preventing full closure of the valve resulting in a failed LLRT.
- Availability/capability of FLEX equipment to mitigate valve failure during an accident (e.g., does valve failure preclude a flow path needed for FLEX equipment)

b. Is the issue clearly of low safety significance?
   - Delta CCDP < 1E-07 and minimal degradation in of defense in depth or safety margin.

   Based on MD 8.3 assessment (i.e., CCDP of 2.5E-05 for LaSalle Unit 2 failed HPCS valve) and potential for a large number of ECCS valves to be affected at multiple plant sites, this does not appear to be an issue of low safety significance.

LIC-504 Provides Two Approaches for Evaluation:

1. Appendix B – Standard Approach
2. Appendix C – Integrated risk-informed Decision-Making Process

Both options consider five principles of risk-informed regulation:

- Compliance with existing regulations

Maintenance of adequate safety margins
- Maintenance adequate defense in depth
- Demonstration of acceptable levels of risk
- Implementation of defined performance measurement strategies

The detailed Appendix C should be used when there is a:

1. Need for highly deliberative process (multiple technical disciplines, large uncertainty, unintended consequences)
2. Need for structured assessment of risk, defense-in-depth, safety margins (structured assessment of five key principles of integrated decision-making is needed

Appendix B LIC-504 Process – Standard Approach

a) **Define LIC-504 Assessment Team**
   a. Decision Authority: NRR ET
   b. Management Lead: NRR/DE
   c. Project Manager: NRR/DPR (Benney/Wilkins)
   d. Technical Lead:
   e. Team Members
      i. NRR/DE
      ii. NRR/DIRS
      iii. NRR/DSS
      iv. NRR/DRA
      v. NRO/DCIP
      vi. NRR/DPR
      vii. Region III

b) **Characterize the Emergent Issue**

The emergent issue is the potential need for generic industry actions as a result of the Anchor/Darling Double Disc Gate Valve failures associated with improperly torqued stem-disc connections.

Note, the immediate issues associated with LaSalle Units 1 and 2 are being addressed by the Region III Special Inspection Team and are outside the scope of the HQ LIC-504 assessment. However, the results obtained from the SI will inform the HQ LIC-504 process related to the broader generic implications for the industry.

c) **Define Decision Options**

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Notes:

1. Define each decision option (e.g., shut down plant immediately or shut down in specified time period)
2. What analytical tools are available (e.g., risk analysis tools or engineering models) – may be quantitative or qualitative

3. Identify potential impact on the principles of risk-informed decision-making or other factors being analyzed or evaluated to differentiate the options.
4. Define the basis or standard for accepting or rejecting each decision option.
5. Compare the options and justify the option that is being recommended for implementation.

d) Perform Assessment of each Option

Need to consider five principles of risk-informed regulation:

- Compliance with existing regulations
- Maintenance of adequate safety margins
- Maintenance adequate defense in depth
- Demonstration of acceptable levels of risk
- Implementation of defined performance measurement strategies

e) Integrate Assessment Results including Performance Monitoring Strategies

To be developed

f) Communicate Assessment and Recommendations to Decision Authority

To be developed

g) Document the Decision, including any performance monitoring

To be developed

h) Communicate the Decision

Communication Plan under development

Generic Communications (MD 8.18)

Bulletin (BL)

- A BL is used to request licensee actions and/or information to address significant issues regarding matters of safety, security, safeguards, or environmental significance that also have great urgency. A BL requires a written response. The compensatory actions requested should be commensurate with the urgency of the issue being addressed.
- A BL may NOT request long-term actions or require actions or commitments.

Generic Letter (GL)

- A GL addresses either an emergent or routine technical issue with generic applicability for which NRC staff and stakeholders have interacted. A GL may also be issued without extensive prior interaction between the NRC and stakeholders when the NRC has determined a risk-significant compliance matter should be brought promptly to the attention of licensees.
- A GL may request information and/or compensatory actions and require a written response from licensees regarding matters of safety, security, safeguards, or environmental significance.
- A GL may NOT request long-term actions or require actions or commitments

Regulatory Issue Summary

- A RIS is used to communicate with stakeholders on a broad range of matters.
- A RIS may—
  - Communicate previous NRC endorsement of an industry-developed resolution of a matter on which the staff has interacted with the industry.
  - Communicate previous NRC endorsement of industry guidance on technical or regulatory matters.
  - Provide the status of staff interaction with the nuclear industry on a matter.
    Request the voluntary submittal of information which will assist the NRC in the performance of its functions.
- A RIS may NOT—
    Provide guidance for the implementation of rules and regulations,
  - Provide guidance to NRC staff on regulatory or technical matters,
  - Require a response, commitments, or action, or
  - Be used in lieu of other established agency products

Information Notice

- An IN communicates recently identified operating experience to the nuclear industry. The results of recently completed research that may affect addressees may also be communicated in an IN. Addressees are expected to review the information for applicability to their facilities or operations and consider actions, as appropriate, to avoid similar problems.
- An IN may NOT—
  - Convey or imply requirements,
    Transmit interpretations of regulations, or
  - Request information or action from addressees.

Criteria for Identifying Susceptible Valves

Background on Anchor/Darling Double Disc Gate Valves

The valve key components are the body, the seats, the disk or wedge assembly, stem, and in some cases a stem disk retainer pin and retainer clips. The valve body accepts the stem wedge assembly which lowers into the body. Valve seats are part of the valve body and this is where the sealing of the flow medium is done. The stem is attached to the disk/wedge assembly by one of two methods:

- The stem is screwed into the wedge to a recommended torque which is greater than the capability of the actuator but less than the structural limits of the components. Once torqued, a hole is drilled for the retainer pin and retainer clips. In essence, the pin acts like a lock washer. If torqued properly, the actuator force will not move the stem. If the stem is not torqued properly and pinned at the improper torque, the actuator, if large enough, can supply enough torque which would now be applied to the pin. The pin typically is the weak link.

- The other method for stem attachment to the wedge is a T-Head configuration. The wedge assembly has a T-hear design that would match up with a T-Head stem. This design does not have a pin and would not be vulnerable to this type of separation.

Anchor Darling double disc gate valves are used in both BWR and PWR plants. The Flowserve Part 21 identifies over 40 affected nuclear plant sites.

- *Region III has surveyed licensees in their Region and identified a population of 88 valves (ranging from 4 valves for the Quad Cities site to 28 at DC Cook). Some sites have either fully inspected the valves ((Perry) or performed a wedge pin analysis (Dresden)*

Potential Considerations for Identifying Susceptible Valves

- Flowserve identified the following valve characteristics that increase susceptibility to wedge pin failure:
  - Double-Disc Gate valves with threaded stem to upper wedge connections.
  - Valves with electric motor actuators which produce high output torques are the most susceptible to failure (valves which were assembled with stem torques that exceed the operating torque are not candidates for failure).

- In addition, with the following characteristics may place affected valves in a high priority category for follow-up:
  - Performs a safety-related function
  - Valves with an open safety position or are required to operate multiple times during a design basis accident

Valves that incorporate a press fit stem collar vice an integral stem collar (the collar makes contact with the disc assembly and supports the torqueing process).
  - Valves with abnormal diagnostic testing results (however, while test results may be useful in identifying potential degradation, they may not be sufficient to prove operability)

- Previous history with stem over-torqueing
  - The upgrading of the sizing and setting of the motor actuators to correct inadequacies in the original design and qualification of MOVs identified in the 1980s might have resulted in the original stem-wedge assembly torque or threaded connection capability being exceeded. Application issues (such as pressure/locking or vibration) might have resulted in the assembly torque or thread capability of the stem-disc connection being exceeded by the motor actuator

- High speed valves have to account for motor inertia after the power is removed via torque switch or limit switch. Setting a motor to stop on limit for a high speed valve is a challenging adjustment and must balance correctly positioning the valve without overstressing valve components.

- BWROG TP17-1-112, "Recommendations to Resolve Flowserve 10CFR Part 21 Notification Affecting Anchor Darling Double Disc Gate Valve Wedge Pin Failures (Revision 2)" provides a prioritization scheme based on:
    - Operating history (e.g., flow induced vibration, significant over torque)
    - Open safety-related design basis torque requirement (which could lead to unthreading)
    - Evidence of stem disc separation based on valve diagnostics
    - Recirc discharge valves (BWR-5 and -6) where plant has not complied with SIL-032, -528, -620

Information Needs/Active Questions

Information needed to assess options:

- **What population of valves are vulnerable to failure? Identification of locations where Anchor/Darling used in the fleet and supported safety functions**

  NRR/DIRS, NRR/DRA, and RES supporting evaluation

- **What have other utilities who have performed disassembly and inspection of the affected valves found?**

  Some feedback obtained from BWROG/PWROG call and from Region III survey. Duke Power, First Energy (Perry), PG&E (Diablo Canyon)

- **Risk impact of potential generic issue?**

  NRR/DRA evaluating risk impact

- **Is the guidance developed in response to the Part 21 notifications (e.g., BWR topical report BWROG-TP-13-006, "Recommendations to Resolve Flowserve 10 CFR Part 21 Notification Affecting Anchor Darling double Disc Gate Valve Wedge Pin Failures.") adequate to address the issue and can it be reasonably implemented by licensees?**

  Still under evaluation?

- **What actions were taken by the PWROG in response to the Part 21? What other actions have been taken by PWR plants in general in response to this issue?**

  PWROG plans to issue an owners group letter to their members notifying them of the issues at LaSalle, providing background, and remind licensees that this is a licensee issue that should be included in their corrective action program.

- **Did Exelon implement the same corrective actions for the Part 21 at their other facilities or were the actions taken at LaSalle unique?**

- **What actions were taken by other licensees?**

  Have some information from Duke Power (inspected at least 23 valves, most untorqued, some with calculated torque capability in excess of wedge pin capability -no evidence of damage of valves); Diablo Canyon, and Perry.

Still need more specific information from these inspections results (e.g., Duke margin analysis)?

- **Accessibility of MOV's, ability to test on-line? Would be relevant to the time required to inspect/repair/replace valves**.

- **What monitoring can be used to ensure that the safety implications of the issue do not change over time?**

  Continue to monitor operating experience to ensure that Agency actions effectively resolve issues.

  A review of operating experience conducted by INL indicates that the failure rate for Anchor Darling valves is slightly higher (by a factor of ~ 2.5x) than the general population of motor operated valves. Continued monitoring of performance of these valves may provide an indication of the effectiveness of actions taken under LIC-504.

Option	Action	Basis & Implementation	Time Line	Advantages	Disadvantages
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Option	Action	Basis & Implementation	Time Line	Advantages	Disadvantages
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Option	Action	Basis & Implementation	Time Line	Advantages	Disadvantages

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Option	Action	Basis & Implementation	Advantages	Disadvantages

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Option	Action	Basis & Implementation	Advantages	Disadvantages
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Option	Action	Basis & Implementation	Advantages	Disadvantages
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Communication Plan
June 20, 2017

Goals

This communication plan serves as a reference document as information is discovered as the site chooses to shut down and correct the Unit 1 HPCS injection valve. Significant information, references, observations, and messages should be included in this plan.

Communication Team

The purpose of this section is to identify key stakeholders/organizations that need to be informed of the information related to the LaSalle SIT and pending shutdown.

Office	*Organizations*
Region III	OPA, SLOs, DRS/EB2, DRP/BR1, DRP/TSS/SRA SIT
NRR	DE, DPR, DIRS, DRA, LIC-504 Task Force
OPA	

Background and Milestones

The purpose of this section is to identify how we got here and to develop major milestones of upcoming actions.

Background:

- January 4, 2013. TVA initiates a Part 21 notification as a result of a defect discovered in the HPCI inboard containment isolation valve, which is a 10" Anchor Darling Double Disc Gate Valve (DDGV).

- February 25, 2013. Flowserve submits Part 21 notification to identify that Anchor Darling DDGVs' stems were potentially never completely torqued into the upper wedge prior to installation. This condition in conjunction with high operating torque/thrust on the stem-to-disc connection could lead to wedge pin failure and eventual stem-to-disc separation.

- February 11, 2017. LaSalle Unit 2 HPCS injection valve fails during outage testing.

- April 12, 2017. LaSalle submits LER 50-374/2017-003-00, "High Pressure Core Spray System Inoperable due to Injection Valve Stem-Disc Separation."

- April 24, 2017. SIT begins at LaSalle.
    - June 9, 2017. SIT exits with LaSalle with one apparent violation for the Unit 2 HPCS valve failure and one URI for the remaining outstanding Part 21 valves.

- June 15, 2017. NRR/DPR issues IN 2017-03, "Anchor Darling Double Disc Gate Valve Wedge Pin and Stem-Disc Separation Failures."

- June 19, 2017. (b)(6), Exelon, informs Region III of plans to shut down LaSalle, Unit 1 in the next two weeks to address the Part 21 and the design issue on the HPCS injection valve.

- June 20, 2017. Exelon submits a letter to the NRC confirming the Unit 1 shut down and committing to multiple actions to address the Part 21 issue, the valve design issue, perform diagnostic as-found testing of the susceptible valves, and share information with the industry.

Upcoming Milestones:

- LaSalle to shut down Unit 1 (ETA: 2200 6/22/17)
- Region III issues letter acknowledging receipt of the licensee's June 20 letter (ETA: 6/26/17)
- LaSalle to disassemble Unit 1 HPCS injection valve (ETA: 6/24/17)
- NRR to host Public Meeting with NEI and Flowserve (ETA: 6/29/17)

Key Messages

- The Special Inspection Team exited the Special Inspection on June 9 and communicated that the team has serious concerns with Exelon's operability evaluation for the LaSalle Unit 1 HPCS valve.
  - Exelon has verbally committed to shutting down Unit 1 at LaSalle on Thursday, June 22nd.

- The Agency is striving to be deliberate and timely in our decision-making and open and transparent in our communications with Exelon relative to our underlying questions and concerns, while remaining focused on our regulatory mission of ensuring public health and safety.

- The Agency is handling the generic implications of this issue using the LIC-504 process. Key messages from the LIC-504 process include:
  - This is not a new issue. Following a similar valve failure at Browns Ferry in 2012, the industry took steps to address the issue. In light of recent operating experience, including the LaSalle valve failure, both the NRC and industry are taking additional actions to resolve the concern.
  - These valves are widely used in systems of varying safety significance. However, not all Anchor Darling valves are used in a way that makes them susceptible to this type of failure.
  - The NRC has no immediate safety concerns because other diverse and redundant systems could be used to protect the plant if a valve were to fail.

- The NRC plans on holding a public meeting in early July to further discuss the operating experience and industry actions with stakeholders. The NRC will use the information obtained from the public meeting as part of its assessment of the need for additional regulatory actions.

Communication Tools

Tool	Frequency	Lead	Target Audience	Purpose
Daily Note	Following unit shutdown	DRS/EB2	Agency	High level awareness of plant status and pending valve inspection.

Questions and Answers

Question	Answer
1. Would the Unit 1 HPCS system operate if it was called upon today?	As part of the SIT, the NRC developed concerns about the ability of the HPCS system to operate if needed. These concerns were shared with the licensee as part of the inspection. However, nuclear power plants are robustly designed with multiple, backup safety systems. These backup systems would have been able to provide water to the reactor if the HPCS system failed to operate.

Question	Answer
2. Why is the Agency allowing continued operation of LaSalle Unit 1?	XXXXXXXXXXXXXXXXXX
3. Can FLEX equipment be used to mitigate failure?	The use of FLEX equipment may be possible. However, the FLEX strategy is specific to each plant's design and multiple systems need to fail before the use of FLEX equipment is considered. Each nuclear power plant is robustly designed such that if a system fails to operate, another system is available to perform the same function. If the HPCS system failed to operate, multiple other systems would also need to fail before the use of FLEX equipment would be considered.
4. Does this impact other types of valves?	The valve failure that happened at LaSalle only occurs on valves made by a specific manufacturer during a given time period. To date, the NRC has no reason to believe the failure mechanism can occur on valves made by other manufacturers.
5. Why did it take so long for the NRC to initiate the SIT after the Unit 2 valve was identified to fail?	At the time the Unit 2 valve failed, the site was shutdown and HPCS was not required to be operable; therefore, there was not an immediate safety concern. The valve was replaced prior to the startup of the unit. During the follow-up inspections, the residents reviewed the past-operability and identified the potential generic implications which prompted the SIT.
6. Why did the NRC take no actions following the initial Part 21 notifications from TVA/Flowserve?	Sites address Part 21 notifications as part of their CAP. For the initial Part 21 notifications from TVA/Flowserve, there was not an immediate safety concern since the notification only identified a degraded condition, but the specific operability of each valve affected would be evaluated on a case-by-case basis. Only when applying many factors (e.g., size of the valve, size of the actuator, operating history, safety function) could the operability for each component be known.
7. Will the Agency take any enforcement actions on the vendor (Flowserve)?	The Vendor Inspection branch has a previously scheduled inspection expected to occur in mid-July. As a result of the SIT, the Agency will supplement that inspection with inspectors from the SIT to provide additional insight.
8. How could the SIT conclude that no performance deficiency existed at LaSalle? They operated for ~ 2 years with an inoperable HPCS injection valve and no regulatory actions are being recommended?	As part of the inspection, the SIT identified a design flaw within the valve itself. This was brought up to the vendor, and the vendor (Flowserve) is updating their Part 21 notification to include this design flaw. The SIT was able to identify the design flaw as a result of the failed Unit 2 valve. The ability to detect this design flaw upon initial receipt of the component would be

Question	Answer
	beyond the requirements of a normal owner's acceptance evaluation that the licensees implement. Therefore, it was not within the ability to foresee and correct and our process requires this to be a performance deficiency.
9. Did the Agency endorse the BWROG Topical Report for addressing the Part 21 notifications?	No. The agency did not endorse the BWROG Topical Report.
10. Is the Agency going to provide any generic communications on this issue?	Yes. An information notice was submitted on June 15, 2017 to highlight the issue to the industry (IN 2017-03, "Anchor Darling Double Disc Gate Valve Wedge Pin and Stem-Disc Separation Failures."). The Generic Communications Branch is currently evaluating the need for additional generic communications (e.g., Bulletin, Generic Letter, etc.)
11. How is the Agency handling the generic implications of this issue?	
12. From the timeline, it appears that the licensee knew about the wedge pin being broken since 1987. Why was this never reported?	
13. Why did it take the SIT 7 weeks to conclude the site lacked reasonable assurance of operability?	

Contacts: Mark Jeffers, DRS
Karla Stoedter, DRP

LaSalle Unit 1 Shutdown Internal Communications Plan
June 20, 2017

Goals

This communication plan serves as a reference document as LaSalle, Unit 1 shuts down to inspect and repair the Unit 1 HPCS injection valve. Significant information, references, observations, and messages should be included in this plan.

Communication Team

The purpose of this section is to identify key stakeholders/organizations that need to be informed of the information related to the LaSalle SIT and pending shutdown.

Office	*Organizations*
Region III	OPA, SLOs, DRS/EB2, DRP/BR1, DRP/TSS/SRA SIT
OEDO	
NRR	DE, DPR, DIRS, DRA, LIC-504 Task Force
OPA	
OCA	
Other Regions	

Background and Milestones

The purpose of this section is to identify how we got here and to develop major milestones of upcoming actions.

Background:

- January 4, 2013. TVA initiates a Part 21 notification as a result of a defect discovered in the HPCI inboard containment isolation valve, which is a 10" Anchor Darling Double Disc Gate Valve (DDGV).

- February 25, 2013. Flowserve submits Part 21 notification to identify that Anchor Darling DDGVs' stems were potentially never completely torqued into the upper wedge prior to installation. This condition in conjunction with high operating torque/thrust on the stem-to-disc connection could lead to wedge pin failure and eventual stem-to-disc separation.

- February 11, 2017. LaSalle Unit 2 HPCS injection valve fails during outage testing.

- April 12, 2017. LaSalle submits LER 50-374/2017-003-00, "High Pressure Core Spray System Inoperable due to Injection Valve Stem-Disc Separation."

- April 24, 2017. SIT begins at LaSalle.

- June 2, 2017. Exelon submits a letter to the NRC committing to multiple actions to address the Part 21 issue on the Unit 1 and Unit 2 susceptible valves no later than the next unit refueling outages.

- June 9, 2017. SIT exits with LaSalle with one apparent violation for the Unit 2 HPCS valve failure and one URI for the remaining outstanding Part 21 valves. The associated inspection report is expected to be issued by July 31, 2017.

- June 15, 2017. NRR/DPR issues IN 2017-03, "Anchor Darling Double Disc Gate Valve Wedge Pin and Stem-Disc Separation Failures."

- June 19, 2017, (b)(6), Exelon, informs Region III of plans to shut down LaSalle, Unit 1 in the next two weeks to address the Part 21 and the design issue on the HPCS injection valve.

- June 20, 2017. Exelon submits a letter to the NRC confirming the Unit 1 shut down and committing to multiple actions to address the Part 21 issue, the valve design issue, perform diagnostic as-found testing of the susceptible valves, and share information with the industry.

- June 22, 2017. Exelon shut down LaSalle, Unit 1 to correct the Part 21 and design issue on the HPCS injection valve.

Upcoming Milestones:
- Region III issues letter acknowledging receipt of the licensee's June 20 letter (ETA: 6/26/17)
- NRC to observe LaSalle performing stem rotation checks and diagnostic testing of valve (ETA: 1500 6/23/17)
- NRC to observe LaSalle disassembling the Unit 1 HPCS injection valve (ETA: 0600 6/24/17)
- NRC to observe LaSalle inspecting the Unit 1 HPCS injection valve components (ETA: 1100 6/24/17)
- NRR to host Public Meeting with NEI and Flowserve (ETA: 6/29/17)

Key Messages
- The Special Inspection Team exited the Special Inspection on June 9 and communicated that the team has serious concerns with Exelon's operability evaluation for the LaSalle Unit 1 HPCS valve.

- The Agency is striving to be deliberate and timely in our decision-making and open and transparent in our communications with Exelon relative to our underlying questions and concerns, while remaining focused on our regulatory mission of ensuring public health and safety.

- The LaSalle resident inspectors, one of which was an SIT team member, and two additional SIT team members will be at the site over the weekend to observe the HPCS injection valve work and communicate the results to NRC management. Region III will communicate this information to the LIC-504 team.

- The Agency is handling the generic implications of this issue using the LIC-504 process. Key messages from the LIC-504 process include:
  - This is not a new issue. Following a similar valve failure at Browns Ferry in 2012, the industry took steps to address the issue. In light of recent operating experience, including the LaSalle valve failure, both the NRC and industry are taking additional actions to resolve the concern.
  - These valves are widely used in systems of varying safety significance. However, not all Anchor Darling valves are used in a way that makes them susceptible to this type of failure.
  - The NRC has no immediate safety concerns because other diverse and redundant systems could be used to protect the plant if a valve were to fail.

- The NRC plans on holding a public meeting to further discuss the operating experience and industry actions with stakeholders. The NRC will use the information obtained from the public meeting as part of its assessment of the need for additional regulatory actions.

Communication Tools

Tool	Frequency	Lead	Target Audience	Purpose
Daily Note	Following unit shutdown	DRS/EB2	Agency	High level awareness of plant status and pending valve inspection.

Questions and Answers

Question	Answer
1. Does this impact other types of valves?	The valve failure that happened at LaSalle has only been observed on Anchor/Darling double disk gate valves manufactured during a given time period. To date, the NRC has no reason to believe the failure mechanism can occur on valves made by other manufacturers.
2. Does the NRC plan to take any enforcement action at LaSalle?	We are currently evaluating the possibility of issuing design control related enforcement action at LaSalle. As part of the inspection, the SIT identified a design flaw within the valve itself. This was discussed with the vendor, and the vendor (Flowserve) is updating their Part 21 notification to include this design flaw. The SIT was able to identify the design flaw as a result of the failed Unit 2 valve. The ability to detect this design flaw upon initial receipt of the component would be beyond the requirements of a normal owner's acceptance evaluation that the licensees implement.
3. Will the Agency take any enforcement actions on the vendor (Flowserve)?	The Vendor Inspection branch has a previously scheduled inspection expected to occur in the immediate future. As a result of the SIT, the Agency will supplement that inspection with inspectors from the SIT to provide additional insight.
4. Is the Agency going to provide any generic communications on this issue?	Yes. An information notice was issued on June 15, 2017 to highlight the issue to the industry (IN 2017-03, "Anchor Darling Double Disc Gate Valve Wedge Pin and Stem-Disc Separation Failures."). The Generic Communications Branch is currently evaluating the need for additional generic communications (e.g., Bulletin, Generic Letter, etc.)

Question	Answer
5. How is the Agency handling the generic implications of this issue?	The NRC has held several discussions with industry representatives to discuss the generic implications of this issue. In addition, we have entered the NRR process to ensure the generic nature of this issue is understood throughout the appropriate agency offices and a standardized approach is developed to address this issue at other licensee's that may be impacted.

Contacts: Mark Jeffers, DRS
Karla Stoedter, DRP

Communication Plan
June 20, 2017

Goals

This communication plan serves as a reference document as information is discovered as the site chooses to shut down and correct the Unit 1 HPCS injection valve. Significant information, references, observations, and messages should be included in this plan.

Communication Team

The purpose of this section is to identify key stakeholders/organizations that need to be informed of the information related to the LaSalle SIT and pending shutdown.

Office	*Organizations*
Region III	OPA, SLOs, DRS/EB2, DRP/BR1, DRP/TSS/SRA SIT
NRR	DE, DPR, DIRS, DRA, LIC-504 Task Force
OPA	

Timeline

The purpose of this section is to identify major milestones that provide understanding of how we got here and to develop major milestones of upcoming actions.

Previous Milestones

- January 4, 2013. TVA initiates a Part 21 notification as a result of a defect discovered in the HPCI inboard containment isolation valve, which is a 10" Anchor Darling Double Disc Gate Valve (DDGV).
- February 25, 2013. Flowserve submits Part 21 notification to identify that Anchor Darling DDGVs' stems were potentially never completely torqued into the upper wedge prior to installation. This condition in conjunction with high operating torque/thrust on the stem-to-disc connection could lead to wedge pin failure and eventual stem-to-disc separation.
- April 13, 2013. BWROG issue a Topic Report (Rev 0) to generically address the Flowserve/TVA Part 21 notifications and provide recommendations on prioritizing the susceptible valves. Specifically, the guidance recommends licensees evaluate each valve using valve stroke surveillance testing, observation of stem rotation, diagnostic testing, and valve seat leakage as bases for operability.
- April 28, 2016. BWROG revises the Topical Report (Rev 1) to include Operating Experience provided by Duke. Duke was more aggressive in resolving the initial Part 21 notification and disassembled 26 valves susceptible to the Part 21. 24 of the 26 were found with loose stem-to-wedge connections (i.e., no pre-torque) confirming the initial Part 21 issue.
- February 11, 2017. LaSalle Unit 2 HPCS injection valve fails during outage testing.
- April 12, 2017. LaSalle submits LER 50-374/2017-003-00, "High Pressure Core Spray System Inoperable due to Injection Valve Stem-Disc Separation."
- April 14, 2017. MD 8.3 evaluation completed for LaSalle Unit 2 failure.
- April 21, 2017. Charter finalized to perform LaSalle SIT.
- April 24, 2017. SIT begins at LaSalle.
    - April 25, 2017. BWROG Topical Report revised (Rev 2) to include LaSalle Lessons Learned.
    - April 28, 2017. LaSalle vendor (Kalsi Engineering) completes analysis of the Unit 2 HPCS injection valve diagnostic traces. Concludes that the licensee could not have identified that the Unit 2 HPCS injection would have failed based on previous testing.

- May 1, 2017. LaSalle performs an Operability Evaluation (Rev 0) for the other affected Part 21 valves. Specifically, the licensee is crediting the use of stem rotation checks and diagnostic traces to justify operability.
- May 4, 2017. SIT completes review of Operability Evaluation (Rev 0). Identifies discrepancies with the licensee's methodology to justify operability of the Unit 1 HPCS injection valve.
- May 9, 2017. LaSalle vendor (Kalsi Engineering) completes a separate analysis of the Unit 1 HPCS injection valve diagnostic traces. Concludes that the Unit 1 valve diagnostic trace abnormalities are different than the Unit 2 valve trace abnormalities.
- May 10, 2017. LaSalle revises the Operability Evaluation (Rev 1) to include valve history for the Unit 1 HPCS injection valve and include the updated vendor analysis.
- May 12, 2017. SIT completes review of the revised Operability Evaluation (Rev 1), continues to identify discrepancies with the licensee's methodology (b)(5) Deliberative

(b)(5) Deliberative Privilege

- May 18, 2017. BWROG Topic Report revised (also listed as Rev 2) to include LaSalle Lessons Learned.
- May 18, 2017. NRR/DE initiates LIC-504 process to track the generic issue related to the original Part 21 issue.
- May 21, 2017. LaSalle revises the Operability Evaluation (Rev 2) to include Operating Experience provided by Duke and wedge pin analysis performed by LaSalle vendor (Kalsi Engineering).
- May 30, 2017. LaSalle vendor (MPR) completes the Unit 2 HPCS injection valve failure analysis. Confirms a design flaw in the wedge pin collar. Concludes that valves of similar design are susceptible to similar failure mechanism.
- June 2, 2017. Exelon submits letter to Region III committing to additional defense-in-depth actions for the Unit 1 HPCS injection valve.
- June 8, 2017. LaSalle revised the Operability Evaluation (Rev 3) to include Operating Experience provided by Energy Northwest and the MPR failure analysis report.
- June 9, 2017. SIT exits with LaSalle with one apparent violation for the Unit 2 HPCS valve failure and one URI for the remaining outstanding Part 21 valves.

(b)(5) Deliberative Privilege

- June 15, 2017. NRR/DPR issues IN 2017-03, "Anchor Darling Double Disc Gate Valve Wedge Pin and Stem-Disc Separation Failures."
- June 16, 2017. NRR/RIII senior management meet with DEDO to discuss options going forward. Meeting concludes to move down multiple parallel paths (b)(5) Deliberative Privilege

  (b)(5) Deliberative Privilege
- June 19, 2017. Exelon executive contacts RIII to inform the Region of LaSalle's plan to shut down Unit 1 on June 22nd and replace Unit 1 HPCS injection valve internals.

Upcoming Milestones:

- LaSalle submits letter of committed actions (ETA: COB 6/20/17)
- (b)(5) Deliberative Privilege
- LaSalle to shut down Unit 1 (ETA: 2200 6/22/17)
- LaSalle to disassemble Unit 1 HPCS injection valve (ETA: TBD)
- NRR to host Public Meeting with NEI and Flowserve (ETA: 6/29/17)

Key Messages

- The Special Inspection Team exited the Special Inspection on June 9 and communicated that the team has serious concerns with Exelon's operability evaluation for the LaSalle Unit 1 HPCS valve. These concerns include:
  - Stem rotation checks and MOV diagnostic data have not been demonstrated to identify stem degradation. Furthermore, these checks were never intended to demonstrate operability, rather, these were to prioritize when valves should be evaluated/corrected.
  - Initial MOVATS testing identified potential for plastic deformation of the wedge pin in 1987; therefore, valve susceptible to 30 years of thread degradation.
  - Columbia opex identified broken wedge pin and loose threaded connection on the similar valve (HPCS injection valve).
  - The difference in cycles between the Unit 1 valve and the Unit 2 valve is within the margin of error.
  - Thrusts being applied to the Unit 1 valve are sufficient to shear the pin and degrade the threaded connection.
  - Licensee could not benchmark their operability methodology. Specifically, using this methodology on the failed Unit 2 valve, the licensee would have concluded that the valve was operable.
  - Failure analysis performed for the Unit 2 valve identifies a design issue in the valve itself. Therefore, this design flaw and the operating history of the valve will lead to failure. I.e., it is not a question of "if" the valve will fail, but "when" the valve will fail.

- The Agency has received a letter from Exelon outlining their commitments to limit unnecessary work on safety systems that may be relied upon to operate should the HPCS Unit 1 valve fail during an event. Since receipt of the letter, the licensee has gained additional insights from a failure analysis evaluation of the Unit 2 HPCS valve and from the recent Columbia HPCS valve testing and disassembly. It is unclear to the Agency how Exelon has incorporated this new information into the previous commitments or if revisions are necessary.
  - Exelon has verbally committed to shutting down Unit 1 at LaSalle on Thursday June 22nd. It is expected that they will be submitting a new/revised letter outlining their new commitments by June 21st. (b)(5) Deliberative Privilege

    (b)(5) Deliberative Privilege

- The Agency is striving to be deliberate and timely in our decision-making and open and transparent in our communications with Exelon relative to our underlying questions and concerns, while remaining focused on our regulatory mission of ensuring public health and safety.

- The Agency is handling the generic implications of this issue using the LIC 504 process. Key messages from the LIC-504 process include:
  - This is not a new issue. Following a similar valve failure at Browns Ferry in 2012, the industry took steps to address the issue. In light of recent operating experience, including the LaSalle valve failure, both the NRC and industry are taking additional actions to resolve the concern.
  - These valves are widely used in systems of varying safety significance. However, not all Anchor Darling valves are used in a way that makes them susceptible to this type of failure.
  - The NRC has no immediate safety concerns because other diverse and redundant systems could be used to protect the plant if a valve were to fail.
  - The NRC plans on holding a public meeting in early July to further discuss the operating experience and industry actions with stakeholders. The NRC will use the information obtained from the public meeting as part of its assessment of the need for additional regulatory actions.

Communication Tools

Tool	Frequency	Lead	Target Audience	Purpose
Daily Notes	(b)(5) Deliberative Privilege	DRS/EB2	Agency	(b)(5) Deliberative Privilege
Press Release		OPA	Public	

Background

Browns Ferry Issued the original Part 21 following failure of an Anchor Darling Double Disc Gate Valve in January 2013. Shortly following Browns Ferry's Part 21 report, Flowserve (who had been working with Browns Ferry to investigate the failure) issued a separate but related Part 21 in February 2013. Flowserve reported that the failure was due to the shearing of the wedge pin which serves a joint locking function at the threaded interface between the valve stem and upper wedge.

Flowserve determined that the root cause of the wedge pin failure was excessive load on the pin since the stem operating torque exceeded the torque to tighten the stem into the upper wedge before installation of the wedge pin. The additional stem torque produced a load on the wedge pin creating a stress which exceeded the pin shear strength causing failure. The recommended assembly stem torque did not envelope the operating torque of the Browns Ferry application providing the potential for an over load situation and ultimate failure. The operating torque for the Browns Ferry valve was unusually high due to the fast closing time of the actuator and very conservative closing thrust margin.

In response to the Part 21 notifications from Flowserve and TVA, the BWROG issue a Topic Report in April 2013 to generically address the identified issues and provide recommendations on prioritizing the susceptible valves. Specifically, the guidance recommended licensees evaluate each valve using valve stroke surveillance testing, observation of stem rotation, diagnostic testing, and valve seat leakage as bases for operability. Three years later in April 2016, the BWROG revised the Topical Report to include Operating Experience provided by Duke. Duke was more aggressive in resolving the initial Part 21 notification and disassembled 26 valves susceptible to the Part 21. 24 of the 26 were found with loose stem-to-wedge connections (i.e., no pre-torque) confirming the initial Part 21 issue.

On February 11, 2017, the LaSalle Unit 2 HPCS injection valve stem was found to be separated from the upper wedge/disc assembly during a fill and vent activity[1]. Prior to the failure, the site was implementing the guidance from the BWROG Topical Report and the valve had successfully passed a local leak rate test where the valve had cycled successfully several times. Valve disassembly and inspection revealed the wedge pin had sheared and the valve stem threads were damaged. Following the identification of the separation, the licensee redesigned and repaired the failed Unit 2 HPCS Injection valve. The Unit 2 HPCS valve failure prompted the Region to perform a MD 8.3 evaluation which ultimately led to the SIT.

[1] See LER 50-374/2017-003-00, "High Pressure Core Spray System Inoperable due to Injection Valve Stem-Disc Separation" (ADAMS ML17102B424).

Questions and Answers

Question	Answer
1. Would the Unit 1 HPCS system operate if it was called upon today?	
2. Why is the Agency allowing continued operation of LaSalle Unit 1?	
3. Can FLEX equipment be used to mitigate failure?	
4. Does this impact other types of valves?	
5. Why did it take so long for the NRC to initiate the SIT after the Unit 2 valve was identified to fail?	
6. Why did the NRC take no actions following the initial Part 21 notifications from TVA/Flowserve?	
7. Will the Agency take any enforcement actions on the vendor (Flowserve)?	
8. How could the SIT conclude that no performance deficiency existed at LaSalle? They operated for ~ 2 years with an inoperable HPCS injection valve and no regulatory actions are being recommended?	
9. Did the Agency endorse the BWROG Topical Report for addressing the Part 21 notifications?	
10. Is the Agency going to provide any generic communications on this issue?	
11. How is the Agency handling the generic implications of this issue?	
12. From the timeline, it appears that the licensee knew about the wedge pin being broken since 1987. Why was this never reported?	
13. Why did it take the SIT 7 weeks to conclude the site lacked reasonable assurance of operability?	

Contacts: Mark Jeffers, DRS
Karla Stoedter, DRP

Agency Mission Meeting
June 28, 2017

OEDO

Non-Responsive Record

ADM

Non-Responsive Record

NRO

Non-Responsive Record

NRR

- Public meeting tomorrow on Anchor-Darling valve operating experience.

Non-Responsive Record

NSIR

Non-Responsive Record

OCFO

Non-Responsive Record

OCIO

Non-Responsive Record

OE

Non-Responsive Record

OGC

Non-Responsive Record

RES

Non-Responsive Record

RI

Non-Responsive Record

RIII

- LaSalle Unit 1 status was provided.

Non-Responsive Record

RIV

Non-Responsive Record

SBCR

Non-Responsive Record

ACRS

Non-Responsive Record

Non-Responsive Record