FLOWSERVE

Flowserve Corporation
Anchor/Darling Valves
Edward Valves

June 11, 2024

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555-0001

Subject: 10 CFR Part 21 Report – ½" 1878 Piston Check Valve with adjustable cracking pressure SN: 96CEE at Duke, Catawba Flowserve Evaluation #113

Flowserve Corporation hereby submits the enclosed written notification of the identification of a defect, in accordance with the requirements of 10 CFR 21.21(d)(3). This notification pertains to the failure of the ½" 1878 Piston Check Valve SN: 96CEE at Duke, Catawba.
Additional valve information:
Piston Check Valve UTC# 0197089
Flowserve Part Number: 04002441(130505003)
Catalog Identification Number: 0000881121
Reference Drawings 05-35947-01 & 12-69520-01

Sincerely,

Aaron G. Goodbar
Nuclear Quality Assurance Manager
Flowserve Corp, Flow Control Division
1900 S. Saunders St.
Raleigh, NC 27603

Enclosures:

1. Plants / customers potentially impacted
2. Reportable condition per 21.21(d)
3. Description of Evaluation

cc:
Hylton Kipe – Director, Flowserve Plant Manager
Matt Hobbs – Flowserve Engineering Manager
Chuck Dowd – Director, Global Sales

✓	RC	Reportable Condition
	NC	Not Capable (§21.21(b))

Enclosure 1:

List of Plants / Customers potentially Impacted:

- Duke – Catawba

Enclosure 2: Reportable Condition per 21.21(d)

10 CFR 21 REPORT

½" 1878 Piston Check Valve with adjustable cracking pressure SN: 96CEE at Duke, Catawba

1. **Name and address of the individual or individuals informing the Commission**

   Aaron G. Goodbar
   Nuclear Quality Assurance Manager
   Flowserve Corp, Flow Control Division
   1900 S. Saunders St.
   Raleigh, NC 27603

2. **Identification of the facility, the activity, or the basic component supplied for such facility or such activity within the United States which contains a defect or noncompliance.**

   Duke Energy Carolinas, LLC (Duke Energy)
   Catawba Nuclear Station

3. **Identification of the firm construction the facility or supplying the basic component which fails to comply or contains a defect**

   Flowserve Corp, Flow Control Division
   1900 S. Saunders St.
   Raleigh, NC 27603

4. **Nature of the defect or failure to comply and the safety hazard to which is created or could be created by such defect or failure to comply.**

   The piston check valve with adjustable cracking pressure received by Duke Energy failed bench test performance for designed cracking pressure with an allowable range of 180 – 220 psig . The valve is used to provide overpressure protection of containment penetration piping due to thermal expansion of fluid trapped between the containment isolation valves when the valves are closed, the valves are required to crack open before the maximum 220 psig setpoint to perform this function.

5. **The date on which the information of such defect or failure to comply was obtained.**

   Flowserve was initially notified on April 23, 2024. Flowserve provided an acceptance response and notice of volunteer to perform evaluation within 45 days upon receipt of the check valve to Duke on April 24, 2024. Flowserve received the valve for evaluation on May 1, 2024. Flowserve provided an initial evaluation response letter on May 8, 2024. Flowserve provided an evaluation summary (see Enclosure 3 of this report) on June 7, 2024.

6. **In the case of a basic component which contains a defect or failure to comply, the number and location of these components in use at, supplied for, being supplied for, or may be supplied for, manufactured, or being manufactured for one or more facilities or activities subject to the regulations in this part.**

   Flowserve confirms that the piston check valves with adjustable cracking pressure has been provided to one (1) domestic nuclear plant with a known list contained within Enclosure 1 of this report.

7. **The corrective action, which has been, is being, or will be taken; the name of the individual or organization responsible for the action; and length of time that has been or will be taken to complete the action.**

   See Enclosure 3 of this report. Flowserve has already initiated internal CAR (202404-99375) to: (1) revise/create additional assembly and test procedure for the Model 1878 piston check valve to add more specific instructions for testing before and after the lock weld has been applied to verify the valve cracking pressure is properly set and tested, and (2) provide training to assembly and test personnel on the importance of ensuring that the appropriate settings are correct and adequately tested.

   These actions will be completed by September 30, 2024.

8. **Any advice related to the defect or failure to comply about the facility, activity, or basic component that has been, is being, or will be given to purchasers or licensees.**

   Nuclear power plants with model 1878 piston check valves with adjustable cracking pressure that have not undergone acceptance testing should verify that these suspect piston check valves will perform at designed cracking pressure when tested.

9. In the case of an early site permit, the entities to whom an early site permit was transferred.

Not applicable.

Flow Control Division
Anchor/Darling Valves
BW/IP Valves
Edward Valves
Valtek Control Products
Worcester Valves

Enclosure 3: Description of Evaluation

5-June-2024

Customer: Duke Energy

Subject: Drawing 12-69520-01, Cracking Pressure Evaluation, RMA SO 141990

Overview:

Valve S/N: 96CEE, supplied on sales order 130505, built in 2021, was returned to Flowserve after Duke observed a cracking pressure of 310 and 360 psig during bench testing, prior to a planned installation. The valve has a design requirement, cracking pressure range of 180-220 psig.

Evaluation:

The valves were received with the seal welds on the bonnet cap cut.

There was evidence that a lock weld had been placed on the adjustment screw that was removed and replaced.

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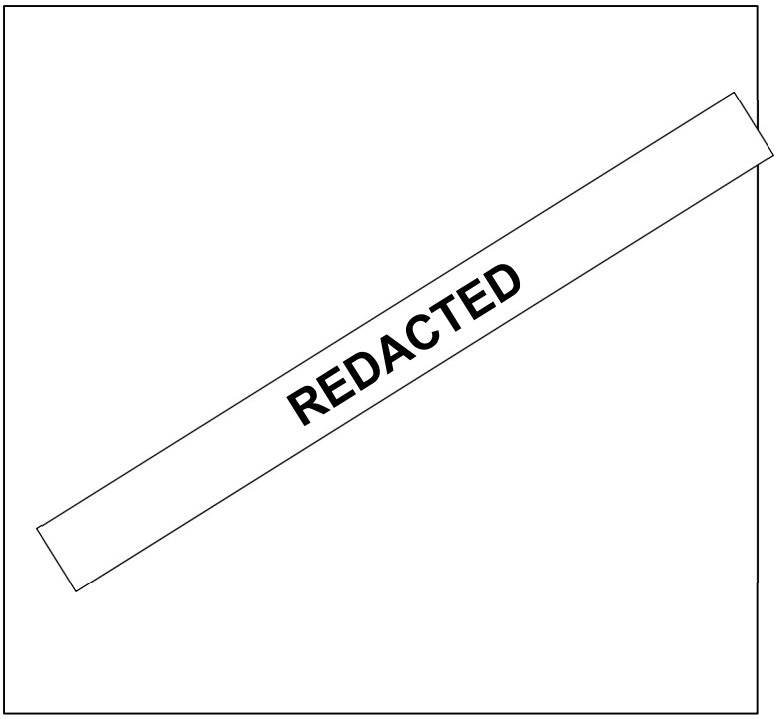
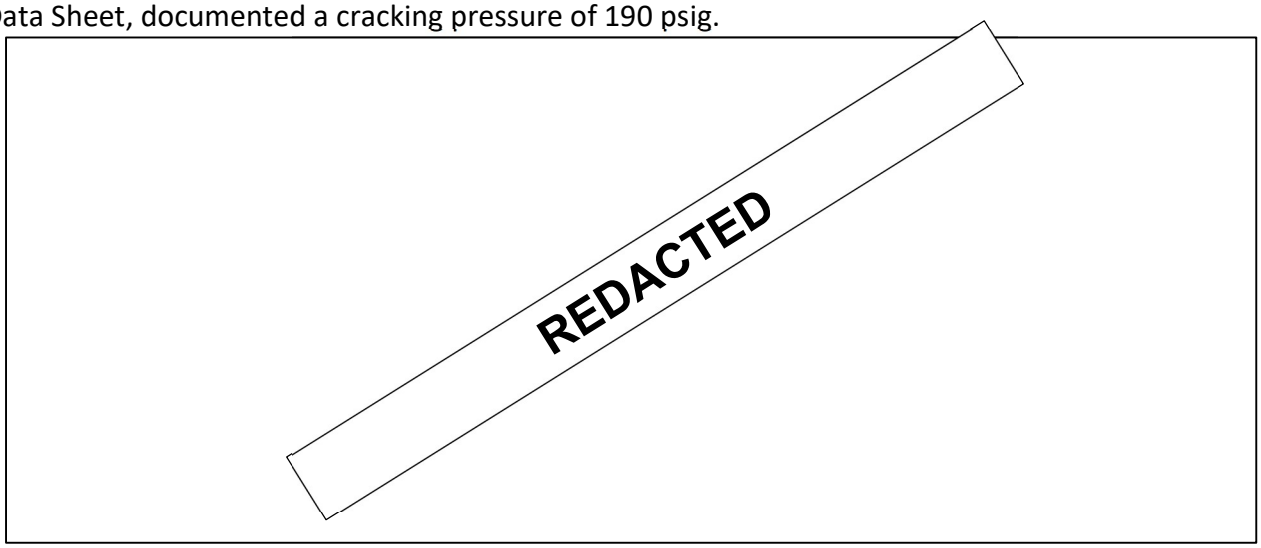
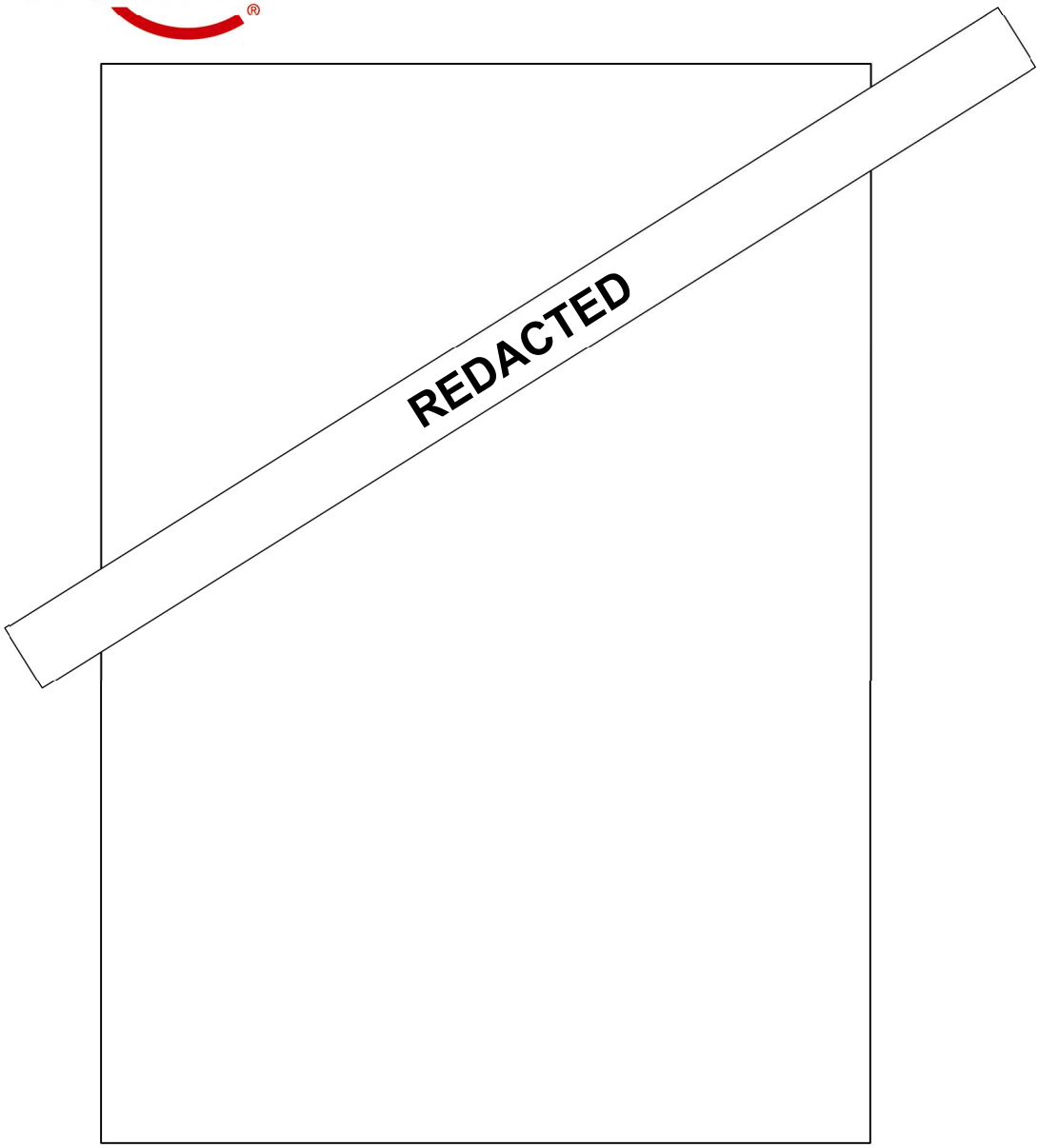


Review of manufacturing records indicated that a lock weld was removed and replaced during the assembly and test operation during sales order 130505. The sales order 130505 Hydro and Test Data Sheet, documented a cracking pressure of 190 psig.

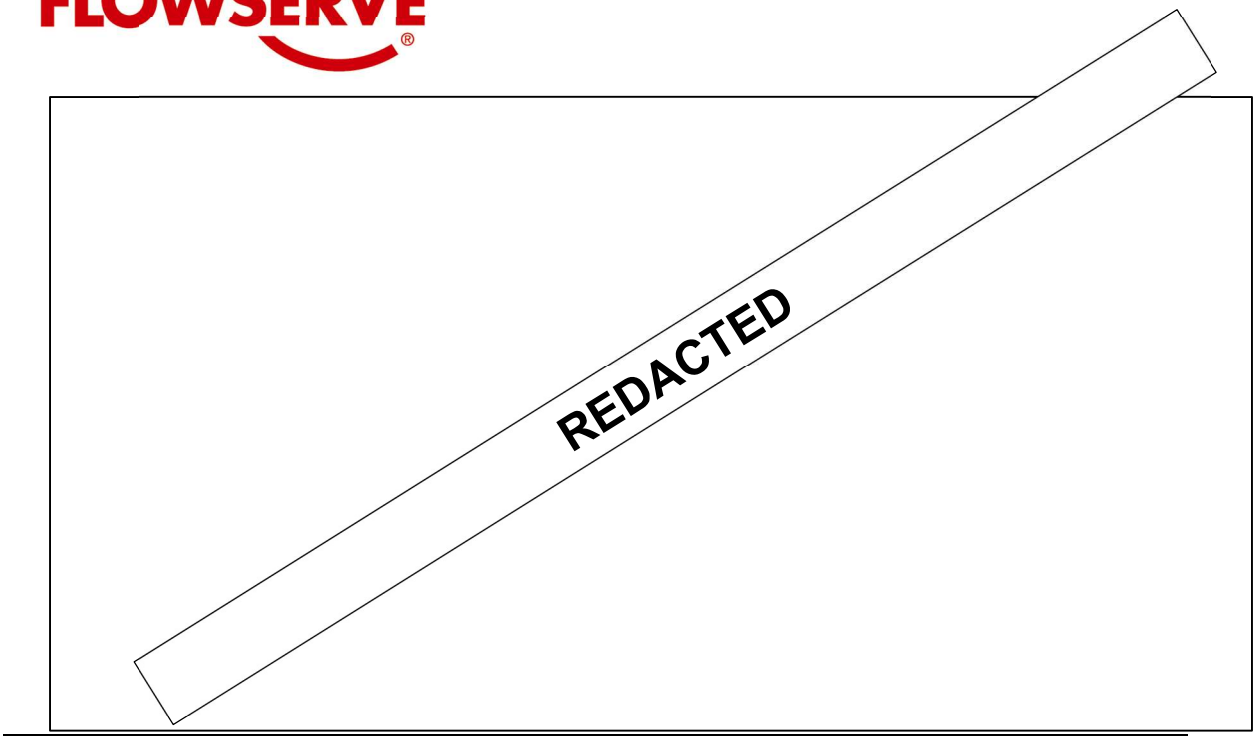


The valve was disassembled to evaluate the internal components. It was noted that the disc had some scale around the lower OD and at the seat contact area. The OD was consistent at 1.119-1.120 inches all with the drawing tolerances. The disc OD and body bore has a tight fit, with a design clearance of .005-.011 inches, this is the former product line standard, which had been increased to .008-.014 inches in 2003 due to a reported instance that had particulate trapped. This design was kept at the .005-.011 clearance due to the buckling potential of the long, high strength spring. It was not believed that the scale, fit or any foreign material was to cause any sticking which would increase the cracking pressure.

The internal components were measured to determine a calculated cracking pressure based on the compressed spring force in the as-assembled condition. Some measurements were difficult to take due to the ground conditions on the body and bonnet cap so a range may be recorded and should be considered estimates but are acceptable for estimating the spring force and expected cracking pressure. The figure below documents the measurements taken or calculated, all measurement taken on the components appeared to be within the drawing tolerances.



The position of the adjustment screw and dimensions taken of the internals estimated the spring was deflected 1.576-1.596 inches in the closed position (4.684-4.704 working height). An estimate was also made for the spring compression by stacking the components together prior to compressing the spring, shown in the picture below, this estimate was 1.60 inches, confirming the detailed measurements.



The valve was tested in Flowserve's shop to determine a cracking pressure, but a cracking pressure was not able to be determined in the received condition due to increased leaking past the seat as under seat pressure was built-up. A distinction between leakage and cracking could not be determined. Leakage was presumed to be from the observed scale around the seat.

Valve closure and seat leakage test were performed with pressure over the seat in accordance with MS-7259 to quantify the leakage and determine the acceptability of the seat; test pressure could only go up to 1500 psi due to the temporary O-ring seals placed between the body, bonnet cap and cover. A leakage of .1-.2 cc in one minute (vs. a 0167cc original factory acceptance) and 1.2 cc in five minutes (vs .0833 cc) were observed, confirming the bad seat condition.

The body and disk seats were lapped. Valve closure and seat leakage tests were re-performed and zero leakage was observed with 1500 psig of pressure over the seat. The cracking pressure tests were reperformed; cracking was observed at 450-470 psig. The cracking pressure determination was performed with the valve full of water, and applying a pressure source under the seat, pressure was slowing increased until water was seen leaking-by or flowing through the outlet. There was zero leakage observed until the 450-470 psig range was reach, at which point a steady rise of water was observed in the outlet water column. To verify this cracking pressure, the pressure was further increased and the inlet end isolated; after isolation the pressure on the inlet side of the valve dropped and stabilized (held steady) once it reached 450 -470 psig.

Conclusions:

The dimensional estimates for the cracking pressure collude with Duke Energy's observations the cracking pressure is above the 180-220 psi setpoint requirement, and higher than what Duke Energy estimated. Estimates from the dimensional inspection predicted that based on the adjustment screw position, the cracking pressure would be 453-458 psi. After lapping the seats, testing concluded a cracking pressure in the range of 450-470 psi. It cannot be concluded from the engineering evaluation how the valve was documented to have a 190 psi cracking pressure in the hydro test report and returned with a cracking pressure in the range on 450-470 psi.
However it does indicate that additional process guidelines and parameters should be added for process improvement along with more robust training and oversight. Flowserve has already initiated internal CAR (202404-99375) to (1) revise/create additional assembly and test procedure for the Model 1878 piston check valve to add more specific instructions for testing before and after the lock weld has been applied to verify the valve cracking pressure is properly set and tested, and (2) provide training to assembly and test personnel on the importance of ensuring that the appropriate settings are correct and adequately tested.