



# AUTOMATIC VALVE

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**World Class Air Valves and Controls**

Nuclear Regulatory Commission  
 Notification Desk  
 Fax:301-816-5151

12/16/03

Subject: Potential 10 Part 21 Concern

Dear Sir or Madam:

Please find attached Automatic Valves' analysis of a potential 10 CFR Part 21 concern regarding a specific lot of fluorocarbon rubber inserts.

The following plants have components containing the suspect lots as follows.

Nebraska Public Power - Cooper Station:

| Part Number | Purchase Order Number | Date Originally Shipped | Quantity | Serial Numbers    |
|-------------|-----------------------|-------------------------|----------|-------------------|
| 2028123     | 4500026300            | 01/09/2003              | 20       | 63927,64123-64141 |

Exelon:

| Part Number             | Purchase Order Number | Date Originally Shipped | Quantity |
|-------------------------|-----------------------|-------------------------|----------|
| 11472929 (Limerick)     | 90002981              | 03/31/2003              | 3        |
| 11587926 (Peach Bottom) | 9002625               | 02/13/2003              | 8        |
| 22434-1 (Quad Cities)   | 00052264              | 02/19/2003              | 4        |
| 1385449-1 (Dresden)     | 00051141              | 11/26/2002,12/12/2002   | 67       |

Please call if you have any questions or concerns.

Todd Hutchins  
 CEO  
 Automatic Valve

IE19

|                          |                                     |                  |
|--------------------------|-------------------------------------|------------------|
| AUTOMATIC VALVE          | NUMBER: D7174-003                   | PAGE 1 OF 3      |
| TITLE: CORRECTIVE ACTION | LOCN: I:\WORD\DOCUMENT\D7174003.DOC | DATE: 10-21-1999 |
| SUBJ: CORRECTIVE ACTION  | TYPE: FORM                          | DEPT RESP: DQA   |
|                          |                                     | REV: F-CN8020    |

REQUIREMENTS:

|  |  |  |
|--|--|--|
| <b>NUMBER: 19183 Rev "B" All Revision B changes bold Italics</b>   |  |  |
| Type of Problem: <input checked="" type="checkbox"/> Part  | <u>B7122-145</u>                                   | <input type="checkbox"/> Procedure           |
| Who found Problem: <input type="checkbox"/> AV   | <input type="checkbox"/> Supplier                  | <input type="checkbox"/> Distributor         |
|  |  | <input checked="" type="checkbox"/> Customer |
| Company: <u>Exelon - Dresden Plant</u>   | Contact Name: <u>Paul Chenell, Amir Shahkarami</u> |  |
| Address: _____   | Phone: _____                                       | Fax: _____                                   |
| 1. Team Working on Problem: Leader: <u>D.S. Swinton</u> Members: _____<br>Kevin Armstrong. <i>Tom Troy, Yanhua Yang</i>  |  |  |
| 2. Describe Problem (Initial Concern and Symptoms):<br>On 10/16/2003 Paul Chenell of Dresden reported that a B7122-145, serial number 64065 shipped on 12/11/2002, valve failed to exhaust air with both solenoids de-energized causing the CRD valve to remain in the open position.<br><br>On 10/17/2003 the valve was delivered to Automatic Valve by Amir Shahkarami for analysis of the problem.  |  |  |
| 3. Contain Symptom (Action):   |  |  |
| <ol style="list-style-type: none"> <li>1. Re-inspect all existing 6910-001 plungers to verify the correct overall length (<i>Done 10-17-03</i>).</li> <li>2. Rebuild, retest, and return the B7122-145 valves to Dresden (<i>Shipped 11-26-03</i>).</li> <li>3. <i>Notify customers potentially impacted, by Fax, to inspect plunger lengths (10/24/03).</i></li> <li>4. <i>Inspect all units installed at Dresden station (completed 10-30-03, 15 of 274 plungers found out of specification)</i></li> <li>5. <i>Inspect all units installed at Cooper station (completed 10-29-03, 0 of 64 plungers found out of specification)</i></li> <li>6. <i>Hold shipment for all 6910-001 plungers from suspect lot</i></li> </ol> |  |  |
| Approved by: <u>Todd Hutchins</u>  | Title: <u>CEO</u>                                  | Date: <u>12/15/2003</u>                      |

|                          |                                     |                  |
|--------------------------|-------------------------------------|------------------|
| AUTOMATIC VALVE          | NUMBER: D7174-003                   | PAGE 2 OF 3      |
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| SUBJ: CORRECTIVE ACTION  | TYPE: FORM                          | DEPT RESP: DQA   |
|                          |                                     | REV: F-CN8020    |

4. **Root Cause/s of Problem:** **10 CFR Part 21 Report Required: Yes**  
 The valve was first functionally tested in the normal manner – that is at 35 psig low pressure & at 145 psig high pressure. The valve functioned without problems at low pressure but failed to return to its normally closed position at 145 psig when both solenoids were de-energized. Further functional testing revealed that at an inlet pressure of approximately 100 psig the valve would fail to return when de-energized.

When the valve was disassembled, the plunger in the number 2 solenoid, the left hand solenoid when facing the exhaust port, was found to be approximately .020 too long - 1.315" compared to the specified length of 1.290 +.005/-.003. Because the plunger only has a total stroke of less than .030, the natural expansion of the seal material in the plunger, due to a combination of heat and pressure, combined with the out of specification length created a situation where the plunger had no room to move and thus exhaust pilot air when the solenoid was de-energized.

The root cause of the failure is the out of spec plunger. *Procedures require the lengths of all plungers to be inspected prior to use.*

*Analysis of the results of measurement testing revealed an unexpected degree of variation in recorded lengths.*

*Variation was traced to the use of different types of equipment and the inherent difficulty in measuring compressible material with pressure sensitive measurement devices. This may have lead to some units being categorized as in specification initially and out of specification at subsequent inspection. (Refer to corrective action 5.1)*

*Notwithstanding measurement variation, the primary root cause of the observed plunger dimensions is changes to the length of the fluorocarbon insert after it is pressed into the plunger body. This variation is detectable and beyond measurement uncertainty.*

*Dissection of returned plungers revealed abnormal compression set among all plungers which were beyond specification limits and normal compression set among plungers which were within specification limits.*

*Chemical analysis and durometer testing did not show any significant differences in the chemical properties or material hardness of the lot or in previous lots of identical insert material.*

*However, the following results were obtained when plunger insert samples were compressed by 23 % for 24 hours at 230 degrees F:*

| Scenario   | Average Set % | # tested |
|--|---------------|----------|
| Unused insert, suspect lot, visible set, as received,        | 92            | 3        |
| Unused insert, suspect lot, visible set, post cured at 260 F | 11            | 2        |
| Unused insert, previous lot no visible set, as received      | 10            | 3        |
| Unused insert,, suspect lot no visible set, as received      | 9             | 2        |
| Field return insert, suspect lot, visible set                | 36            | 4        |
| Field return insert, suspect lot, no visible set             | 10            | 2        |

*From this we concluded that there is a cure problem with a portion of the suspect lot and that post cure takes place when the solenoid is continuously energized. Based on the test results, we believe that a portion of the lot was not properly post cured.*

*The degree of growth of the plunger insert due to compression set is observed to be variable. This depends on exact dimensions of the molded insert when installed, the ID of the plunger retaining the insert and the exact cure duration variation of the bad plunger inserts*

*The degree of growth also seems to be terminal. Returned plungers (field failure) and other samples from the suspect lot on hand) at Automatic Valve have not changed dimensions during the period of study. Five plungers tested at 200 degrees F for five days exhibited thermal expansion and did not detectably change size when cooled down. Ten plungers subjected to 230 degrees F for ten days exhibited thermal expansion and did not detectably change size when cooled down. (Refer to corrective action 5.2, 5.3)*

|                          |                                     |                  |
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| SUBJ: CORRECTIVE ACTION  | TYPE: FORM                          | DEPT RESP: DQA   |
|                          |                                     | REV: F-CN8020    |

Approved by: Todd Hutchins *TH* Title: CEO Date: 12/15/2003

5. Corrective Action:

5.1) *Specific individual measurement equipment is specified for plunger measurement.*

5.2) *Specific lot definition based on curing process (as opposed to pre-vulcanized rubber lot) to define lot homogeneity for all plunger inserts*

5.3) *A sample of each homogeneous processed sample to be tested for compression set as part of dedication process.*

Test Conducted to Verify It: *Test samples to be placed under worst case temperature and pressure characteristics for a period of 10 months*

Approved by: Todd Hutchins *TH* Title: CEO Date: 12/15/2003

6. Implementation (Describe: Include Applicable CN Numbers):  
*CN 8897 defines lot and compression set and measurement characteristics for 6910-001 plungers..*

Approved by: Todd Hutchins *TH* Title: CEO Date: 12/15/2003

7. Corrective Action to System to Prevent Recurrence:  
 To be determined.

Approved by: Title: CEO Date:

8. Verification (Describe):  
 To be determined.

Approved by: Title: CEO Date:

|                                    |                       |  |       |
|------------------------------------|-----------------------|--|-------|
| General Information or Other (PAR) |                       | Event #  | 40393 |
| Rep Org: AUTOMATIC VALVE           |                       | Notification Date / Time: 12/16/2003 15:01 (EST) |       |
| Supplier: AUTOMATIC VALVE          |                       | Event Date / Time: 12/16/2003 (EST)              |       |
|                                    |                       | Last Modification: 12/16/2003                    |       |
| Region: 3                          | Docket #:             |  |       |
| City:                              | Agreement State: No   |  |       |
| County:                            | License #:            |  |       |
| State: MI                          |                       |  |       |
| NRC Notified by: TODD HUTCHINS     | Notifications:        | THOMAS KOZAK                                     | R3    |
| HQ Ops Officer: GERRY WAIG         |                       | PHIL HARRELL                                     | R4    |
| Emergency Class: NON EMERGENCY     |                       | CHRISTOPHER CAHILL                               | R1    |
| 10 CFR Section:                    |                       | SUSIE BLACK                                      | NRR   |
| 21.21                              | UNSPECIFIED PARAGRAPH |  |       |

#### 10 CFR 21.21 FAILURE OF SOLENOID OPERATED VALVE TO CLOSE AT ELEVATED AIR PRESSURE

The following is taken from a facsimile from Automatic Valve:

"Describe Problem (Initial Concern and Symptoms):

On 10/16/2003 Paul Chenell of Dresden reported that a B7122-145, serial number 64065 shipped on 12/11/2002, valve failed to exhaust air with both solenoids de-energized causing the CRD valve to remain in the open position.

"On 10/17/2003 the valve was delivered to Automatic Valve for analysis of the problem. Contain Symptom (Action): Re-inspect all existing 6910-001 plungers to verify the correct overall length (Done 10-17-03). Rebuild, retest, and return the B7122-145 valves to Dresden (Shipped 11-26-03).

Notify customers potentially impacted, by Fax, to inspect plunger lengths (10/24/03).

Inspect all units installed at Dresden station (completed 10-30-03, 15 of 274 plungers found out of specification)

Inspect all units installed at Cooper station (completed 10-29-03, 0 of 64 plungers found out of specification)

Hold shipment for all 6910-001 plungers from suspect lot.

"Root Cause/s of Problem: 10 CFR Part 21 Report Required: Yes

The valve was first functionally tested in the normal manner- that is at 35 psig low pressure & at 145 psig high pressure. The valve functioned without problems at low pressure but failed to return to its normally closed position at 145 psig when both solenoids were de-energized. Further functional testing revealed that at an inlet pressure of approximately 100 psig the valve would fail to return when de-energized.

"When the valve was disassembled, the plunger in the number 2 solenoid, the left hand solenoid when facing the exhaust port, was found to be approximately .020 too long - 1.315" compared to the specified length of 1.290 +.005/- .003. Because the plunger only has a total stroke of less than .030, the natural expansion of the seal material in the plunger, due to a combination of heat and pressure, combined with the out of specification length created a situation where the plunger had no room to move and thus exhaust pilot air when the solenoid was deenergized.

General Information or Other (PAR)

Event # 40393

"The root cause of the failure is the out of spec plunger. Procedures require the lengths of all plungers to be inspected prior to use.

"Analysis of the results of measurement testing revealed an unexpected degree of variation in recorded lengths. Variation was traced to the use of different types of equipment and the inherent difficulty in measuring compressible material with pressure sensitive measurement devices. This may have led to some units being categorized as in specification initially and out of specification at subsequent inspection. (Refer to corrective action 5.1).

"Notwithstanding measurement variation, the primary root cause of the observed plunger dimensions is changes to the length of the fluorocarbon insert after it is pressed into the plunger body. This variation is detectable and beyond measurement uncertainty.

"Dissection of returned plungers revealed abnormal compression set among all plungers which were beyond specification limits and normal compression set among plungers which were within specification limits.

"Chemical analysis and durometer testing did not show any significant differences in the chemical properties or material hardness of the lot or in previous lots of identical insert material.

"However, the following results were obtained when plunger insert samples were compressed by 23 for 24 hours at 230 degrees F:

"Scenario [Average Set %, # tested]  
Unused insert, suspect lot, visible set, as received [92%, 3]  
Unused insert, suspect lot, visible set, post cured at 260 F [11%, 2]  
Unused insert, previous lot no visible set, as received [10%, 3]  
Unused insert, suspect lot no visible set, as received [9%, 2]  
Field return Insert, suspect lot, visible set [36%, 4]  
Field return Insert, suspect lot, no visible set [10%, 2]

"From this we concluded that there is a cure problem with a portion of the suspect lot and that post cure takes place when the solenoid is continuously energized. Based on the test results, we believe that a portion of the lot was not properly post cured.

"The degree of growth of the plunger insert due to compression set is observed to be variable. This depends on exact dimensions of the molded insert when installed, the ID of the plunger retaining the insert and the exact cure duration variation of the bad plunger inserts.

"The degree of growth also seems to be terminal. Returned plungers (field failure) and other samples from the suspect lot on hand) at Automatic Valve have not changed dimensions during the period of study. Five plungers tested at 200 degrees F for five days exhibited thermal expansion and did not detectably change size when cooled down. Ten plungers subjected to 230 degrees F for ten days exhibited thermal expansion and did not detectably change size when cooled down. (Refer to corrective action 5.2, 5.3)

5. Corrective Action:

- 5.1) Specific individual measurement equipment is specified for plunger measurement.
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- 5.3) A sample of each homogeneous processed sample to be tested for compression set as part of dedication process.

Test Conducted to Verify It: Test samples to be placed under worst case temperature and pressure characteristics for a period of 10 months.

General Information or Other (PAR)

Event # 40393

"6. Implementation (Describe: Include Applicable CN Numbers):

CN 8897 defines lot and compression set and measurement characteristics for 6910-001 plungers..

"7. Corrective Action to System to Prevent Recurrence: To be determined.

"The following plants have components containing the suspected lots as follows:

Nebraska Public Power - Cooper Station  
Exelon - Limerick, Peach Bottom, Quad Cities, Dresden"

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