Part 21 (PAR) Event # 50900

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| **Rep Org:** CURTISS WRIGHT FLOW CONTROL CO. | | **Notification Date / Time:** 03/17/2015 09:59 | (EDT) |
| **Supplier:** CURTISS WRIGHT FLOW CONTROL CO. | | **Event Date / Time:** 03/17/2015 | (EDT) |
| | | **Last Modification:** 05/01/2015 | |
| **Region:** 1 | **Docket #:** | | |
| **City:** EAST FARMINGDALE | **Agreement State:** | Yes | |
| **County:** | **License #:** | | |
| **State:** NY | | | |
| **NRC Notified by:** JOHN DeBONIS | **Notifications:** | GLENN DENTEL | R1DO |
| **HQ Ops Officer:** STEVE SANDIN | | BINOY DESAI | R2DO |
| **Emergency Class:** NON EMERGENCY | | PART 21/50.55 REACTORS | EMAIL |
| **10 CFR Section:** | | | |
| 21.21(a)(2) INTERIM EVAL OF DEVIATION | | | |

INTERIM PART 21 REPORT - POTENTIAL TEST INDUCED DEFECT IN A 0867F MAIN STEAM SAFETY RELIEF VALVES

The following report was received from Curtiss - Wright via email:

"This letter provides interim notification of a potential test induced defect in a 0867F Series Main Steam Safety Relief Valves (MS-SRVs) manufactured and supplied by Target Rock (TR). The information required for this notification is provided below:

"(i) Name and address of the individual or individuals informing the Commission.

William Brunet
Director of Quality Assurance
James White
General Manager
Target Rock, Business Unit of Curtiss-Wright Flow Control Corporation
1966E Broadhollow Road
East Farmingdale, NY 11735

"(ii) Identification of the basic component supplied for such facility or such activity within the United States which may fail to comply or contains a potential defect.

Target Rock 0867F Series of Main Steam-Safety Relief Valves Manufactured by Target Rock. This is a 3-stage piloted valve consisting of a main valve (the 'Main') with an actuator mounted to it (the 'Topworks'). The 0867F is the latest generation of the 67F line of MS-SRVs, including the original 3-Stage and 2-Stage designs, and this

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product line has over 40 years of plant operational experience. Only the 0867F is under investigation. This is due to the differences between the 0867F design and the other designs.

"(iii) Identification of the firm supplying the basic component which fails to comply or contains a defect.

Target Rock, Business Unit of Curtiss-Wright Flow Control Corporation
1966E Broadhollow Road
East Farmingdale, NY 11735

"(iv) Nature of the defect or failure to comply and the safety hazard which is created or could be created by such defect or failure to comply.

As we understand it, the Pilgrim Station recently manually opened the Target Rock Main Steam Safety Relief Valves (MS-SRVs) as part of cooling down the reactor following a loss of offsite power. One of the four installed MS-SRVs may not have fully opened. As-found steam testing of the affected MS-SRV did not duplicate this failure; the valve opened on demand. However, the valve did not re-close as expected. Internal inspections found damaged parts in the main stage subassembly that could potentially affect the ability of the MS-SRV to operate as designed.

We are investigating potential root causes for this damage. However, we are still unable to determine if a specific defect exists. GE SIL-196, Supplement 17 determined Main Spring relaxation was caused by 'extreme dynamics encountered during limited flow testing . Valve dynamics under full flow conditions (i.e. discharge not gagged) are much less severe than those under limited flow conditions.' These extreme dynamics, under limited flow test conditions, are the focus of our investigation. Specific areas of investigation include;

a) Testing of materials to verify they are consistent with our material specifications,
b) evaluation of differences between the 0867F and earlier designs, and
c) evaluation of the differences between different limited flow test loop configurations and test procedures

"(v) The date on which the information of such defect or failure to comply was obtained.

The Pilgrim event occurred on January 27, 2015. As-found testing occurred on February 2, 2015.

"(vi) In the case of a basic component which contains a defect or fails 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.

While we have yet to determine if a specific defect exists, the following plants were supplied 0867F MS-SRVs:

- Pilgrim (Model 09J-001) Quantity Shipped = 8
- Fitzpatrick (Model 09H-001) Quantity Shipped = 4, Quantity on order= 8
- Hatch 1 and 2 (Model 09G-001) Quantity Shipped= 24, Quantity on order= 12

The following plants will be supplied 0867F MS-SRVs:

- Hope Creek (Models 14J-001, 14J-002) Quantity on order = 7

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

The root cause of the potential test induced defect has not yet been confirmed as of the date of this report. Therefore, no specific corrective actions have been initiated. Target Rock Problem Report 080 will document the corrective actions when they are determined and complete the 10 CFR Part 21 evaluation of the potential test induced defect. This determination will be based on further mechanical and material evaluations. TR anticipates completing these evaluations within 45 days; however, in the event the evaluations are not completed, TR will forward another interim report within 45 days.

"(viii) 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.

We are working with all three (4) sites to identify appropriate precautions.

"(ix) In the case of an early site permit, the entities to whom an early site permit was transferred.

Not applicable.

"Should you have any questions regarding this matter, please contact Michael Cinque, Director of Program Management at (631 ) 293-3800."

* * * UPDATE FROM JOHN DeBONIS (VIA EMAIL) TO HOWIE CROUCH AT 1355 EDT ON 5/1/15 * * *

Curtiss-Wright provided an update to state that their root cause analysis is still in progress and they anticipate completion within 60 days.

Notified NRR Part 21 Group (via email), R1DO (Gray), and R2DO (Ehrhardt).

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CURTISS-WRIGHT

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NID#15308
May 1, 2015

**Attn: Document Control Desk**
**U.S. Nuclear Regulatory Commission**
Washington, D.C. 20555-001

Subject: 10 CFR Part 21 Interim Report
Updated Notification of a Potential for Test Induced Damage
**0867F Series Main Steam Safety Relief Valves**

Dear Sir or Madam:

This letter provides an updated interim notification of a potential for test induced damage in 0867F Series Main Steam Safety Relief Valves (MS-SRVs) manufactured and supplied by Target Rock (TR) that could impact its ability to function as designed. The information required for this notification is provided below:

*(i) Name and address of the individual or individuals informing the Commission.*

William Brunet
Director of Quality Assurance

Michael Cinque
General Manager

Target Rock, Business Unit of Curtiss-Wright Flow Control Corporation
1966E Broadhollow Road
East Farmingdale, NY 11735

*(ii) Identification of the basic component supplied for such facility or such activity within the United States which may fail to comply or contains a potential defect.*

Target Rock 0867F Series Main Steam-Safety Relief Valves Manufactured by Target Rock.

This is a 3-stage piloted valve consisting of a main valve (the "Main") with an actuator mounted to it (the "Topworks"). The 0867F is the latest generation of the 67F line of MS-SRVs, including; the original 3-Stage (73/7467F), the vertical discharge 3-Stage (9867F), and the 2-Stage (7567F) designs. This product line has over 40 years of plant operational experience. TR reviewed all designs and has determined this notification only applies to the 0867F valves due to differences between the 0867F design and the other designs.

*(iii) Identification of the firm supplying the basic component which fails to comply or contains a defect.*

Target Rock, Business Unit of Curtiss-Wright Flow Control Corporation
1966E Broadhollow Road
East Farmingdale, NY 11735

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

As we understand it, in January 2015, the Pilgrim Station manually opened Target Rock 0867F Main Steam Safety Relief Valves (MS-SRVs) during reactor cool down, following a loss of offsite power. One of the four installed 0867F MS-SRVs may not have fully opened (S/N 9). As-found steam testing of the affected MS-SRV did not duplicate this failure; the valve opened on demand. However, the valve did not re-close as expected.

Internal inspections showed; (a) the main piston was free to "wobble" on the stem, (b) deep fretting damage to the main guide ID, (c) the locking tab was deformed to the point it could no longer perform its intended function, (d) shortened free height of the main spring, and (e) significant deformation of the mating surfaces of both the stem and the piston.

Review of material certifications for Pilgrim S/N 9 components (main disc, main guide, Stellite liners in the main guide, main piston rings, main piston and lock nut) verified these components meet TR specification requirements. In addition, material testing of similar main discs of current and past vintages determined the base material and hardness of the Stellite 6 overlay meet all TR and ASME requirements.

Operational Experience

There are hundreds of Target Rock 67F series MS-SRVs in plant service, some for greater than 40 years. Re-certification requirements of the ASME OM-1 Code result in a significant experience base of inspection and testing. This experience base indicates the observed damage rarely occurs.

We are continuing the search for relevant Operating Experience (OE) and are currently aware of the following:

a) Pilgrim 0867F: Three (3) Pilgrim 0867F main assemblies, identified as S/N 9, 4 and 3, had main guide grooving and fretting wear, as well as damage to main disc threads, piston and piston rings. All of these valves opened under limited flow as-found testing at the set pressure. Additionally, S/N 9 and 4 were manually tested and successfully opened when low pressure (approximately 100 psig) was provided at the valve inlet. None of these valves re-closed during the limited flow test.
b) Hatch 0867F: TR performed disassembly and inspection of three (3) Hatch 0867F main assembles none of which exhibited any fretting nor any apparent damage to the threads or mating shoulders. Only one exhibited de-torqueing and none exhibited de-shouldering (see later discussion).
c) Hatch 7567F: In 2002 a Hatch 2-Stage valve had damage similar to Pilgrim S/N 9 that caused the valve to fail open. This failure resulted in General Electric (GE) Service Information Letter (SIL) 646 which required modifications to the main disc and piston. More recently (2012) a Hatch 2-stage main assembly was observed to have minor fretting of the main guide; the valve opened and closed normally during limited flow as-found testing.

d) Browns Ferry 7567F: TR has been made aware of one 2-stage valve that failed to close at BFN-2. Failure to close was attributed to not having performed GE SIL 646 modifications.

Potential Root Cause

At this time, TR believes the most likely root cause is excessive impact loads during limited flow testing that relieves the torque applied to the piston/stem interface (de-torqueing) that may subsequently lead to creation of a significant clearance between the piston and the main disc (de-shouldering). If the excessive impact load also damages the locking tab, plant vibratory loads can allow the piston to rotate creating/increasing the clearance between it and the stem. If the clearance becomes significant, the piston tilts in its guide bore which can inhibit valve re-closing under certain conditions.

Piston de-torqueing by itself is not sufficient to affect proper valve operation based on the following:

a) Interviews and discussions with test facility personnel and field service technicians verified it is not uncommon for the main piston to be found de-torqued after as-found testing. Forty (40) years of as-found testing further verified a de-torqued condition alone has not resulted in a failure to operate. The table below summarizes available information dating back to 2007 and is considered typical.

| Supplemental Main Disassembly And Inspection | 73/7467F 3-Stage | 7567F 2-Stage | 9867F 3-Stage | 0867F 3-Stage | Total |
|---|---|---|---|---|---|
| # Of Valves Inspected | 11 | 53 | 37 | 5 | 106 |
| # Of Valves With Lock Nut Torqued | 5 | 26 | 34 | 3 | 68 |
| # Of Valves With Piston Torqued | 3 | 18 | 16 | 0 | 37 |
| # Of Valves With Lock Tab Engaged W/ Lock Nut | 11 | 51 | 37 | 5 | 104 |
| # Of Valves With Lock Tab Engaged W/ Piston Recess | 11 | 49 | 37 | 4 | 101 |
| # Of Valves With Stem Shoulder Like New | 11 | 47 | 36 | 4 | 98 |
| # Of Valves With Piston Migrated On Stem | 0 | 1 | 0 | 0 | 1 |
| # Of Valves Failing To Re-Close During As-Found Testing | 0 | 0 | 0 | 0 | 0 |

b) The main disc/main piston connection has a tab washer that locks the piston/disc/jam nut to limit unthreading motion in the event the piston comes de-torqued. The tab washer in Pilgrim S/N 9 main assembly could no longer perform this function.
c) The jam nut is a secondary locking mechanism to prevent piston loosening.
d) The main spring also acts as a resistive load to dampen piston vibration and prevent relative motion between the disc and piston if it has sufficient installed length. However, if the impact loads cause excessive shortening of the spring, this additional protection may not be effective. We believe spring free height needs to be at least 6.3 inches (88 lb nominal preload) to provide the minimum preload necessary to provide this mitigating resistive load. Pilgrim S/N 9 spring free height had been reduced to 5.45 inches (20 lb nominal preload).

TR considers the most likely chain of events which contribute to the discrepant conditions is the following:

1. Limited flow testing imparts impact loads that damage internals. GE SIL-196, Supplement 17 determined Main Spring relaxation was caused by "extreme dynamics encountered during limited flow testing.... Valve dynamics under full flow conditions (i.e. discharge not gagged) are much less severe than those under limited flow conditions."
2. When the impact load is greater than the local yield strength, the preload on the joint is removed by slight plastic deformation. Relief of preload is acceptable.
3. If the impact load is excessive it may deliver significant plastic deformation of the mating surfaces on piston and/or disc. In this case, the relative motion between the piston and disc may increase. The impact may also be sufficient to permanently deform threads on the piston/and or disc. There was evidence of rolled threads on the Pilgrim S/N 4 and 9 main piston and main disc, indicating an excessive force was applied.
4. Excessive impact load may also cause the tab washer to bend around the jam nut axially so it is no longer staked in the piston slot. With preload removed and the tab washer no longer in the piston slot, flow induced vibration acts on the piston to create/increase the clearance between the piston and stem.
5. In some cases the magnitude of the clearance allows the piston to dither, wearing grooves into the main guide (fretting). The induced vibration load is plant specific.
6. The main spring free length is also decreased due to the velocity attained during opening (reference GE SIL 196, Supplement 17). If the spring free length is shortened to near the installed height of main disc and piston assembly, the spring may not provide adequate load to keep the piston from vibrating.
7. Given the noted discrepancies, the valve may not operate as designed.

Applicability to Other 67F Designs

This potential root cause is limited to the 0867F design provided GE SIL 646 and SIL 196, Supplement 17 modifications have been implemented. There are a number of differences between the 0867F and earlier designs which incrementally reduce their opening velocity, and therefore their impact loads, during limited flow testing.

a) 7567F and 9867F models have a much smaller flow area between the valve inlet and underside of the piston and a large bypass orifice around the piston. These reduce main disc/piston speed.
b) Model 73/7467F has three (3) specific differences from the 0867F that decreases the impact force, including; (a) smaller main throat sizes; (b) shorter stroke; and (c) a filter installed around the main guide which acts to decrease the pressure on the underside of the piston during valve opening.

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

The Pilgrim event occurred on January 27, 2015. As-found testing occurred on February 2, 2015.

*(vi) In the case of a basic component which contains a defect or fails 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.*

While we have yet to determine if a specific test induced defect exists, the following plants were supplied 0867F MS-SRVs:

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- Hope Creek (Models 14J-001, 14J-002) Quantity on order = 7

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

The root cause of the potential test induced damage has not yet been confirmed as of the date of this report. TR has started to collect data to support a potential redesign to address loads generated during limited flow testing. Target Rock Problem Report 080 will document the corrective actions when they are determined and complete the 10 CFR Part 21 evaluation of the potential test induced damage. This final determination will be based on our continuing evaluations. TR anticipates completing these evaluations within 60 days

*(viii) 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.*

We are working with all affected sites to identify appropriate precautions.

TR has identified a mitigating solution to ensure the main assembly is not exposed to damage during as-left testing. TR is developing a test fixture to differentiate between short springs and increased friction in an installed main assembly. TR will continue to work with the utilities as additional information becomes available.

TR has also identified an option to remove the base assembly from the main body after as-left testing to inspect the threaded main disc/main piston connection. If the joint is satisfactory, the valve can be reassembled and retested for main seat leakage and base/body leakage. If the joint is unsatisfactory, the joint can be inspected and re-torqued. This requires removal of the internal subassembly from the main body. The valve can be reassembled and retested for main seat leakage and base/body leakage.

*(ix) In the case of an early site permit, the entities to whom an early site permit was transferred.*

Not applicable.

Should you have any questions regarding this matter, please contact Michael Cinque, General Manager at (631) 293-3800

Very Truly Yours,

Michael Cinque
General Manager
Target Rock, Business Unit of Curtiss-Wright Flow Control Corporation

cc: James White
William Brunet
Steve Pauly
Alex DiMeo
John DeBonis
Ed Bradshaw