

Part 21 (PAR)

Event # 50900

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: 06/30/2015
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).

*** UPDATE FROM JOHN DeBONIS (VIA EMAIL) TO STEVEN VITTO AT 1256 EDT ON 6/30/15 ***

Curtiss-Wright provided an update to state their root cause analysis findings and corrective actions. Corrective actions are estimated to be completed within 12 months.

"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

"Valves Currently Installed

"Target Rock recommends valves currently installed be inspected to ensure the main piston shoulder has contact with the main disc stem shoulder. These inspections should be scheduled based on plant-specific indications of the potential for fretting. These inspections can be performed by removing the base assembly from the main body and physically measuring for shoulder-to-shoulder contact.

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

Notified NRR Part 21 Group (via email), R1DO (Dimitriadis), and R2DO (Suggs).



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NID#15428
June 30, 2015

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

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

Reference: (1) Target Rock Letter NID#15155 to U.S. NRC Document Control Desk,
"Interim Report - Notification of a Potential Test Induced Defect", dated
March 12, 2015
(2) Target Rock Letter NID#15308 to U.S. NRC Document Control Desk,
"Interim Report - Updated Notification of a Potential for Test Induced
Damage", dated May 1, 2015

Dear Sir or Madam:

Target Rock, a business unit of Curtiss-Wright Flow Control Corporation (TR), submitted the Reference (1) and (2) Interim Reports regarding a potential test induced defect in the 0867F Series of Main Steam Safety Relief Valves (MS-SRV). This letter provides an update on our investigation and notification of a test induced defect that could impact the valves' ability to function as designed.

(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 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.

Background

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.

Post (As-found) test internal inspections revealed: (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.

Root Cause

In its root cause evaluation, TR considered all potential causes starting with the adequacy of design in accordance with the specification requirements for the application into which these valves are installed, including, but not limited to manufacturing and sub-contract processes, compliance of installed components with design requirements (materials, material properties, dimensions, test facility set-up and processes, test results etc.). Through these efforts TR concluded the 0867F valve is appropriately designed and manufactured in accordance with the specification requirements.

Although TR's review and analyses concluded the 0867F valves are designed appropriately, these efforts did yield a root cause for the noted valve condition as follows:

TR determined the root cause of main guide fretting due to piston ring wear resulted from excessive impact load during limited flow testing which relieves the torque applied to the piston/stem interface (de-torqueing) leading to the creation of a significant clearance between the piston and the main disc (de-shouldering). This loss of shoulder-to-shoulder contact allows relative motion between the main piston and main disc. If the excessive impact load also damages the jam nut or tab washer and shortens the main spring well below the GE SIL-196 requirement, plant vibratory loads can allow the piston to rotate circumferentially and rock relative to the stem shoulder further increasing the clearance between it and the stem. This action is time dependent - increasing the amount of time the piston is exposed to these conditions will increase the propensity for fretting wear.

The chain of events that lead to fretting of the main guide is given below. Fretting of the main guide was not required to be assumed or considered in the valve design.

1. Limited flow testing imparts impact loads that damage internals on the 0867F design. 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 much greater than the local yield strength, the preload on the joint is not only removed but clearance is established between the disc and piston shoulders. Additional cycles increase the clearance and damage to disc undercut, disc threads and piston shoulder. This is significantly different than the minor local yielding that occurs during normal limited flow cycling for all other 67F designs. These designs allow very little plastic deformation of the disc undercut and no plastic deformation of the piston shoulder and threads. Under this scenario, shoulder to shoulder contact (gaps up to 0.002 inch) is maintained and relief of preload is acceptable.
3. If the impact load is excessive, it may deliver significant plastic deformation of the mating surfaces on the piston and/or disc. The relative motion between the piston and disc will increase. The impact load is 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, in-plant flow induced vibration acts on the piston to increase the clearance between the piston and stem shoulder.
5. 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 near the installed height of main disc and piston assembly, the spring will not provide adequate resistive load to keep the piston from vibrating.
6. In some cases, gaps greater than 0.002 inches may allow the piston to rock on the stem shoulder, wearing grooves into the main guide (fretting). The induced vibration load is plant specific.
7. The fretting wear of the main guide liner also wears the piston rings. The fretting wear can progress to a point where an additional clearance exists between the piston rings and the main guide. This clearance can grow in size such that the effective area of the clearance is on the same order as the effective area of the 2nd stage seat. If this happens, a differential pressure cannot be established across the main piston to provide the opening force. As inlet pressure decreases, this effect will be exacerbated.
8. Given the noted discrepancies, the valve may develop fretting driven by plant-specific conditions (for example vibration/pressure loads) that increase main stage friction during stroking that was not required to be assumed or considered in the valve design.
9. With fretting present, the valve may not operate under all design conditions.

Applicability to Other 67F Designs

This 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 opening velocity, and therefore impact loads, on the earlier designs, 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.

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
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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.

Target Rock Actions estimated to be completed within 12 Months

Target Rock Problem Report 080 has documented the root cause and contributing factors. TR is pursuing an enhanced 0867F design, which will: (a) eliminate actions noted below for valves currently or not yet installed; (b) continue to meet in-service specification requirements; and (c) be better able to mitigate the extreme loads encountered in limited flow testing. As part of this effort, TR will focus, but not limit its efforts on an the main valve subassembly which will potentially include the main body, main disc, main piston, jam nut and locking tab to reduce the impact velocity of the main disc/piston assembly to be on the same order of magnitude as the other valve designs (73/7467F, 7567F and 9867F). The target impact velocity will initially be 2.6 m/s (102 in/s) or slower.

By reducing the impact velocity, the main spring loss of free height will be minimized and the tab washer will remain in place. We also expect modified valves will continue to exhibit de-torquing, consistent with the as-found condition of the other valve designs (73/7467F, 7567F and 9867F), but there will be no de-shouldering which is the required predecessor for fretting. Limited flow and full flow testing will verify the change does not violate any operational specification requirements. Inspections will verify the redesign has not de-shouldered. TR will use a threshold shoulder-to-shoulder gap of 0.002 or less post-test to substantiate the adequacy of the design based on a practical maximum gap requirement that can be measured and still verify the integrity of the joint. The main spring free height should remain above the GE SIL 196, Supplement 17 recommendation of 6.32 inches for at least 30 limited flow cycles.

The current time frame to complete the redesign and qualification testing is expected to be within 12 months. The final configuration will be based on our continuing evaluations.

(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.

Valves Currently Installed

Target Rock recommends valves currently installed be inspected to ensure the main piston shoulder has contact with the main disc stem shoulder. These inspections should be scheduled based on plant-specific indications of the potential for fretting. These inspections can be performed by removing the base assembly from the main body and physically measuring for shoulder-to-shoulder contact. At this time, TR has limited 0867F information with regard to the as-found condition of the piston/main disc shoulder. Of thirteen (13) total main valves inspected, nine (9) were Pilgrim main valves, four (4) were Hatch main valves and zero (0) were FitzPatrick main valves. Four (4) Pilgrim valves had a measurable gap (greater than 0.002 inches). None of the Hatch valves had a measurable gap. Because of the difference in as-found gap measurement, there may be differences between plants that have a significant difference in the potential extent of condition for installed valves. The inspection schedule should be determined by the end user based on the potential for de-shouldering and subsequent in-plant fretting.

To facilitate these inspections TR is developing a test fixture to differentiate between short springs and increased friction in an installed main assembly. The fixture will allow the user to determine the condition of the spring load as a function of valve lift. This fixture may also be an option for As-left testing of the main valve assembly.

Valves Not Yet Installed

For valves that will be certified (As-left test), TR recommends minimizing limited flow cycles and performing additional inspections after the test. These inspections require the base assembly to be removed 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, which requires removal of the internal subassembly from the main body. If the main spring free length is reduced below the GE SIL 196 requirement, the main spring shall be replaced. The valve can be reassembled and retested on steam for main seat leakage and base/body leakage, without the need for cycling the valve again. Provided the valves have satisfactorily passed the post-lifting inspection described above after limited-flow testing, these valves are acceptable for installation in the plant.

(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,

A handwritten signature in black ink, appearing to read 'M. Cinque', with a long horizontal flourish extending to the right.

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