

CPF No. 3-2011-5006H – Keystone Pipeline Corrective Action Order
September 2012 Monthly Report

Executive Summary

In accordance with the Corrective Action Order (CAO) issued by PHMSA on June 3, 2011 and amended on June 28, 2011, TC Oil Pipeline Operations, Inc. (Keystone) submits the following information in a report format.

Remediation Work not completed in Q1 2012 has now been completed at all delivery terminals, fixed speed and VFD stations, and validation vibration tests were completed at all facilities. The status of the remaining remediation work is listed below.

Issue	Status
Bracing of 4" bypass nozzles on pump #4 (fixed speed stations)	Bracing was installed at two out of eight stations. A validation test completed at Severance confirmed the effectiveness of the bracing.
Unit high point vent bracing (VFD stations)	Bracing was improved at all stations. The validation tests were completed at all but 3 stations.
Pig launcher PSV bracing	The pig launcher PSV bracing was improved at Fort Ransom and Steele City. The launchers remain out of service until validation tests are completed.
PT201/PT203 manifold bracing	PT201/PT203 manifold bracing will be installed at four VFD stations and validated through strain tests.
Fort Ransom station drain	The station drain upstream from the PCV was abandoned. Acceptability of the remaining nozzle will be validated through a strain test.
Fort Ransom pig launcher vent nozzle	The pig launcher vent nozzle was braced. The launcher remains out of service until validation testing is completed.
Hartford Delivery Terminal PT manifolds	Four PT manifolds will be replaced with a design not sensitive to vibration
Hartford Delivery Terminal PSV2205 & PSV 2206	Bracing of PSV 2205 and PSV 2206 will be validated through strain tests.
Hartford Delivery Terminal drain	Terminal drain valve and water injection valve downstream from the PCV will be removed and the nozzles closed with blind flanges.
Cushing vibration survey	Cushing vibration survey was partially completed. All vibration readings adjacent to the PCV are lower than 0.1 in/s. No vibration concerns anywhere within the terminal are expected. Another test will be scheduled to collect the missing data.
Patoka Delivery Terminal vibration survey	Patoka vibration survey will be scheduled.

Introduction

Keystone oil pipeline system operates from Hardisty, Alberta to delivery terminals in Wood River and Patoka, Illinois and Cushing, Oklahoma. On May 7, 2011, the system experienced a reportable oil release of approximately 400 barrels at the Ludden, ND pump station. On May 29, 2011, a second reportable oil release of approximately 10 barrels occurred at the Severance, KS pump station.

A Corrective Action Order (June 3, 2011) and subsequent Amended Corrective Action Order (June 28, 2011) were issued to TC Oil Pipeline Operations, Inc (Keystone). A series of Monthly Reports have been submitted beginning in July of 2011 to document Keystone's progress regarding the work undertaken to ensure the reliable operation of the Keystone Pipeline.

The following Monthly Report is submitted per Item 11 of the CAO.

Vibration Remediation Work

Remediation Work not completed in Q1 2012 has been now completed at all delivery terminals, fixed speed and VFD stations and validation vibration tests were completed at all facilities. Vibration measurements of more than 2700 small diameter branch connections and piping attachments were taken in three principal directions at 24 fixed speed and VFD pump stations and three delivery terminals. In total, over 8000 data points have been recorded.

While the work to date indicates that the remedial work has been successful to ensure the safe and reliable operation of the Keystone pipeline, the latest series of validation testing identified opportunities to further improve the long term integrity of the following small diameter branch connections:

1. Unit Discharge MOV Bypass Nozzles

Unit discharge MOV bypass nozzles are located upstream and downstream from the pump discharge motor operated valve (MOV). Based on the results of recent strain testing a decision was made to brace the nozzles on pump #4 at all eight fixed speed stations. To date, the bracing was installed at Severance and Fort Ransom pump stations as shown in Figures 1 and 2. The bracing will be installed at the remaining six stations no later than October 31, 2012. A validation test was completed at Severance pump station to determine the effectiveness of the nozzle bracing. All strain levels were below the screening value of 100 $\mu\epsilon$.



Figure 1: Braced pump #4 discharge MOV bypass nozzles at Severance fixed speed station: upstream from MOV (left) and downstream from MOV (right).



Figure 2: Braced pump #4 discharge MOV bypass nozzles at Fort Ransom fixed speed station: downstream from MOV (top) and upstream from MOV (bottom)

2. Fort Ransom Station Drain Upstream from the PCV

Based on the recent strain and vibration tests, Fort Ransom station drain upstream from the PCV was abandoned by removing the drain valve and closing the drain nozzle with a blind flange. The existing bracing was modified to provide support for the abandoned drain as shown in Figure 3.



Figure 3: Fort Ransom abandoned station drain upstream from the PCV

3. Fort Ransom Pig Launcher Vent Nozzle

As reported in August 2012 monthly report, vibration of the pig launcher vent nozzle at Fort Ransom fixed speed station exceeded the screening value of 1 in/s. The nozzle was braced as shown in Figure 4. The pig launcher will remain isolated from service until a validation vibration test is completed to verify the effectiveness of the nozzle bracing.



Figure 4: Braced pig launcher vent nozzle at Fort Ransom

4. Hartford Delivery Terminal

As reported in August 2012 monthly report, vibration of eight branch connections and attachments at Hartford Delivery Terminal exceeded the screening value of 1 in/s when energy dissipation across the PCV was at the 2000 kW level. Further testing and evaluation determined that six of the attachments require modifications to improve their long term integrity:

- Four PT manifolds PT2201, PT2204, PT2207 and PT2208 upstream and downstream from the PCV will be replaced with manifolds not affected by vibration, as shown in Figure 5.
- The terminal drain and water injection connection downstream from the PCV will be abandoned by removing the valves shown in Figure 6 and closing the nozzles with blind flanges.

In addition, strain test of the braced PSV assembly upstream and downstream from the PCV will be completed to verify the effectiveness of the bracing.



Figure 5: Hartford Delivery Terminal- existing (left) and replacement (right) PT manifolds

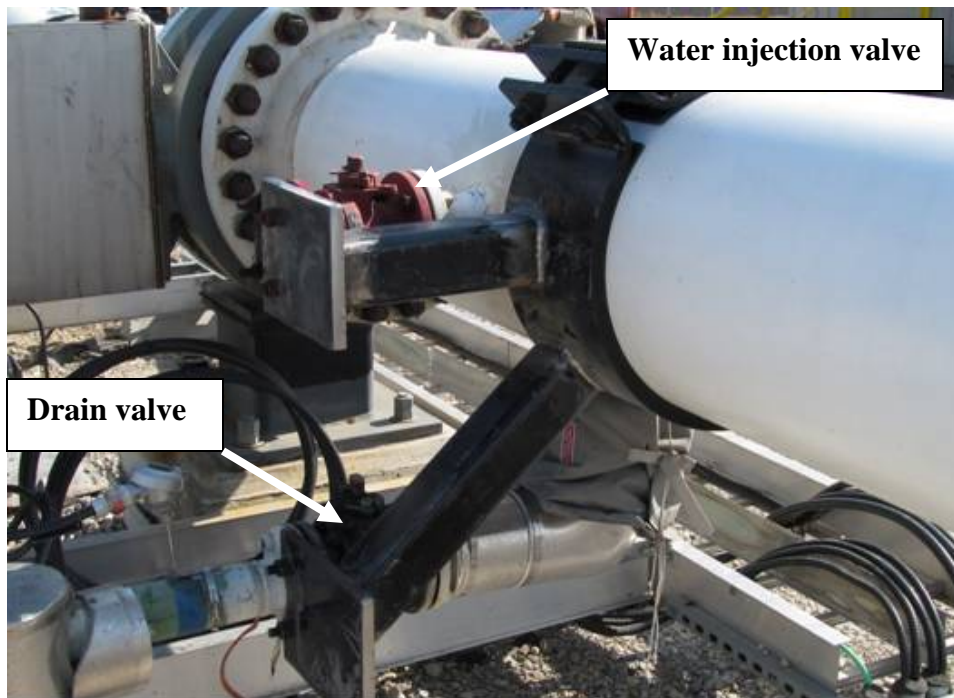


Figure 6 Hartford Delivery Terminal – drain and water injection branch connections

5. Pump #4 Unit Drains at Fixed Speed Stations

As reported in August 2012 monthly report, additional tests of unbraced pump #4 unit drains were planned at selected fixed speed stations to validate their acceptability. Such validation test was completed at Severance fixed speed station. The test determined that all piping strains were below the screening value of 100 $\mu\epsilon$. The Severance test confirmed that bracing of pump #4 unit drains at the fixed speed stations is not required. Previous strain tests at Fort Ransom, Freeman and Ludden fixed speed stations also showed that pump #4 unit drains were acceptable without bracing.

Final Vibration Report

Keystone will continue to report on the progress of additional component modifications, testing and evaluation within the Monthly Report format until such time as all modifications and evaluations have been completed. A final Vibration Report encompassing all final vibration related modifications and the results of testing and evaluation will be submitted after the conclusion of this iterative process.