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Ken Crowl
Manager, U.S. Regulatory Compliance
TransCanada U.S. Pipeline

717 Texas Street
Houston, TX 77002

tel 832.320.5462
fax 832.320.6462
email ken_crowl@transcanada.com
web www.transcanada.com

January 25, 2013

Mr. Patrick Fahn
North Dakota Public Service Commission
600 E. Boulevard, Dept 408
Bismarck, ND 58505-0780

VIA ELECTRONIC DELIVERY AND COURIER

Dear Mr. Fahn:

Please find attached the October, November and December 2012 monthly reports summarizing our submissions to the U.S. Pipeline and Hazardous Materials Safety Administration (PHMSA) for each respective month as required by the Amended Corrective Action Order (CAO) issued June 23, 2011. As requested by Ms. Sacco's May 17th, 2011 e-mail, we are providing documents that do not require FOIA protection.

If you have any questions regarding the enclosed documents, please contact me.

Sincerely,

Ken Crowl

Ken Crowl
Manager, U.S. Regulatory Compliance
TransCanada U.S. Pipelines
717 Texas Street
Houston, TX 77002

770 PU-06-421 Filed: 1/28/2013 Pages: 19
Summary of Oct., Nov., Dec., 2012 monthly report submitted to PHMSA

TransCanada Keystone Pipeline, LP

Ken Crowl, Manager, US Reg. Compliance

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., as agent for TransCanada Keystone Pipeline. LP (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.

As reported in the September 2012 monthly report, the latest series of validation testing identified opportunities to further improve the long term integrity of several small diameter branch connections. Most of the additional scope and validation testing has been completed as summarized in the table below. The remaining scope is targeted to be completed no later than November 30, 2012, with the exception of long term action items for Patoka delivery terminal, as described in Section 9 of this report. An addendum to the final report will be issued once all the remaining work is completed.

Issue	Status
Bracing of 4" bypass nozzles on pump #4 (fixed speed stations only)	Bracing was installed and validation testing was completed at all eight fixed speed stations. One nozzle at Freeman station requires further evaluation to determine acceptability.
Unit high point vent bracing (VFD stations)	Bracing was improved at all stations. The validation tests were completed at all stations. All vibration levels are below the screening value of 1 in/s. ISSUE CLOSED
Pig launcher PSV bracing	The PSV bracing improvement at Fort Ransom was successful. The Steele City pig launcher will remain out of service until additional evaluation of the PSV piping is completed.
PT201/PT203 manifold bracing	PT201/PT203 manifold bracing was installed at four VFD stations. Validation testing was completed and vibration and/or strain levels are acceptable at all stations. ISSUE CLOSED
Fort Ransom station drain	The station drain upstream from the PCV was abandoned. Acceptability of the remaining nozzle was validated through a strain test. Additional steps to improve the long term integrity of this connection are being developed.
Fort Ransom pig launcher vent nozzle	The pig launcher vent nozzle was braced and validation test was completed. All vibration levels are below the screening value of 1 in/s. ISSUE CLOSED.
Hartford Delivery Terminal PT manifolds	Four PT manifolds were replaced with a design not sensitive to vibration. ISSUE CLOSED
Hartford Delivery Terminal PSV2205 & PSV 2206	Validation testing of PSV 2205 and PSV 2206 bracing is scheduled for November 1, 2012.
Hartford Delivery Terminal drain	Terminal drain valve and water injection valve downstream from the PCV were removed and the nozzles were closed with blind flanges. Validation testing is scheduled for November 1, 2012.
Cushing vibration survey	Cushing vibration survey was fully completed. All vibration readings are lower than the screening value of 1 in/s. ISSUE CLOSED
Patoka Delivery Terminal vibration survey	Further steps to improve long term piping integrity at Patoka delivery terminal are being implemented.

Introduction

The 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 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 now been 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.

As reported in the September 2012 monthly report, the remedial work has been successful to ensure the safe and reliable operation of the Keystone pipeline. During the remediation work, additional testing identified opportunities to further improve the long term integrity of the pipeline. The additional scope and validation testing on the following small diameter branch connections is described below:

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 recent strain test results the nozzles on pump #4 at all eight fixed speed stations were braced as shown in Figure 1. Effectiveness of the bracing was verified through a strain test at Severance pump station. The test results were provided in the September 2012 monthly report. In addition, all the MOV bypass nozzles, which prior to bracing showed vibration higher than the screening value of 1 in/s when energy dissipation across the station PCV was at 3000 kW level, were re-tested after bracing. Vibration of all the braced nozzles was below the screening value of 1 in/s, except for the downstream nozzle at Freeman fixed speed station which was measured to be 1.19 in/s. This nozzle will be further evaluated to determine acceptability.

Figure 1: Examples of braced pump #4 discharge MOV bypass nozzles at the fixed speed stations: upstream from MOV (left) and downstream from MOV (right).

2. Unit High Point Vent Bracing at VFD stations

Validation tests of improved unit high point vent bracing were completed at all affected VFD stations. All vibration readings were below the screening value of 1 in/s. Unit high point vent bracing is therefore acceptable at all VFD stations.

3. Pig Launcher PSV Bracing at Fort Ransom and Steele City

Pig launcher PSV bracing was improved at Fort Ransom fixed speed station and Steele City VFD station. The improvements were validated through vibration tests. Vibration levels of the PSV at Fort Ransom were below the screening value of 1 in/s however the PSV outlet and test port valve at Steele City exceeded the screening value. The pig launcher at Steele City will remain out of service until additional evaluation of the PSV piping design is completed.

4. PT201/PT203 manifold bracing

As reported in the September 2012 monthly report, vibration levels of PT201 manifolds at Steele City, Tina, Salisbury and Pierron VFD stations and PT203 at Pierron exceeded the screening value of 1 in/s. These manifolds were braced as shown in Figures 2 and 3. Effectiveness of the bracing was verified through vibration tests at all four stations. In addition, strain test of the PT201 manifold was completed at Steele City VFD station at 2000 kW energy dissipation across the PCV. This manifold was selected for the strain test because it can be exposed to higher levels of vibratory excitation than PT manifolds at other VFD stations (due to higher energy dissipation levels across the PCV occurring at Steele City). All vibration readings of the braced PT manifolds at Tina, Salisbury and Pierron were below the screening value of 1 in/s. Although vibration of the braced PT201 manifold at Steele City exceeded the screening value of 1 in/s, all the strain levels in the critical area shown in Figure 2 were below the screening value of 100 $\mu\varepsilon$. Bracing of the PT201/ and PT203 manifolds was therefore effective in reducing the strains to acceptable levels.

Figure 2: Braced PT201 manifold at Steele City VFD station

Figure 3: Braced PT201 (left) and PT203 (right) manifolds at Pierron VFD station

5. Fort Ransom Station Drain Upstream from the PCV

As reported in the September 2012 monthly report, the 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. A validation test was completed to determine piping strains associated with the remaining drain nozzle. Lower than expected strain reduction was achieved and additional steps are being developed to improve the long term integrity of this connection.

6. Fort Ransom Pig Launcher Vent Nozzle

As reported in the September monthly report, the pig launcher vent nozzle at Fort Ransom was braced to reduce its vibration. A vibration test was completed to validate the effectiveness of the bracing. All the vibration levels were below the screening value of 1 in/s, as summarized in the table below.

Branch connection	Vibration prior to bracing [in/s]	Vibration after bracing [in/s]
Launcher ¾" Vent Valve – X	4.878	**0.465**
Launcher ¾" Vent Valve - Y	0.345	**0.216**
Launcher ¾" Vent Valve - Z	0.952	**0.540**
Launcher 2" Vent Flange - X	2.459	**0.287**
Launcher 2" Vent Flange - Y	0.767	**0.184**
Launcher 2" Vent Flange - Z	0.659	**0.393**

7. Hartford Delivery Terminal

The following additional remediation work was completed at Hartford Delivery Terminal to improve long term piping integrity:

- PT manifolds PT2201, PT2204, PT2207 and PT2208 upstream and downstream from the PCV were replaced with manifolds not sensitive to vibration, as shown in Figure 4.
- The terminal drain and water injection connection downstream from the PCV were abandoned by removing the valves and closing the nozzles with blind flanges. Before and after configurations are shown in Figure 5.
- PSV2205 and PSV2206 bracing was improved to minimize vibration of the PSV assemblies.

Validation testing of the implemented improvements is scheduled to be completed on November 1, 2012.

Figure 4: New PT2201, PT2204, PT2207 and PT2208 manifolds at Hartford Delivery Terminal

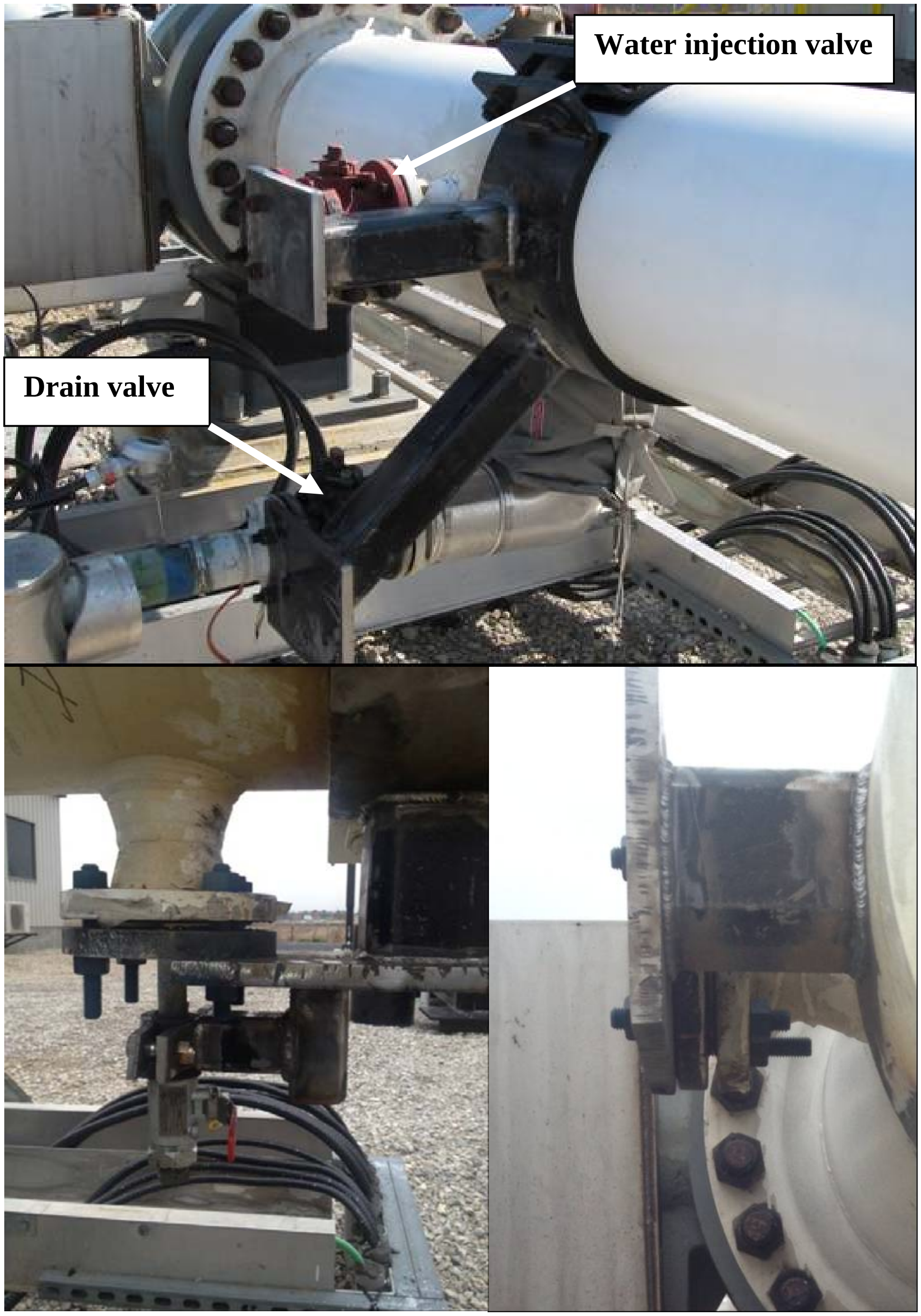

Figure 5: Hartford Delivery Terminal – drain and water injection branch connections: original configuration (top), abandoned drain (bottom left) and abandoned water injection (bottom right)

8. Cushing Delivery Terminal Vibration Survey

A vibration survey of all piping attachments and small diameter branch connections at Cushing delivery terminal was completed. All vibration readings are below the screening value of 1 in/s.

9. Patoka Delivery Terminal

Piping vibration levels in excess of the screening value of 1 in/s were measured during short periods of time at the commencement and/or conclusion of some of the delivery cycles to the Patoka terminal. Accordingly, a four stage program is being implemented to mitigate the piping vibration and ensure facility integrity. The elements and associated timelines are as follows:

1. Replace the terminal inlet pressure control valve (PCV) actuator and tune the PID control loop to minimize pressure oscillations. Install automation on the terminal outlet isolation valve to generate sufficient back pressure to mitigate PCV cavitation. Both actions are scheduled to be completed by the end of October, with testing scheduled for early November.
2. Remove certain small diameter branch connections susceptible to vibratory excitation per the fixed speed station remediation work scope. These modifications are currently scheduled to coincide with a Patoka outage planned for November 26 to 28, 2012.
3. Install a control valve downstream from the PCV as a long term measure to generate sufficient back pressure to mitigate cavitation. This installation will coincide with the first cut-out outage scheduled for the end of January 2013.
4. Replace the primary PCV with a new valve incorporating a low noise trim. Delivery of this valve is in the 24 week range, with installation to follow in a subsequent cut-out outage.

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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.

As reported in the October 2012 monthly report, opportunities to further improve the long term integrity of several small diameter branch connections was identified and most of the additional scope and validation testing has been completed. The current status of the remaining scope is summarized in the table below.

Issue	Status
Bracing of 4” bypass nozzles on pump #4 (fixed speed stations only)	Bracing was installed and validation testing was completed at all eight fixed speed stations. Bracing of one nozzle at Freeman station was further modified to improve its long term integrity. ISSUE CLOSED
Steele City pig launcher PSV bracing	The pig launcher PSV bracing improvement at Steele City was implemented and validated. Piping vibration levels are acceptable. ISSUE CLOSED
Fort Ransom station drain	The station drain upstream from the PCV was permanently removed from service. Bracing of the remaining nozzle will be modified to further improve its long term integrity.
Patoka Delivery Terminal	Short term improvements to ensure piping integrity at Patoka delivery terminal were completed and validated. Piping vibration levels are acceptable. ISSUE CLOSED
Hartford Delivery Terminal	Short term improvements to ensure piping integrity at Hartford delivery terminal will be implemented in December 2012.

Introduction

The 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.

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

Vibration Remediation Work

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 remedial work has been successful to ensure the safe and reliable operation of the Keystone pipeline. Additional testing carried out during the remediation work identified opportunities to further improve the long term integrity of the pipeline. The additional scope and validation testing on the following small diameter branch connections is described below:

1. Unit Discharge MOV Bypass Nozzles

Unit discharge MOV bypass nozzles are located upstream and downstream from the pump discharge motor operated valve (MOV). As reported in the October 2012 monthly report, the nozzles on pump #4 at all eight fixed speed stations were braced and the effectiveness of the bracing was verified through vibration tests at all the stations. Vibration of all the braced nozzles was below the screening value of 1 in/s, except for the downstream nozzle at Freeman fixed speed station which was measured to be 1.19 in/s. The bracing of this nozzle was further reinforced to improve the nozzle long term integrity. Figure 1 shows the original (left) and reinforced (right) bracing. A validation strain and vibration test of the improved bracing was completed at 3000 kW energy dissipation across the station PCV. All vibration levels were below the screening value of 1 in/s and the peak strain was 139 $\mu\varepsilon$. A 3D FEA was used to determine strain amplification between the strain gauge location and the adjacent weld toe. The analysis determined the strain amplification factor to be 3.17, as shown in Figure 2. The resulting peak strain at the weld toe was 441 $\mu\varepsilon$ and the resulting factor of safety for the nozzle was 1.96, based on the material endurance limit of 866 $\mu\varepsilon$. The bracing improvement was effective in reducing the nozzle vibration and strains to acceptable levels.

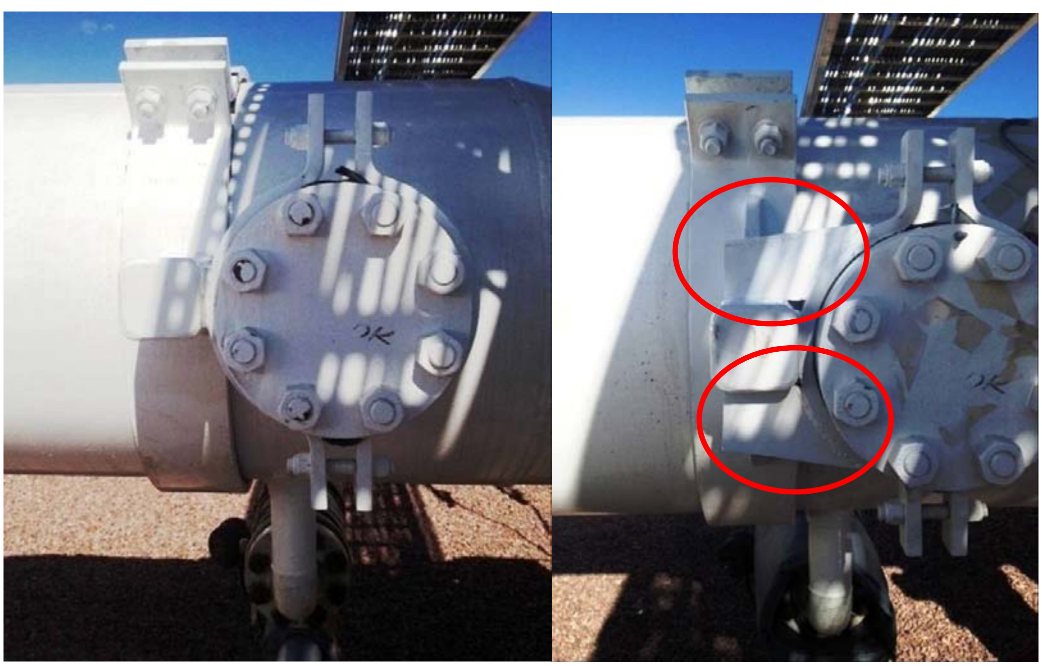


Figure 1: Braced pump #4 discharge MOV bypass nozzle at Freeman fixed speed station: original brace (left) and reinforced brace (right).

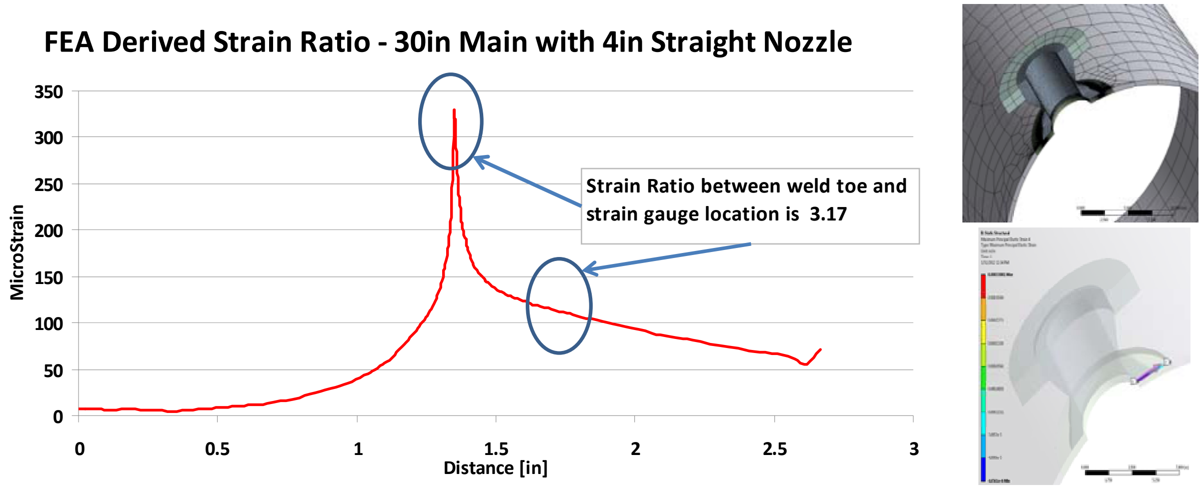


Figure 2: Results of FEA for pump discharge MOV bypass nozzle

2. Pig Launcher PSV Bracing at Steele City

Pig launcher PSV bracing was improved at Steele City VFD station and validated through a vibration test. Piping vibration levels are below the screening value of 1 in/s and are therefore acceptable. Before and after vibration readings are provided in the table below.

Branch connection	Vibration before [in/s]	Vibration after [in/s]
Launcher PSV Outlet 1st Elbow – X	1.001	**0.891**
Launcher PSV Outlet 1st Elbow – Z	1.131	**0.693**
Launcher PSV HP Test Port Valve - Y	1.185	**0.742**
Launcher PSV LP Test Port Valve - Y	1.230	**0.484**

3. Fort Ransom Station Drain Upstream from the PCV

Fort Ransom station drain upstream from the PCV was removed from service by removing the drain valve and closing the drain nozzle with a blind flange. The existing drain brace was modified to match the remaining nozzle. A validation strain test was completed and the factor of safety for the nozzle was determined to be 1.39. Additional bracing modifications will be implemented to improve the long term integrity of this nozzle.

4. Patoka Delivery Terminal

As reported in the October 2012 monthly report, an improvement program is being implemented at Patoka delivery terminal to mitigate piping vibration and to ensure long term integrity of the terminal. Improvements of the terminal inlet pressure control valve (PCV) actuator and tuning of the PID control loop to minimize pressure oscillations have been completed. In addition, the terminal outlet isolation valve was automated to generate a back pressure on the PCV, which reduces peak energy dissipation across the PCV during transients. A vibration test was completed on November 27 to validate the effectiveness of these improvements. All piping vibration levels were below the screening value of 1 in/s, as shown in the attached table. In addition, continuous vibration monitoring of selected attachments exposed to the highest levels of vibratory excitation was used to further validate that no excessive vibration occurred during normal operation.

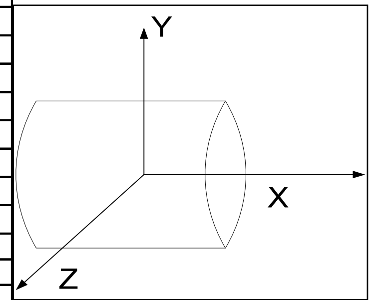
5. Hartford Delivery Terminal

Based on validation tests of the additional remediation work completed at Hartford delivery terminal in October 2012 a decision was made to implement at Hartford an improvement program, similar to the program currently being implemented at Patoka delivery terminal. The program implementation is scheduled to commence in early December 2012.

Q4 Vibration Log - Patoka Delivery Terminal		
STATION NAME:	**PTOKA**	
Date	**November 27 2012**	
Time	11am	
	Units	**Value**
Station flow	m3/hr	**3910**
Station suction temperature	deg C	**32**
Station suction pressure	kPa	**1450**
Station discharge temperature	deg C	
Station discharge pressure	kPa	
PCV inlet pressure	kPa	**1450**
PCV outlet pressure	kPa	**770**
PCV position	%	**57**
Pig Receiver open to flow?	yes/no	**y**
Energy Dissipation	kW	**739**
Location	**Vibration**	**Vibration**
	in/s RMS	in/s RMS*1.414
Pig Barrel - Sample Group 1		
Reciever PSV Flange - X	0.203	0.287
Reciever PSV Flange - Y	0.087	0.123
Reciever PSV Flange - Z	0.193	0.273
Reciever PSV Body - X	0.248	0.351
Reciever PSV Body - Y	0.093	0.132
Reciever PSV Body - Z	0.211	0.298
Reciever PSV 1" Discharge Piping 1st Elbow - X	0.228	0.322
Reciever PSV 1" Discharge Piping 1st Elbow - Y	0.112	0.158
Reciever PSV 1" Discharge Piping 1st Elbow - Z	0.205	0.290
Reciever PSV Bypass Valve Flange - X	0.136	0.192
Reciever PSV Bypass Valve Flange - Y	0.077	0.109
Reciever PSV Bypass Valve Flange - Z	0.148	0.209
Reciever PSV 2" Discharge Piping 1st Elbow - X	0.262	0.371
Reciever PSV 2" Discharge Piping 1st Elbow - Y	0.169	0.239
Reciever PSV 2" Discharge Piping 1st Elbow - Z	0.236	0.334
Reviever PSV Test Port High Pressure Side - X	0.155	0.219
Reviever PSV Test Port High Pressure Side - Y	0.196	0.277
Reviever PSV Test Port High Pressure Side - Z	0.316	0.447
Reviever PSV Test Port Low Pressure Side - X	0.241	0.341
Reviever PSV Test Port Low Pressure Side - Y	0.317	0.448
Reviever PSV Test Port Low Pressure Side - Z	0.189	0.267
Reciever Vent Valve - X	0.150	0.212
Reciever Vent Valve - Y	0.188	0.266
Reciever Vent Valve - Z	0.099	0.140
Reciever 2" Blind Flange - X	0.192	0.272
Reciever 2" Blind Flange - Y	0.127	0.180
Reciever 2" Blind Flange - Z	0.136	0.192
Receiver Drain Valve - X	0.202	0.286
Receiver Drain Valve - Y	0.085	0.120
Receiver Drain Valve - Z	0.135	0.191
Reciever Kickerline Flange Upstream of MOV - X	0.109	0.154
Reciever Kickerline Flange Upstream of MOV - Y	0.093	0.132
Reciever Kickerline Flange Upstream of MOV - Z	0.112	0.158
Reciever Kickerline Elbow Upstream of MOV - X	0.234	0.331
Reciever Kickerline Elbow Upstream of MOV - Y	0.113	0.160
Reciever Kickerline Elbow Upstream of MOV - Z	0.291	0.412
Reciever Kickerline Flange Downstream of MOV - X	0.095	0.134
Reciever Kickerline Flange Downstream of MOV - Y	0.069	0.098
Reciever Kickerline Flange Downstream of MOV - Z	0.112	0.158
Reciever Kickerline Elbow Downstream of MOV - X	0.241	0.341
Reciever Kickerline Elbow Downstream of MOV - Y	0.110	0.156
Reciever Kickerline Elbow Downstream of MOV - Z	0.341	0.482
Reciever Kickerline Drain Valve - X	0.123	0.174

Coordinate System

X	**Large Pipe Axis**
Y	**Vertical**
Z	**Radial or Horizontal**



Reciever Kickerline Drain Valve - Y	0.140	0.198
Reciever Kickerline Drain Valve - Z	0.107	0.151
Piping Upstream of PCV - Sample Group 2		
Terminal Inlet PT-2201 Flange - X	0.137	0.194
Terminal Inlet PT-2201 Flange - Y	0.126	0.178
Terminal Inlet PT-2201 Flange - Z	0.139	0.197
Terminal Inlet PT-2201 Manifold - X	0.207	0.293
Terminal Inlet PT-2201 Manifold - Y	0.148	0.209
Terminal Inlet PT-2201 Manifold - Z	0.171	0.242
Terminal Inlet PT-2204 Flange - X	0.182	0.257
Terminal Inlet PT-2204 Flange - Y	0.355	0.502
Terminal Inlet PT-2204 Flange - Z	0.222	0.314
Terminal Inlet PT-2204 Manifold - X	0.297	0.420
Terminal Inlet PT-2204 Manifold - Y	0.371	0.525
Terminal Inlet PT-2204 Manifold - Z	0.227	0.321
Terminal Inlet TW-2202 Flange - X	0.151	0.214
Terminal Inlet TW-2202 Flange - Y	0.190	0.269
Terminal Inlet TW-2202 Flange - Z	0.315	0.445
Terminal Inlet TT-2201 Flange - X	0.153	0.216
Terminal Inlet TT-2201 Flange - Y	0.222	0.314
Terminal Inlet TT-2201 Flange - Z	0.169	0.239
Terminal Inlet PSV 2752 - X	0.212	0.300
Terminal Inlet PSV 2752 - Y	0.160	0.226
Terminal Inlet PSV 2752 - Z	0.380	0.537
PSV 2752, 1st Elbow on the PSV Discharge Line - X	0.194	0.274
PSV 2752, 1st Elbow on the PSV Discharge Line - Y	0.153	0.216
PSV 2752, 1st Elbow on the PSV Discharge Line - Z	0.384	0.543
PSV 2752 Test Port Tee - X	0.143	0.202
PSV 2752 Test Port Tee - Y	0.186	0.263
PSV 2752 Test Port Tee - Z	0.262	0.371
PSV 2752 Test Port Plug - X	0.197	0.279
PSV 2752 Test Port Plug - Y	0.185	0.262
PSV 2752 Test Port Plug - Z	0.205	0.290
Drain Valve Upstream of PCV - X	0.137	0.194
Drain Valve Upstream of PCV - Y	0.084	0.119
Drain Valve Upstream of PCV - Z	0.180	0.255
Piping Downstream of PCV - Sample Group 3		
PT-2207 Transmitter Flange - X	0.421	0.595
PT-2207 Transmitter Flange - Y	0.273	0.386
PT-2207 Transmitter Flange - Z	0.355	0.502
PT-2207 Transmitter Manifold - X	0.417	0.590
PT-2207 Transmitter Manifold - Y	0.234	0.331
PT-2207 Transmitter Manifold - Z	0.424	0.600
PT-2208 Transmitter Flange - X	0.420	0.594
PT-2208 Transmitter Flange - Y	0.455	0.643
PT-2208 Transmitter Flange - Z	0.289	0.409
PT-2208 Transmitter Manifold - X	0.484	0.684
PT-2208 Transmitter Manifold - Y	0.373	0.528
PT-2208 Transmitter Manifold - Z	0.409	0.578
Drain Valve Downstream of PCV - X	0.326	0.461
Drain Valve Downstream of PCV - Y	0.132	0.187
Drain Valve Downstream of PCV - Z	0.394	0.557
PSV 2209 - X	0.395	0.559
PSV 2209 - Y	0.105	0.148
PSV 2209 - Z	0.330	0.467
PSV 2209 1st Elbow on the PSV Discharge Line - X	0.436	0.617
PSV 2209 1st Elbow on the PSV Discharge Line - Y	0.134	0.190
PSV 2209 1st Elbow on the PSV Discharge Line - Z	0.363	0.513
PSV 2209 Test Port Tee - X	0.293	0.414
PSV 2209 Test Port Tee - Y	0.084	0.119
PSV 2209 Test Port Tee - Z	0.307	0.434

PSV 2209 Test Port Plug - X	0.360	0.509
PSV 2209 Test Port Plug - Y	0.156	0.221
PSV 2209 Test Port Plug - Z	0.287	0.406
3" Horizontal Water Injection Valve - X	0.222	0.314
3" HorizontalWater Injection Valve - Y	0.072	0.102
3" Horizontal Water Injection Valve - Z	0.064	0.091
3" Vertical (Top) Water Injection Valve - X	0.220	0.311
3" Vertical (Top) Water Injection Valve - Y	0.086	0.122
3" Vertical (Top) Water Injection Valve - Z	0.070	0.099
3" Vertical (Bottom) Water Injection Valve - X	0.188	0.266
3" Vertical (Bottom) Water Injection Valve - Y	0.113	0.160
3" Vertical (Bottom) Water Injection Valve - Z	0.052	0.074
3" QMB Sample Flange - X	0.182	0.257
3" QMB Sample Flange - Y	0.075	0.106
3" QMB Sample Flange - Z	0.086	0.122
Meter Bank 1 - Sample Group 4		
Mater Bank 1 PT-2211 Root Valve - X	0.168	0.238
Mater Bank 1 PT-2211 Root Valve - Y	0.076	0.107
Mater Bank 1 PT-2211 Root Valve - Z	0.084	0.119
Mater Bank 1 PI-2212 Root Valve - X	0.192	0.272
Mater Bank 1 PI-2212 Root Valve - Y	0.055	0.078
Mater Bank 1 PI-2212 Root Valve - Z	0.072	0.102
Mater Bank 1 PT-2221 Root Valve - X	0.151	0.214
Mater Bank 1 PT-2221 Root Valve - Y	0.068	0.096
Mater Bank 1 PT-2221 Root Valve - Z	0.086	0.122
Terminal Outlet - Sample Group 6		
PSV 2753 - X	0.424	0.600
PSV 2753 - Y	0.273	0.386
PSV 2753 - Z	0.450	0.636
PSV 2753 1st Elbow on the PSV Discharge Line - X	0.694	0.981
PSV 2753 1st Elbow on the PSV Discharge Line - Y	0.329	0.465
PSV 2753 1st Elbow on the PSV Discharge Line - Z	0.579	0.819
PSV 2753 Test Port Tee - X	0.333	0.471
PSV 2753 Test Port Tee - Y	0.319	0.451
PSV 2753 Test Port Tee - Z	0.346	0.489
PSV 2753 Test Port Plug - X	0.342	0.484
PSV 2753 Test Port Plug - Y	0.319	0.451
PSV 2753 Test Port Plug - Z	0.403	0.570
3" Blind Flange - X	0.256	0.362
3" Blind Flange - Y	0.261	0.369
3" Blind Flange - Z	0.319	0.451
MOV 2208 body - X	0.178	0.252
MOV 2208 body - Y	0.120	0.170
MOV 2208 body - Z	0.177	0.250
MOV 2208 actuator - X	0.325	0.460
MOV 2208 actuator - Y	0.317	0.448
MOV 2208 actuator - Z	0.363	0.513

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., as agent for TransCanada Keystone Pipeline. LP (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.

As reported in the November 2012 monthly report, opportunities to further improve the long term integrity of several small diameter branch connections was identified and most of the additional scope and validation testing has been completed. The current status of the remaining scope is summarized in the table below.

Issue	Status
Fort Ransom station drain	The station drain upstream from the PCV was permanently removed from service. Double bracing of the remaining nozzle was installed and validated through vibration and strain tests. ISSUE CLOSED
Hartford Delivery Terminal	Short term improvements to ensure piping integrity at Hartford delivery terminal were implemented and their effectiveness is being evaluated to determine acceptability.

Introduction

The 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 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 has now been completed at all delivery terminals, fixed speed and VFD stations and validation vibration tests were completed at all facilities.

The remedial work has been successful to ensure the safe and reliable operation of the Keystone pipeline. Additional testing carried out during the remediation work identified opportunities to further improve the long term integrity of the pipeline. The additional scope and validation testing on the following small diameter branch connections is described below:

1. Fort Ransom Station Drain Upstream from the PCV

The long term integrity of Fort Ransom station drain nozzle located upstream from the PCV was improved by the addition of a second brace as shown in Figure 1. The effectiveness of the double brace was validated through a vibration and strain test at 3500 kW energy dissipation across the PCV. The maximum vibration of the drain nozzle was 1.04 in/s and maximum piping strain was 112 $\mu\varepsilon$. A 3D FEA was used to determine strain amplification between the strain gauge location and the adjacent weld toe. The analysis determined the strain amplification factor to be 2.7, as shown in Figure 2. The resulting peak strain at the weld toe was 302 $\mu\varepsilon$ and the resulting factor of safety for the nozzle was 2.86, based on the material endurance limit of 866 $\mu\varepsilon$. The bracing improvement was effective in reducing the nozzle vibration and strains to acceptable levels.

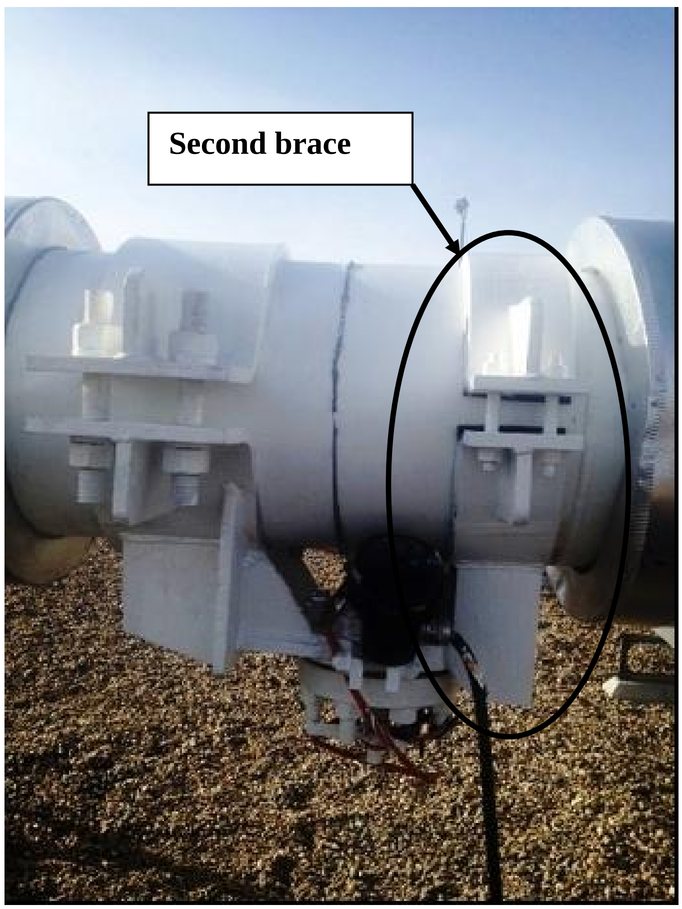


Figure 1: Fort Ransom drain nozzle upstream from the PCV with double bracing

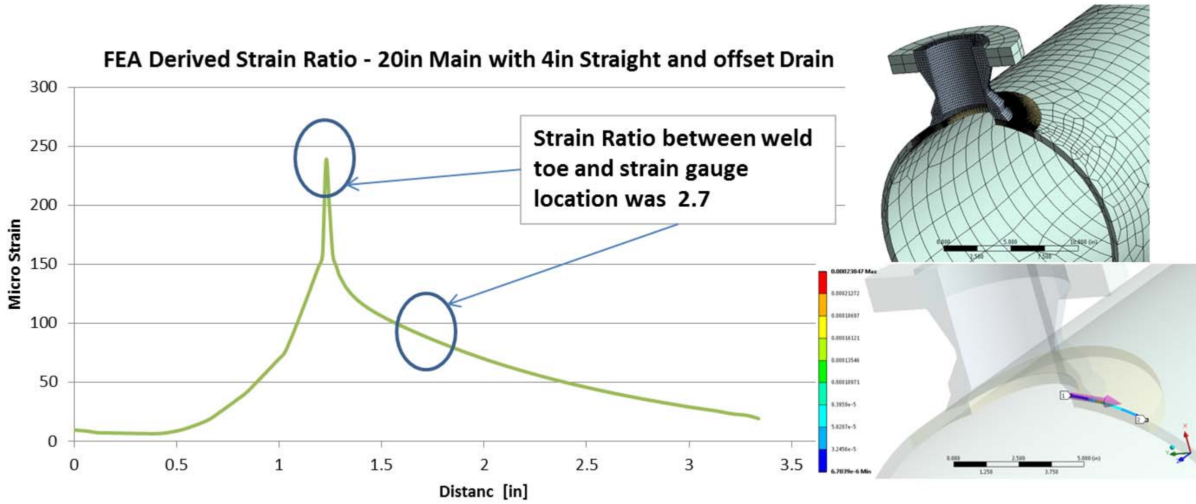


Figure 2: Results of FEA for 4" drain nozzle from 20" header

2. Hartford Delivery Terminal

An improvement program was implemented at Hartford delivery terminal to mitigate piping vibration and to ensure long term integrity of the terminal. Calibration of the terminal inlet PCV actuator and tuning of the PID control loop to minimize pressure oscillations have been completed. In addition, the terminal outlet isolation valve was automated to generate a back pressure on the PCV and to reduce peak energy dissipation across the PCV during transients. A continuous vibration monitoring of selected attachments exposed to the highest levels of vibratory excitation was installed to validate that the effectiveness of the implemented improvements. Once sufficient data from the continuous monitoring system is gathered, a complete vibration survey of all small bore branch connections and attachments will be completed to ensure long term integrity of the terminal piping.