

RECEIVED

MAR 06 2012

PUBLIC SERVICE COMMISSION



**TransCanada**  
*In business to deliver*

Ken Crowl  
Manager US Pipeline Compliance  
US Pipeline Operations

**tel** 832.320.5462  
**fax** 832.320.6462  
**email** ken\_crowl@transcanada.com  
**web** www.transcanada.com

March 5, 2012

Mr. Patrick Fahn  
North Dakota Public Service Commission  
600 E. Boulevard, Dept. 408  
Bismarck, ND 58505-0480

VIA ELECTRONIC DELIVERY AND COURIER

Mr. Fahn,

As discussed during our meeting with the North Dakota PSC on October 26, 2011, TC Oil Pipeline Operations, Inc. submits the enclosed information which summarizes our February 2012 monthly reports submitted to the U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration (PHMSA) as required under the Amended Corrective Action Order (CAO) issued on June 23, 2011. As Ms. Sacco requested in her May 17<sup>th</sup>, 2011 email, we are providing documents that do not require FOIA protection.

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

Sincerely,

A handwritten signature in cursive script that reads "Ken Crowl".

Ken Crowl  
Manager, US Pipeline Compliance – U.S. Pipeline Operations  
TransCanada U.S. Pipelines  
717 Texas Street  
Houston, TX  
77002

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

## **Executive Summary**

In accordance with the Corrective Action Order (CAO) issued by PHMSA on June 3, 2011 and amended on June 23, 2011, TC Oil Pipeline Operations, Inc. (Keystone) submits the following information in a report format.

The scope of work within the Work Plan submitted to PHMSA on September 1, 2011 and approved on October 21, 2011 is expected to be completed by March 31, 2012 as planned. As a result of validation testing in 2011 and 2012 additional improvements were identified. As a result of the additional scope of work, final completion of modifications and final validation testing and reporting to ensure long term integrity will be delayed to allow for system wide implementation. This will be completed as expeditiously as possible but will be finished no later than September 30<sup>th</sup>, 2012.

Testing of the latest designs of the station PSV Test Port and Unit MOV Thermal Bypass Line Drain carried out at Freeman Fixed Speed Station at high level of energy dissipation across the station Pressure Control Valve (>3000 kW) determined that the higher levels of piping strain reported has been virtually eliminated. The new station PSV Test Port design will be installed at all Fixed Speed and VFD Stations and the new Unit MOV Thermal Bypass Line Drain design will be installed at all Fixed Speed Stations. The current design of the Unit MOV Thermal Bypass Line Drain is acceptable at the VFD stations due to lower levels of maximum energy dissipation from the pressure control valves.

Additional testing and evaluation of the TV-0052 drain line adjacent to the Pressure Control Valve (single plane configuration) is ongoing at Freeman station in order to optimize the drain bracing. Once the bracing design is finalized, it will be implemented at all Fixed Speed Stations with single plane drains adjacent to the Pressure Control Valve

Large Bore Piping support modifications were completed at the Severance Fixed Speed Station. Evaluation of the piping support modification's effect on Station and Unit component vibrations is scheduled to begin the week of March 12, 2012.

## **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. A series of Monthly Reports have been submitted beginning in July of 2011 to document TC Oil Pipeline Operations, Inc.'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.

### **Q1 2012 Vibration Remediation Work**

As a result of validation testing in 2011 and 2012 the following additional improvements were identified:

#### **VFD Stations:**

- Brace long 4" nozzles adjacent to the unit discharge MOV (required at Pierron station only)
- Support injection pump piping (only required at David City pump station)
- Install new Station PSV test port design and refine bracing
- Install bracing on pump suction piping vents
- Brace high point vents on the unit expansion loops
- Excavate and install foam around station discharge piping drain lines by Station Pressure Control PCV and Station PSV
- Vibration testing of all small bore attachments.

#### **Delivery Terminals**

- Install new Station PSV test port design and refine bracing
- Replace Pressure Transmitter manifolds (required at Hartford and Patoka Terminals only)

#### **Fixed Speed Stations**

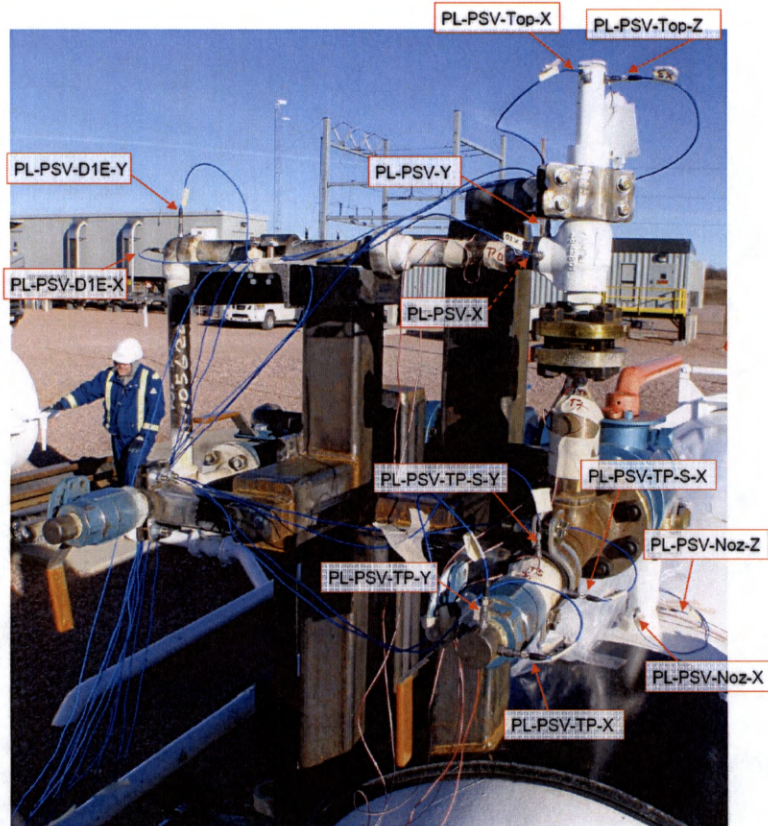
- Replace unit suction MOV bypass drain valve with a bleed plug
- Install new Station PSV test port design and refine bracing
- Brace station discharge piping drain lines by Station Pressure Control PCV and Station PSV
- Replace pump 4 Pressure Transmitter manifolds

The scope of work above has started and is complete at Edinburg, Niagara, Luverne, Stanton, David City, and Wilber pump stations. The program and associated validation testing and reporting will be finished no later than September 30<sup>th</sup>, 2012.

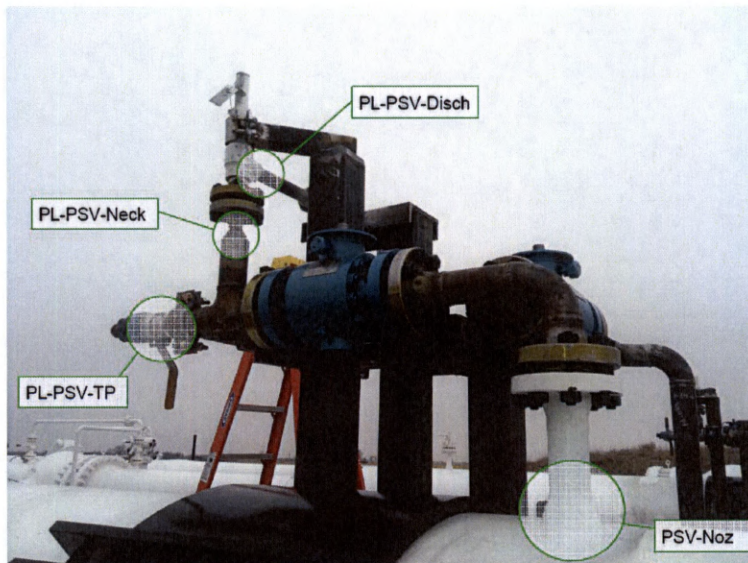
### **Pigging Barrel Pressure Safety Valves**

The Pigging Barrel Pressure Safety Valve modifications have been completed at all facilities with the exception of the Cushing Delivery Terminal, and the Salisbury and Steele City VFD pump stations. Fabrication of the Pigging Barrel Pressure Safety Valves (PSV) is in progress for these remaining stations and will be installed as a part of the Q1 2012 Station Vibration Remediation Work. The expected completion date is March 31, 2012.

The new PSV piping configuration was extensively tested at Freeman Fixed Speed Station to prove the effectiveness of the new piping design and bracing. Pictures below show the location of vibration transducers and strain sensors used during the testing.



Location of vibration transducers on the pigging barrel new PSV assembly at Freeman



Location of strain gauges on the pigging barrel new PSV assembly at Freeman

Testing at high energy dissipation across the station Pressure Control Valve (> 3000 kW) showed vibration levels exceeding the screening criteria limit on the PSV top, test port and first discharge elbow. Subsequent strain testing, carried out, in accordance with Keystone Vibration Evaluation Criteria escalation procedure, determined that strain in all areas of concern met the screening limit. The new PSV piping and bracing design was therefore considered satisfactory for all Pigging Barrels.

### **Final Vibration Report**

Testing has been completed to validate the effectiveness of modifications completed in 2011. The validation program resulted in additional refinements to the work scope and the modifications are in the process of being implemented. Keystone will continue to report on the progress of component 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 that will be finished no later than September 30<sup>th</sup>, 2012.

### **Next Steps and Timelines**

#### **Large Bore Piping**

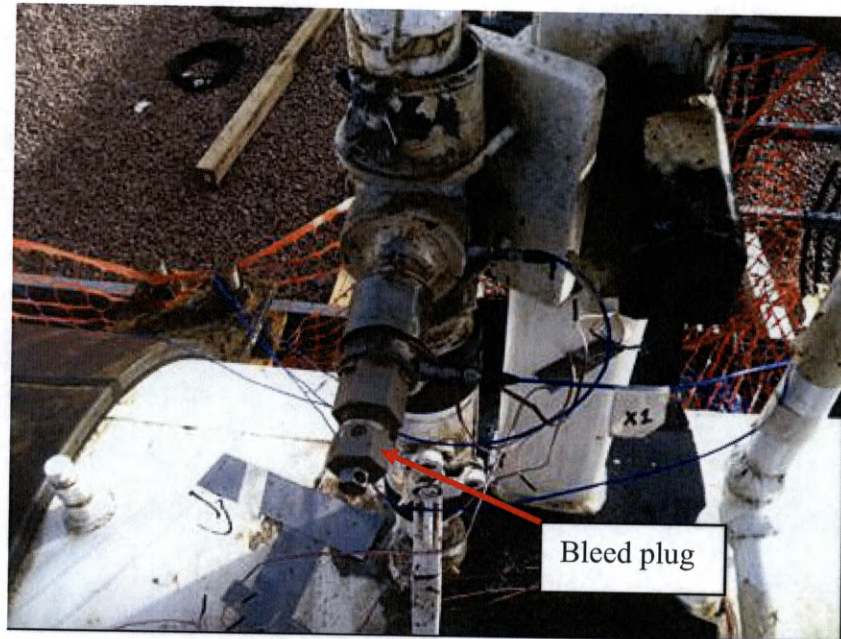
The Severance Station Large Bore Piping support modifications are complete. Evaluation of the modifications is currently scheduled for the week of March 12, 2012.

#### **PSV Test Port**

Testing of the PSV Test Port configuration described in the January 2012 Monthly Report and shown below did not achieve the desired reduction of strain in the test port piping when the energy dissipation across the station Pressure Control Valve was up to the 3000 kW level. Further refinements of the PSV Test Port design were made and tested on February 21, 2012 at the Freeman Fixed Speed Station. The testing determined that the test port piping strain and vibration were substantially decreased and are well below the screening limits. The final PSV Test Port configuration includes a shorter bleed plug shown below, which reduces unsupported mass of the port. The final PSV test port configuration will be implemented at all Fixed Speed and VFD Stations as a part of the Q1 2012 remediation work.



Previous PSV Test Port



Final PSV Test Port with short bleed plug.

### **TV-0052 drain line adjacent to Pressure Control Valve**

There are two different drain valve configurations adjacent to the station Pressure Control Valve (PCV). One is a vertical, single plane design and the other is a two plane design. Strain testing of both designs at high levels of energy dissipation (>3000 kW) resulted in dynamic strain values (pk-pk) exceeding the screening criteria recommended by SwRI.

### **Single plane TV-0052 drain line**

Testing and FEA analysis of the single plane drain design, shown on the picture below, determined that the dynamic stresses in the main pipe and the drain nozzle were of sufficient magnitude to warrant modifications. Consequently, several different bracing designs were developed and tested at Freeman Fixed Speed station. The testing results are currently being evaluated to determine the optimum design to be implemented at all Fixed Speed stations with single plane drains. The evaluation and any required modifications will be finished no later than September 30<sup>th</sup>, 2012.



Single plane TV-0052 drain line

**Two plane TV-0052 drain line**

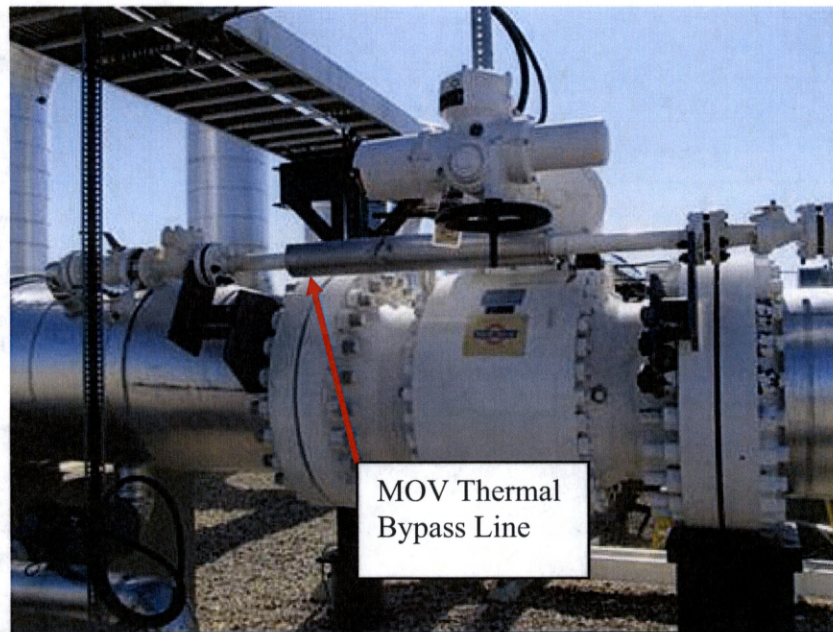
Vibration and strain gauge testing of the two plane drain design shown on the picture below was carried out at Hartington station, and FEA analysis of the drain line was performed to determine if piping stresses are acceptable. It was determined that the current configuration provides acceptable stress levels.



Two plane TV-0052 drain line

### Unit MOV Thermal Bypass Line

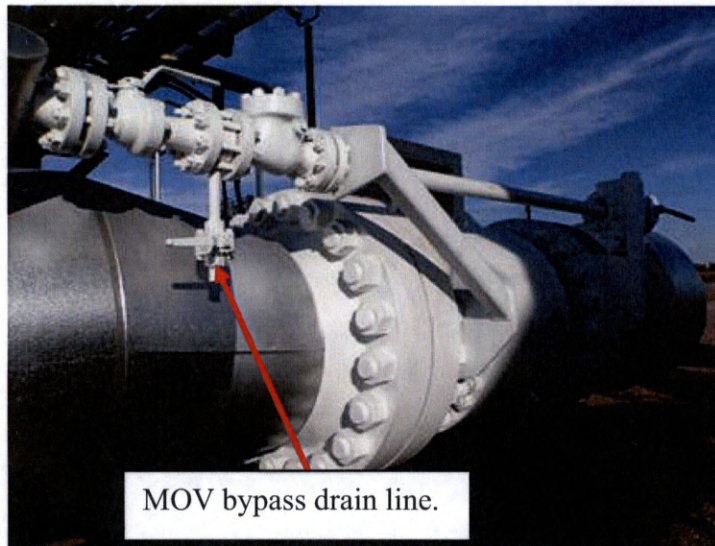
Bracing of the Unit MOV Thermal Bypass Line resulted in a greatly reduced vibration. However, subsequent Fixed Speed station testing at >3000 kW energy dissipation revealed that the piping vibration between the supports exceeds screening criteria under certain conditions. Extensive additional strain, vibration and mode shape testing was performed at the Freeman pump station and FEA analysis of the bypass piping was performed to determine if the piping stresses are acceptable. It was determined that the current configuration provides acceptable stress levels. Based on the results of the analysis, the current configuration is acceptable and no further changes are required.



MOV Thermal Bypass Line

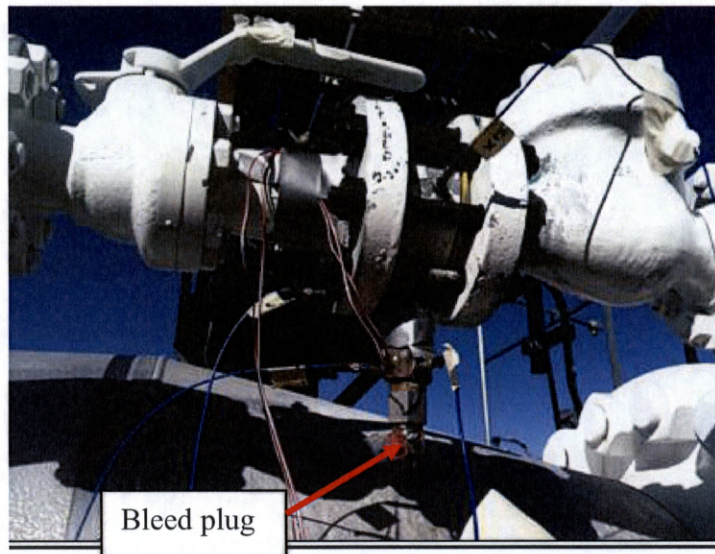
### Unit MOV Thermal Bypass Line Drain

As reported in January 2012 Monthly Report, testing of Fixed Speed Stations at high PCV energy dissipation levels (>3000 kW) revealed that the unit suction MOV bypass piping drain valve vibration exceeded screening criteria. Subsequent strain testing confirmed high level of stress in the drain attachment. A new configuration of the drain piping was developed and tested at Freeman station on February 18, 2012. The original and new configurations are shown below. The testing of the new configuration determined that the piping strain and vibration substantially decreased and was well below screening limits. The final MOV bypass drain configuration will be implemented at all Fixed Speed Stations as a part of the Q1 2012 remediation work.



MOV bypass drain line.

Unit MOV Thermal Bypass Line Drain (original design)



Bleed plug

Unit MOV Thermal Bypass Line Drain (final design)