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**PUBLIC SERVICE COMMISSION**

VIA ELECTRONIC DELIVERY AND COURIER

December 20, 2011

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

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US Pipeline Operations

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Re: CPF No. 3-2011-5006 Keystone Pipeline Corrective Action Order

Dear 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 October and November 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 28, 2011. As Ms. Sacco requested in her May 17, 2011 email, we are providing documents that do not require FOIA protection.

Additionally, the Commissioners requested at the October meeting information regarding our emergency response plan design as it relates to varying environmental conditions, and asked if they could be provided with copies of our evaluation of the emergency response to the Ludden release. Attached is a high level overview detailing what is contained within the Emergency Response Plan that was submitted to the state of North Dakota. The evaluation of our emergency response contains security sensitive and proprietary information that cannot be released without FOIA protection.

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

Respectfully,

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

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

**741 PU-06-421** Filed: 12/21/2011 Pages: 15  
**Summary of October and November monthly  
PHSMA reports**

TransCanada Keystone Pipeline, LP

Ken Crowl

## **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 with attachments.

The bracing program described in the Work Plan submitted to PHMSA on September 1, 2011 and approved on October 21, 2011 has been substantially completed. Fifteen sites comprised of Fixed and Variable Frequency drive configurations are complete, and an additional 5 sites await the installation of an improved design Pressure Safety Valve assembly on the Pigging Barrels to complete the submitted scope of work. All sites are expected to be completed in accordance with the approved Remedial Work Plan.

A third party has been engaged to assess vibration levels at high energy dissipation values across the Pressure Control Valve at all Fixed Speed sites in order to validate the work performed to date. An update will be submitted in the December Monthly Report.

Strain testing of the components in close proximity to the MOV under varying operational scenarios has been performed; the results of the testing are positive.

## **Introduction**

Keystone operates the Keystone oil pipeline system 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.

As a result of the above mentioned oil releases 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.

## **Small Bore Piping Bracing**

In accordance with the Scope of Work communicated in the September Monthly Report, a program of bracing was undertaken on Oct 3<sup>rd</sup>. For reference the scope is listed below.

### **FIXED SPEED STATIONS**

- Refine Permanent PSV bracing at Fixed Speed sites as necessary
- Install bracing on 2" Unit MOV suction valve relief bypass line
- Implement modification(s) to all Unit Pressure and Temperature transmitter attachments
- Install new design PSV piping and supports on Pigging Traps
- Implement modifications to Sump Injection Pump discharge piping supports.

**VARIABLE SPEED STATIONS**

- Off-mount VFD Station Unit Pressure Transmitters
- Off- mount all Temperature Transmitters from Station Piping
- Install bracing on 2” Unit MOV suction valve relief bypass line
- Install Permanent PSV bracing at VFD sites
- Implement modification(s) to all Unit Pressure and Temperature transmitter attachments
- Implement modification(s) to all VFD site Station Pressure and Temperature transmitter attachments
- Install new design PSV piping and supports on Pigging Traps
- Implement modifications to Sump Injection Pump discharge piping supports.

**Product Receipt and Delivery Sites**

- Install new design PSV piping and supports on Pigging Traps
- Implement modifications to Pressure Transmitter attachments in proximity of Delivery Site Pressure Control Valves

To date, the following Stations have the full scope of work outlined above completed and await post outage testing;

<b>Asset</b>	<b>Type</b>	<b>Status</b>	<b>Required Completion Date</b>
<b>Edinburg</b>	VFD	Complete	31-Mar-12
<b>Niagara</b>	VFD	Complete	31-Mar-12
<b>Luverne</b>	VFD	Complete	31-Mar-12
<b>Ludden</b>	Fixed	Complete	31-Dec-11
<b>Ferney</b>	Fixed	Complete	31-Dec-11
<b>Carpenter</b>	VFD	Complete	31-Mar-12
<b>Roswell</b>	Fixed	Complete	31-Dec-11
<b>Hartington</b>	VFD	Complete	31-Mar-12
<b>Stanton</b>	VFD	Complete	31-Mar-12
<b>David City</b>	VFD	Complete	31-Mar-12
<b>Wilber</b>	VFD	Complete	31-Mar-12
<b>Seneca</b>	Fixed	Complete	31-Dec-11
<b>Severance</b>	Fixed	Complete	31-Dec-11
<b>Turney</b>	Fixed	Complete	31-Dec-11
<b>Tina</b>	VFD	Complete	31-Mar-12

The following Stations have the scope of work above completed with the exception of the Pigging Barrel Pressure Safety Valve Spool pieces. Delays have been encountered completing the fabrication of the spool pieces. The spool piece installation and testing is expected to be complete on schedule by December 31, 2011. If further delays are encountered with the Pigging Barrel Pressure Safety Valve Spool pieces, the installation work and subsequent testing of the component(s) will be completed in 2012.

Asset	Type	Pigging Barrel PSV Status	Required Completion Date
Fort Ransom	Fixed	In Progress	31-Dec-11
Freeman	Fixed	In Progress	31-Dec-11
Salisbury	VFD	In Progress	31-Mar-12
Patoka	Delivery	In Progress	31-Dec-11
Cushing	Delivery	In Progress	31-Dec-11

## **Next Steps and Timelines**

### **Large Bore Piping**

Worley Parsons has been engaged to assist Keystone with the assessment of Large Bore Piping supports within the Keystone Pipeline System. Keystone will carry out piping stress analysis to identify potential additional support requirements, with Worley Parsons providing piping and structural design / drafting support. Keystone has focussed on reducing the unsupported length of pipe within the Station and provide additional static and dynamic support in the Station Discharge piping.

Keystone's stress engineer has finished the pipe stress analysis of the Severance and Freeman Fixed Speed pump stations, and Worley Parson's detail design for the existing support modifications and additional supports (including foundations) are 95% complete for Severance Pump Station and 75% complete for Freeman Pump Station.

The foundation construction for Severance is scheduled to start December 12<sup>th</sup>.

### **Post Modification Vibration Testing – Station Outage**

Following the August 2-8, 2011 outage, data was collected to evaluate the effectiveness of the modifications performed at the Fixed Speed Pump Stations. A complete report on the effectiveness of modifications will be submitted by December 31, 2011. An interim vibration report was submitted as an attachment to the October Monthly Report.

As reported in the Interim Vibration Report, the Station Pressure Safety Valve (PSV) required some adjustments to the support design implemented at the Fixed Speed Stations. Additional bracing was incorporated into the design in order to minimize the vibratory response of the Test Port. Subsequent strain testing produced satisfactory results which will be more fully communicated in the Final Fixed Speed Station Vibration Report.

### **Post Modification Vibration Testing – Unit Outage**

As part of the integrity validation process, comprehensive strain and vibration testing of small bore components was conducted at various sites in October and November 2011. The tests gathered data on both modified and unmodified components to ensure long term integrity of piping attachments at the highest levels of future energy dissipation.

As reported in the October monthly report, the testing protocol used was intended to create conditions that would mimic the energy dissipation across the Pressure Control Valve during current and future operations. Energy dissipation up to 3000 kW was determined to be sufficient

to create conditions assumed to be the worst case present at future operational pressures and flows.

At appropriate strain gauged test points, data was gathered to distinguish differential movement between the component and the base connection. Discreet Vibration Data was collected at all points within the test stations for assessment and comparison to previously collected field data.

### **Preliminary Results**

#### Unit Pressure Transmitter and Thermowell Nozzles

A program to brace the Unit Pressure Transmitter and Thermowell Nozzles was undertaken as a result of successful preliminary testing performed at the Bindloss Station. The bracing was designed to increase the natural frequency of the component and minimize differential motion between the main bore pipe and the nozzle. Vibratory response of the Unit Pressure Transmitter and Thermowell Nozzles following the modifications completed during the Unit Outage are well within overall vibration screening levels and dynamic strain (pk-pk) criteria as recommended by SwRI.



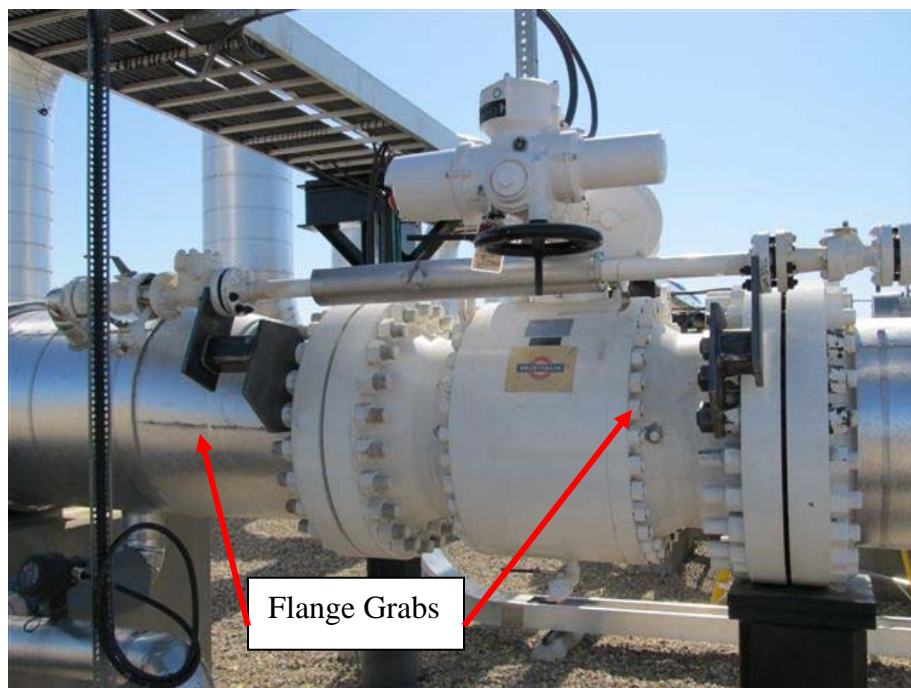
Pressure Transmitter Nozzle Brace



Thermowell Brace

Unit MOV Thermal Bypass Line

The Unit Suction Motor Operated Valve Thermal Bypass Line was an unsupported component susceptible to dynamic motion during operations. As a preventative measure, Keystone incorporated a bracing design to minimize the vibratory response of the MOV Thermal Bypass Line. Evaluation of the modification is in progress.



Unit MOV Thermal Bypass Line Bracing

## Additional Test Results

### 1. TV-0052 - drain line adjacent to Pressure Control Valve

The drain valve adjacent to the PCV is of a vertical, single plane design. Strain testing at high levels of energy dissipation (>3000 kW) resulted in strain values exceeded overall vibration screening levels and dynamic strain (pk-pk) criteria as recommended by SwRI. The drain line was excavated in order to allow the drain line additional flexibility during high energy dissipation conditions with an expectation that strain values would decrease. Subsequent testing produced reduced strain levels as expected, but the tested value was still of a magnitude requiring additional analysis and potential drain line modification to resolve.

Further FEA analysis of strain gage location relative to component stress concentration revealed the dynamic stress was less than the fatigue limit, but of sufficient magnitude to warrant modifications. Consequently, a brace will be applied to a drain and the component tested to determine the effectiveness of the bracing.



TV-0052

### 2. Unit discharge drain valve

Ft. Ransom Unit 4 discharge line drain valve was also strain tested at high energy dissipation values to understand component response. Resulting test values are within overall vibration screening levels and dynamic strain (pk-pk) criteria as recommended by SwRI.



Unit Discharge Drain Line

### 3. Unit suction line vent

Ft. Ransom Unit 4 suction line vent valve was strain tested at high energy dissipation values to understand component response. Resulting strain values exceeded overall vibration screening levels and dynamic strain (pk-pk) criteria as recommended by SwRI. A bracing strategy was applied and subsequent testing revealed values within overall vibration screening levels and dynamic strain (pk-pk) criteria as recommended by SwRI.

As a result of the testing, a scope change was issued for all unit suction vents to have bracing completed. This work scope has been performed at all Fixed Speed Stations and is in progress at VFD sites.

The work scope is expected to be complete by December 31, 2011.



Unit Suction Line Vent Bracing

4. VFD Unit discharge high point vent

The Luverne Unit 4 discharge expansion loop high point vent was evaluated for vibratory and strain response under high energy dissipation conditions. The level of energy dissipation present in the test well exceeded the typical energy dissipation values experienced at the Variable Frequency Drive sites during typical operations.

The vent was subsequently modified with a brace and underwent additional testing. Modified component response to equivalent high energy dissipation was greatly reduced with resulting dynamic strain and overall vibration levels within overall vibration screening levels and dynamic strain (pk-pk) criteria as recommended by SwRI.



VFD Unit High Point Vent Bracing

### **Unit MOV Adjacent Component Strain Testing**

SwRI testing at the Fort Ransom Pump Station as reported in the August Monthly Report, revealed an operational scenario at unit start-up that resulted in a brief period of high vibration and strain in attachments that are in close proximity to the unit when the discharge valve opens and the PCV is in operation.

TransCanada performed a study of starts and did not find any evidence to support that varying the MOV operation resulted in significant improvement to the resulting flow induced vibration and strain, and therefore conclude that modification of Unit Discharge Valve operations is not a viable solution to reduce the realized vibration and strain in near field Unit components. The vibration and strain present in near field Unit components during Unit start have been positively mitigated as a result of the execution of TransCanada's Station and Unit Outage Scopes of Work.

### **Change in Scope of Work**

The additional scope of work indicated as a result of the additional testing described above will be completed by March 31, 2011.

### **Index of Attachments**

Attachments omitted due to confidential, privileged, proprietary and/or security sensitive information contained within the documents.

## **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. as operator of Keystone Pipeline (Keystone) submits the following information in a report format with attachments.

The bracing program described in the Work Plan submitted to PHMSA on September 1, 2011 and approved on October 21, 2011 has begun with completion of four fixed speed sites and four VFD sites. Evaluation of the modifications has started.

Evaluation of the modifications made to attachments outside of the pump station unit valves through additional field testing, inspection, and/or engineering as required in the Work Plan was completed by October 31, 2011. An interim report is included as an attachment to the October Monthly Report. The final report will be issued on or before December 15, 2011.

Strain testing of the components in close proximity to the MOV under varying operational scenarios was performed. The report of the findings is expected to be completed by November 30<sup>th</sup>.

## **Introduction**

The Keystone oil pipeline system extends 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.

As a result of the above mentioned oil releases a Corrective Action Order (June 3, 2011) and subsequent Amended Corrective Action Order (June 28, 2011) were issued to Keystone.

The July 2011 Monthly Report communicated the successful re-start of the Keystone Pipeline to full volumes and the August Report communicated the completion of significant reliability improvements instituted at Fixed Speed Sites. The September Monthly Report communicated positive results from targeted testing of braced pressure and temperature transmitter connections and indicated a plan to implement improvements across the Keystone Pipeline System.

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

## **Small Bore Piping Bracing**

In accordance with the Scope of Work communicated in the September Monthly Report, a program of bracing was undertaken on Oct 3<sup>rd</sup>. For reference the scope is listed below.

### **FIXED SPEED STATIONS**

- Refine Permanent PSV bracing at Fixed Speed sites as necessary
- Install bracing on 2" Unit MOV suction valve relief bypass line

- Implement modification(s) to all Unit Pressure and Temperature transmitter attachments
- Install new design PSV piping and supports on Pigging Traps
- Implement modifications to Sump Injection Pump discharge piping supports.

#### VARIABLE SPEED STATIONS

- Off-mount VFD Station Unit Pressure Transmitters
- Off- mount all Temperature Transmitters from Station Piping
- Install bracing on 2” Unit MOV suction valve relief bypass line
- Install Permanent PSV bracing at VFD sites
- Implement modification(s) to all Unit Pressure and Temperature transmitter attachments
- Implement modification(s) to all VFD site Station Pressure and Temperature transmitter attachments
- Install new design PSV piping and supports on Pigging Traps
- Implement modifications to Sump Injection Pump discharge piping supports.

#### Product Receipt and Delivery Sites

- Install new design PSV piping and supports on Pigging Traps
- Implement modifications to Pressure Transmitter attachments in proximity of Delivery Site Pressure Control Valves

To date, the following Stations have been completed and await post outage testing;

- Fort Ransom – Fixed Speed
- Ferney – Fixed Speed
- Ludden – Fixed Speed
- Luverne – VFD
- Edinburg – VFD
- Carpenter – VFD
- Roswell – Fixed Speed
- Niagara – VFD

Application of the above work scope to the remainder of the Keystone Pipeline US Fixed Speed and Terminal Facilities is anticipated to be complete before December 31, 2011. Variable Speed Stations have an anticipated completion date of March 31, 2011. Based on the results of the testing, additional enhancements will be made as required.

### **Next Steps and Timelines**

#### **Large Bore Piping**

Worley Parsons has been engaged to assist Keystone with the assessment of Large Bore Piping supports within the Pipeline System. Keystone will carry out piping stress analysis to identify potential additional support requirements, with Worley Parsons providing piping and structural design / drafting support.

Keystone has focussed on reducing the unsupported length of pipe within the Station and providing additional static and dynamic support in the Station Discharge piping.

Worley Parsons and Keystone gathered data on the station piping, and Keystone's stress engineers have completed a preliminary pipe stress analysis of the Severance and Freeman Fixed Speed pump stations. Worley Parsons has started detail design for the existing and additional support modifications (including foundations) based on stress analysis results.

### **Post Modification Vibration Testing – Station Outage**

Following the August 2-8, 2011 outage, data was collected to evaluate the effectiveness of the modifications performed at the Fixed Speed Pump Stations. The results of the vibration testing completed at the Severance Pump Station described in the August monthly report indicated improvements due to the modifications made. In October, additional detailed testing, which includes strain gauge testing, was performed at Ft. Ransom. These results are being compiled and evaluated and will be incorporated into the final evaluation report.

Evaluation of the additional field testing, inspection, and/or engineering as required in the Work Plan was completed by October 31, 2011. An interim report is included as an attachment to the October Monthly Report. The final report will be issued on or before December 15, 2011.

### **Post Modification Vibration Testing – Unit Outage**

Strain and Vibration testing of the Unit Outage modifications began in October. Additionally, data was collected on components modified during the Station Outage in August to better understand the response to operational conditions and validate the integrity of the small bore piping modifications.

Vibration levels and concurrent strain data were gathered on 33 components utilizing strain gauges and vibration sensors for assessment. Appropriate data was gathered to distinguish differential movement between the component and the base connection as appropriate.

The testing protocol used was intended to create conditions that would mimic the energy dissipation across the Pressure Control Valve during current and future operations. Discussion and analysis with the Keystone Engineering Group determined that energy dissipation up to 3000 kW would be sufficient to create conditions that are expected to be present at future operational pressures and flows.

### **Unit MOV Adjacent Component Strain Testing**

As reported in the August Monthly Report, SwRI testing at the Fort Ransom Pump Station revealed an operational scenario at unit start-up that resulted in a brief period of high vibration and strain in attachments that are in close proximity to the unit discharge valve when the valve opens and the PCV is in operation. Strain testing of the components in close proximity to the MOV under varying operational scenarios was performed on October 7<sup>th</sup> at the Ft. Ransom Fixed Speed pump station. The testing has been performed with favorable results and a report is expected to be provided November 30<sup>th</sup>.

## **Index of Attachments**

Attachments omitted due to confidential, privileged, proprietary and/or security sensitive information contained within the documents.

## TransCanada Keystone Emergency Response Procedure Description

TransCanada is committed to being able to respond in any environment in the unlikely event of an oil spill. To do so, Keystone has implemented a comprehensive emergency response program consisting of an Emergency Response Plan, emergency response equipment, training and contractors network.

The Keystone emergency response plan (ERP) has been written to guide our personnel and other responders during a response to an oil spill in any environment and conditions within the confines of responding safely. Entire sections of the ERP outline containment and recovery response tactics in various environments and adverse conditions such as to spills on and /or under ice and high flow (flooding) conditions. When typical response strategies such as mechanical removal of oil is not the most effective or feasible option, alternative countermeasures may be used and are also outlined in the ERP. Ultimately, response strategies and tactics identified in the plan are designed to allow for responders flexibility and to be adaptable to changes in the environment in order to maximize our preparedness to responding in all conditions.

In addition to response strategies in the ERP, TransCanada also owns emergency response equipment stored along the entire system. TransCanada also has contracts in place with response organizations such as the National Response Corporation (NRC) which can provide any necessary resources to any location along the Keystone Pipeline. Via company owned equipment and contractors, equipment including helicopters, fixed-wing aircraft, all-terrain vehicles, snowmobiles, backhoes, dump trucks, watercraft, bull dozers, swamp mats, road building contractors, etc, TransCanada is prepared to respond in all conditions where safe to do so.

TransCanada has trained personnel along the Keystone system to ensure that a timely and effective response may be conducted. Emergency responders have been based consistent with industry practice and consistent with applicable regulations, including 49 CFR 194 and 49 CFR 195. They are trained at a minimum to meet the standards including the National Preparedness for Response Exercise Program Guidelines (PREP) developed by the USCG and required by the Oil Pollution Act of 1990 (OPA 90) as well as the OSHA Hazwoper requirements under 29CFR1910.120. The PREP program outlines those training and field drill requirements necessary to maintain the level of preparedness required to effectively respond to a spill including practicing responses in various weather and environmental conditions and in all operating environments. Keystone operating personnel participate in exercises or responses on an annual basis in order to ensure that they remain trained and qualified to operate the equipment in the pipeline operating environments and to ensure that the ERP is effective.