
4-1

Data Request:

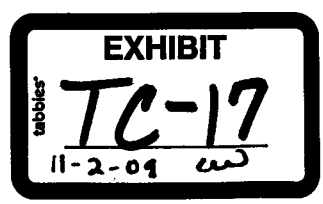
What are the design considerations in the placement of valves on either side of the Little Missouri River, the Cheyenne River, and the White River, particularly the distances over 5 miles from the river bank?

Response:

Federal regulations (49 CFR 195.260) dictate the location of valves for hazardous liquid pipelines. Pertinent to these locations, a valve must be located on the mainline at locations that will minimize damage or pollution (49 CFR 195.260(c)) and on each side of a water crossing that is more than 100 feet wide from high-water mark to high-water mark. Two crossings (White and Cheyenne river crossings) are greater than 100 feet wide, while the Little Missouri River is less than 100 feet wide. Valves were specifically placed at sites to minimize the potential hazard of a spill to these environmentally sensitive rivers.

Federal regulations do not dictate the distance that valves must be located from the waterbodies. Rather, the locations are determined by 1) protection of sensitive resources; 2) siting valves in locations that will minimize a spill reaching the river directly or via tributaries; 3) vehicular access to the valve site since the valves must be checked twice per year; 4) ease of year-round vehicular access since valves must be easily accessible during an emergency; and 5) proximity of electrical power supply for remotely operated valves.

Response prepared by: Heidi Tillquist, AECOM



4-2

Data Request:

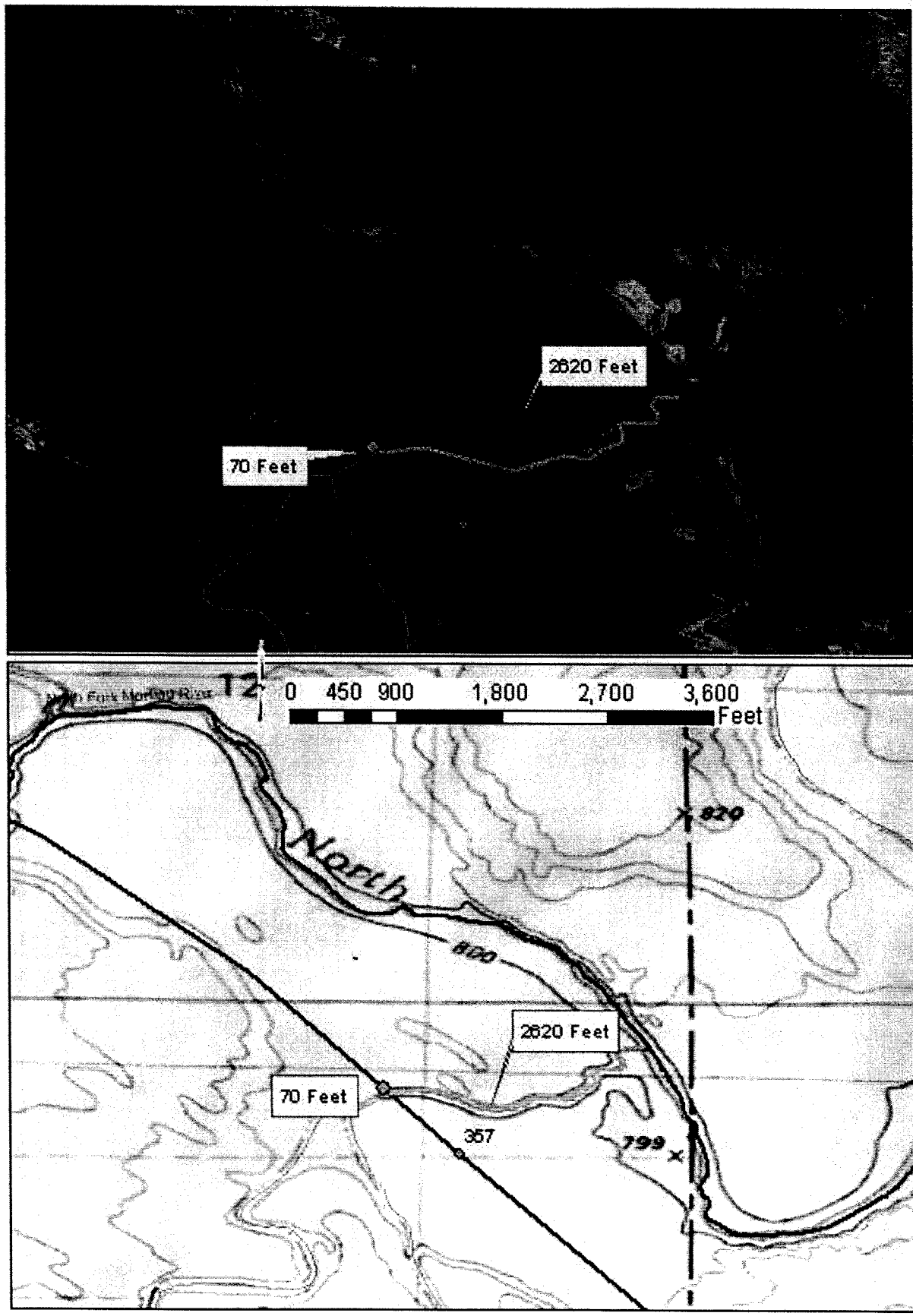
What is the location on the pipeline where the maximum calculated spill volume may be 66,596 barrels and what affect, if any, will there be on HCAs?

Response:

The maximum spill location in South Dakota is at MP 356.86, which is in close proximity to the North Fork Moreau River (see Figure). Keystone has evaluated the portion of pipe to determine if it is capable of affecting an HCA.

A release at this site would follow the terrain and would have to travel overland 2,690 feet prior to reaching the river (see figure). Consequently, the release would need to be substantial to travel this distance. The likelihood of a large spill at this site is extremely low. However, if this rare event occurred, crude oil could potentially enter the river and be transported downstream. Adverse effects to downstream HCAs are highly improbable, since there are no HCAs located downstream for approximately 175 river miles. Emergency response and containment would prevent a spill from reaching the HCA. In addition, Keystone has located a valve nearby to specifically help protect the area in the unlikely event of a release. Siting of the valve location relative to the site used the siting criteria described in response to Data Request 4-1.

Response prepared by: Heidi Tillquist, AECOM


2620 Feet
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T2
0 450 900 1,800 2,700 3,600
Feet
North
820
800
2620 Feet
70 Feet
357
799

4-3

Data Request:

Please provide site-specific frac-out contingency plans for horizontal direction drilling crossings of waterbodies.

Response:

See attached South Dakota specific HDD frac-out contingency plan. This plan applies to all HDD locations in South Dakota.

Response prepared by: Jon Schmidt, TROW

Keystone XL Pipeline Project

HORIZIONTAL DIRECTIONAL DRILL FRAC-OUT CONTINGENCY PLAN

Prepared for:

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450-1st Street, S.W.
Calgary, Alberta T2P 5H1

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Project No:

Revision No:
Issue Date: October 1, 2009

Table of Contents

1. Introduction

This horizontal directional drilling mud contingency plan provides specific procedures and steps to contain the inadvertent releases of drilling mud (frac-outs) for water bodies that are crossed using horizontal direction drilling (HDD) techniques.

Keystone will designate a representative (Keystone Representative) to respond on behalf of Keystone to construction issues that might arise during the operation of the HDD crossing.

2. Drilling Fluid and Drilling Fluid System

The HDD process involves the use of a drilling fluid (also referred to as drilling mud) made up primarily of water. Bentonite clay is added to the water to enhance lubricating, spoil transport and caking properties of the drilling fluid. Bentonite is a naturally occurring, non-toxic, inert substance that meets NSF/ANSI 60 NSF Drinking Water Additives Standards and is frequently used for drilling potable water wells.

The primary purpose of drilling fluid is to power the downhole cutting tools, remove cuttings from the drill hole, stabilize the hole, and act as a coolant and lubricant during the drilling process.

The drilling fluid is prepared in a mixing tank containing both new and clean recycled drilling fluid. The fluid is pumped at rate of 100 to 1,000 gallons per minute (gpm) through the center of the drill pipe to the cutters. Return flow is through the annulus created between the wall of the boring and the drill pipe. The cuttings are then carried back to either the entry or the exit pit, depending on a combination of elevation difference and drilling/hole opening direction. Once in the entry pit, the fluid moves to the pickup pit to be pumped to the fluid processing equipment. Typically, shaker screens, desanders and desilters remove increasingly finer cuttings from the drilling fluid. The cleaned and recycled fluid is returned to the mixing tank and pumps for reuse in the borehole. Cuttings and bentonite mud (clay) are often desirable for agricultural applications. Following completion of the drill, cuttings and clay would be made available to landowners for use, either mixed with native soil and buried on site or land sprayed or land spreaded, with landowner permission, or disposed of in a landfill. Landowners would be instructed that any beneficial use of the bentonite must include safeguards to keep the material separated from public water ways.

The HDD method has the potential for loss or seepage of drilling fluid into the native material through which the drill passes. In some cases, the drilling fluid may be forced to the surface resulting in what is commonly referred to as an inadvertent release or a frac-out. While one of the positive aspects of the HDD method is the avoidance surface disturbance, surface disturbances may occur when there is an inadvertent release of drilling fluid. Drilling fluid release is typically caused by pressurization of the drill hole beyond the containment capability of the overburden soil material or due to inherent weaknesses within the overlying soils such as a fissure or other pathway. In some cases, the pathway can be associated with boreholes advanced for geotechnical investigations or by bridge or building pilings.

The HDD operation is a closed system to minimize the discharge of drilling mud, fluids, and cuttings outside of the work area. To minimize the possibility of fluid escape, mud pits shall be used to contain the drilling fluids. The drilling fluids are cleaned and recycled to the extent possible. Tanks or dumpsters will be installed in lined pits. Care will be taken to prevent the fluids from getting into the soil and to prevent groundwater from entering the pits. Any drilling mud that inadvertently exits at points other than the entry and exit points

shall be contained and collected to the satisfaction of the of the Keystone Representative and the HDD contractor shall immediately notify a Keystone Representative.

3. HDD Contractor Responsibilities and Requirements

The HDD contractor is responsible for execution of the HDD operation, including actions for detecting and controlling the inadvertent release of drilling fluid. Keystone will closely supervise the progress and actions of the HDD contractor through the use of onsite inspection teams.

The HDD contractor will be required to prepare a project specific Spill Prevention Control and Countermeasure (SPCC) Plan which includes project specific procedures concerning monitoring and response to frac-outs including specific project and agency notification protocol. This plan will be reviewed and approved by Keystone prior to initiation of construction. The SPCC Plan developed by the Contractor will specify the equipment to be provided and the quantities of each, including a tracked hydraulic excavator, straw or hay bales, stakes to secure bails, silt fence, sand bags, shovels, pumps, and any other materials or equipment deemed necessary and adequate to contain and clean up inadvertent releases. The SPCC Plan will identify actions or stages for sealing the borehole in the event of fluid migration. The Keystone Representative will review and approve the SPCC Plan prior to the contractor commencing work on-site. The contractor will provide for a vacuum truck and operator to be on call during drilling operations, such that the vacuum truck can respond in a timely manner.

The Contractor will provide a site-specific plan for each HDD crossing, identifying any site-specific requirements and provisions to be made to meet special site conditions.

Ancillary items must be readily available during drilling operations including a light tower in case cleanup operations are needed after dark, a boat with relevant safety equipment during the crossing of large water bodies, and leak free hose to allow pumping spilled drilling mud for mitigation where small creeks or drainages are involved.

4. Fluid Migration Detection

Drilling crews and the Keystone inspection personnel will be responsible for monitoring and detection of frac-outs. The most obvious signs of a frac-out are the visible pooling of drilling mud on the surface or a sudden decease in mud volume during drilling operations or loss in drilling mud pressure. The annular pressure will be specified in the HDD contract. Drilling and mud system personnel will observe the volume of drilling fluid return and immediately report reductions to the foreman and Keystone personnel. The mud system operator will monitor the level in the mud tank. The operator will alert the on-site personnel if there is a noticeable drop in the level of mud in the tank. The contract will specify the use of an Electronic Data Recorder (EDR) to monitor volumes, pressures and other HDD operations.

5. Corrective Action for an Inadvertent Release

In the event of inadvertent release to the surface at locations other than the borehole location, the following actions will be taken by the contractor:

- Notify the Keystone representative who will in turn notify the appropriate agency representative, as required.
- Suspend active drilling operations
- Search for surface fractures
- Determine the volume of lost fluid to surface
- Contain any drilling fluid that has surfaced
- Evaluate the circumstances leading to circulation loss to determine if the fracture can be sealed. This shall include a review of the annular pressure history during the drill
- Thicken the drilling fluid, such as by injecting Loss Control Materials (LCM's), to attempt to seal off the location of the release
- In the event of partial circulation loss, pumping of drilling fluid may be reduced to reduce pressure applied to native formation materials or LCM's may be added. Use of pressure reduction or addition of LCM's will be identified in the contract specification.
- Additional berms will be constructed around the bore pit as directed by the Keystone Representative to prevent release of materials into the adjacent water body
- The contractor will pump the spill in an attempt to recover all of the spilled fluid for disposal
- Measures will be implemented (berm, silt fence, and/or hay bale installation) to prevent silt laden water from flowing into the water body.
- Evaluate whether the fracture should be grouted
- If hand tools cannot contain a small on-land release, small collection sumps may be constructed to pump the released material into the mud processing system.
- Sump pumps or vacuum trucks will be used to remove and dispose of any drilling fluids.

6. Containment of Drilling Fluid Release

Immediately following the detection of the inadvertent drilling fluid release, containment and clean-up operations shall commence. For releases on land, Contractor shall use straw bales, silt fences, sand bags and earth berms to prevent fluid from migrating or flowing from the immediate area of the discharge. If the volume released is too small for containment measures or if the release occurs in an environmentally sensitive area where release of containments can cause additional damage, the receiving area will be allowed to dry naturally. If there is a threat to a sensitive resource or a threat to public safety, HDD activities will cease immediately.

In cases of inadvertent releases to open water or flooded wetlands, it may impractical or impossible to contain the release. For releases in shallow water, the HDD contractor shall install staked sediment barriers as described in the Keystone XL Construction Mitigation and Reclamation Plan (CMRP). Removal by vacuum truck may be attempted if deemed appropriate. The decision to proceed with the drilling operation will be at the sole discretion of the Keystone representative after all methods to seal off the location of the discharge identified in the SPCC Plan have been attempted. After all planned stages have been executed without success, a plan will be developed to continue drilling even though there is some loss of drilling fluid in consultation with Keystone and the appropriate agency. Keystone will notify the appropriate authorities for downstream water intakes of the existence and location of any plume that extends more than 1,000 yards from the worksite. Underwater releases may be allowed to dissipate where cleanup would cause more damage than leaving the material in place. Where cleanup can be accomplished without causing additional damage, the cleanup of the spill will be conducted. The regulating agency with jurisdiction over the operation will be advised of planned actions in response to spills, when those actions do not include complete removal of the spilled material.

In the event of a spill into a waterway, turbidity meters will be used by Keystone environmental inspectors to evaluate turbidity levels. Turbidity will be measured upstream and downstream of the spill, at locations to be determined by the Keystone environmental inspectors.

7. Clean-up of Releases

The clean-up shall commence after the release is contained. Clean-up shall include removal of all visible drilling fluid located in accessible areas. Removal methods will vary based on the volume of the release and the site specific conditions. Removal equipment may include vacuum trucks, loader and track hoe buckets, small pumps, shovels, buckets, brooms and squeegees. If the release occurs in a sensitive area, it may be necessary to pump the fluid into an upland area for additional containment and disposal. After removal of the released drilling fluid, the release area will be returned as close to the original condition as feasible. It may be necessary to store the drilling fluid residue on-site prior to disposal. On-site storage will include secondary containment with the capacity of 110 percent of the volume of drilling fluid residue to be stored.

Any water discharged from the HDD operation will be discharged through filter bags to contain suspended solids.

8. Agency Notification Procedures

If an inadvertent release is discovered, steps will be taken to contain the release as described in Section 4. Notification procedures for Keystone construction management personnel and regulatory agencies are as follows:

When monitoring indicates that an in-stream release has occurred, the Keystone Representative will immediately notify the appropriate Federal and State Agencies as soon as possible. The agency(s) will be consulted regarding the nature of the release the corrective actions to be applied and any additional measures necessary to be employed avoid adverse impacts to the environment, This data will be provided as specified in the project specific notification protocol established for HDD installations.

If downstream migration is imminent and, if water quality will be affected, downstream users will be contacted by Keystone. Relevant contact information will be gathered prior to commencement of construction operations and maintained on site as part of the project specific notification protocol.

In general, if a release occurs on Keystone right-of-way, no agency notifications are required. Keystone will comply with any site-specific notification requirements. On-land releases will be cleaned up and the site will be restored in accordance with the CMRP and landowner line list requirements.

In the event an HDD crossing cannot be successfully completed, the appropriate agencies will be notified with an alternate crossing plan.

4-4

Data Request:

Please provide the final Construction/Reclamation Units and associated restoration and mitigation procedures and corresponding pipeline milepost references.

Response:

The final Construction/Reclamation Units itemized by milepost will be provided to the SDPUC prior to construction.

Response prepared by: Pat Farmer, WESTECH

4-5

Data Request:

Please provide a plan which summarizes how Keystone intends to monitor restoration success (intensity and frequency of inspections) to identify areas where soil productivity has not returned to pre-construction levels. The plan should include the time frames for which landowner claims for loss of soil productivity in agricultural lands will be processed or remediated. Keystone should also summarize how claims will be settled for which a consensus regarding potential damages cannot be reached between the landowner and Keystone.

Response:

Prior to construction, Keystone will develop a post-construction monitoring plan that will evaluate the success of efforts to reestablish equivalent land productivity and mitigate predicted construction impacts. Restoration success is typically determined through revegetation monitoring. Vegetation responds to soil fertility and therefore is a clear indicator of any soil fertility problems. The monitoring plan may include, but not be limited to, the following:

In the first year of monitoring in non-agricultural areas, general indicators of vegetation establishment such as seedling density and total plant cover will be noted. Soil stability will be assessed by recording indicators of accelerated erosion such as rills, gullies, pedestaling, or other features used by the NRCS.

In subsequent years, the ROW will be examined in areas of important habitat that were identified prior to construction or in the first year's monitoring. Vegetation and soil indicators including total vegetation cover, vegetation cover by morphological class, and soil stability will be assessed. Restoration will be considered successful if the surface condition is similar to adjacent undisturbed lands, construction debris has been removed (unless requested otherwise by the landowner or land managing agency), and drainage has been restored. If monitoring reveals that restoration and revegetation have not been successful in a non-agricultural area, Keystone will reseed the area in question or will compensate the landowner to reseed the area.

In agricultural areas, Keystone will rely on landowners to identify and report areas where crop yields are reduced as a result of pipeline construction activities. Keystone will monitor crop yield on such lands with the aid of agricultural specialists, if requested by

the landowner. Revegetation in agricultural areas will be considered successful if crop yields are similar to adjacent undisturbed portions of the same field. If monitoring indicates that restoration in agricultural areas has not been successful, Keystone will compensate landowners for reduced crop yields and, as negotiated with the landowner, will implement procedures to return the land to equivalent capability.

Remediation

If monitoring reveals that restoration and revegetation have not been successful (by the above definitions) in a non-agricultural area, Keystone will reseed the area in question or will compensate the landowner to reseed the area.

In agricultural areas, Keystone will compensate landowners for reduced crop yields and, as negotiated with the landowner, will implement procedures to return the land to equivalent capability.

Remediation time frames will be discussed with each landowner to accommodate site-specific conditions. At the minimum, two growing seasons will be required to determine if remediation will be necessary.

If the landowner and Keystone cannot agree upon remediation claims, Keystone will request and consider the recommendations of an appropriate government office (e.g., NRCS or FSA).

Keystone's compensation program includes advanced damages for crops. On a declining scale over three years, Keystone proposes to advance landowners 100% of crop loss for the year of construction, 75% for the summer growing season following construction and 50% for the summer growing season two years after construction. In cases where yields are less than those already compensated for, or where yields do not return to pre-construction levels after the third season, Keystone will assess claims by verifying yields on site with the landowner.

Where agreement cannot be reached directly with a landowner, Keystone proposes as a next step, a neutral third party adjuster be requested to assess the loss. Any difference between that amount already accounted for under Keystone's advanced damages payment and that determined to be a loss by the neutral third party adjuster, Keystone will pay that difference. If the parties remain in disagreement despite the neutral party adjuster's assessment, a judicial proceeding may be sought by either party. Keystone remains confident that its construction related advanced damages payment will address the vast majority of, if not all, crop issues related to construction. In the cases where it does not, Keystone will act reasonably and fairly to address reasonable claims. It is our intention

to make landowners whole for any loss that may result from our activities or presence of our facilities.

During operations the easement provides protections to landowners by committing to payfor commercially reasonable damages. Similar processes as noted above would continue to be available to the parties.

Response prepared by: Pat Farmer, WESTECH

4-6

Data Request:

Please provide information to demonstrate that training of SCADA control room operators and other employees is sufficient to recognize a release has occurred.

Response:

Because the Keystone XL pipeline will operate in both the USA and Canada, the Keystone XL Pipeline Controllers will be trained to meet the requirements of both US DOT (PHMSA) and NEB (National Energy Board) regulatory requirements. The regulatory requirements for Pipeline Controller training for leak detection in the USA and Canada are outlined in API 1130 Section 6.5 and in CSA (Canadian Standards Association) Z662 Annex E. The combination of the requirements of these two regulatory documents outlines a very thorough training program for control room staff.

For Keystone XL, the training of Pipeline Controllers will utilize:
- a Telvent Simsuite OTS (Operator Training Simulator). For leak detection training, the simulator allows various sizes of leaks and at various locations to be impressed upon the simulation. The Pipeline Controllers learn how to recognition and respond to these simulated leaks.
- a formal pipeline hydraulics training course and training in the use of a pipeline hydraulic calculator that a Controller can use for pipeline hydraulic analysis
- in the OTS testing of the Pipeline Controller's ability to recognize and respond to leaks and qualification testing of the Pipeline Controllers
- table top exercises in how to recognize a leak, how to analyze a leak and how to respond
- training so the Controllers thoroughly understand the capabilities of the four types of leak detection applications that will be used on the Keystone XL pipeline
- training in Emergency Response and how to work with support staff and field staff to verify leak size and location

The following text is the applicable Pipeline Controller training section from API 1130. Keystone XL will meet all of the requirements of this section.

Response prepared by: Don Scott, TransCanada

6.5 PIPELINE CONTROLLER TRAINING & RETRAINING

The users of the CPM system (i.e. the Pipeline Controllers) and any CPM support staff require appropriate CPM training. CPM alarms may be the most complex type of alarm experienced by the Pipeline Controller. Specific training and reference material is necessary to prepare the Pipeline Controller to adequately recognize and respond to these alarms. This requires both a knowledgeable perspective on the alarms themselves as well as the nature of the alarms. The American Petroleum Institute has created a Recommended Practice RP1161 for Controller Training that considers many important related training issues outside the scope of this publication.

The training plans may include;
- Periodic reviews and or knowledge testing of the Pipeline Controller
- Review of training material to be accurate and thorough

Retraining may be aided by review of known cases where the irregular operating condition alarms or abnormal operating conditions have occurred and possible commodity release alarms have been generated.

The following technical areas may be considered: (only as they relate to the CPM system)

• Hydraulics. A Pipeline Controller should be trained in the basic concepts of pipeline steady state hydraulics as they relate to the CPM system. The variances of hydraulic pressure due to elevation profiles, batches of differing density, temperature effects, and DRA. The controller should also be trained in the basic relationship of pressure and temperature during shut-in conditions.

A Pipeline Controller should be trained to recognize the effects of pump start-ups/shutdowns, valve operation switch, pressure setpoints and other everyday activities, which cause transient conditions. Any of these will cause a system flow or pressure transient to appear potentially affecting CPM thresholds leading to non leak alarming.

• Alarming/Performance. The Pipeline Controller should be able to recognize and react to all CPM alarming, cognizant to indicators of CPM system performance.

• Data Presentation. A Pipeline Controller should be trained in the recognition of the CPM notification or alarm and may be trained to research the cause of the alarm (data failure, irregular operating condition or possible commodity release), or in methods of correlation of the alarm to independent data so Controller will pursue the appropriate

response. The presentation of CPM alarm data is a crucial component, such as the trend of the probability of a leak, or the description of the location for which the leak declaration has occurred. Other specifics to Data Presentation can be referred to in API 1165

• Instrument Failure. The Pipeline Controller should be able to qualitatively identify the impact of an instrument failure on the CPM system. The Pipeline Controller should be trained to link the alarm event with the concept that the CPM system could be impaired.

• Validating CPM Alarms. An evaluation of the CPM system and operating conditions is necessary for validating or explaining the cause of a CPM alarm. The Pipeline Controller should be trained to recognize and react to abnormal operating conditions and to take appropriate action. The training may be directed towards following procedures or calling upon and working with external resources for alarm evaluation.

• Line Pack Change (Online). A Pipeline Controller should be trained to recognize CPM hydraulic pressure changes due to varying line pack. A fundamental element in the spectrum of inventory control is the calculation of mass, or the comparison of barrels in versus barrels out. This training would include the ability to recognize the compressibility behaviour of the liquid hydrocarbons that are transported.

A Pipeline Controller should be knowledgeable about sections of the pipeline that are susceptible to intermittent "slack line conditions". The Controller should be knowledgeable about how this condition affects the CPM performance.

• Trending. A Pipeline Controller should be able to recognize benefits provided by trending analysis of pipeline variables from SCADA and CPM. Trending data can be presented graphically or may be presented as a tabular display of historical data. A graphical output may provide the best visual history of CPM parameters. The Controller should be able to cross correlate CPM output with SCADA output wherever possible confirming CPM alarm evaluation.

• CPM System Operation. The Pipeline Controller should be trained to understand the CPM system, and the concept/theory of its operation. A portion of Pipeline Controller training may include periodic review of the use of the CPM system in a training environment. Training may cover all the various CPM systems in use within the Control Center and unique aspects of each application as they apply to individual pipeline segments.

Response prepared by: Don Scott, TransCanada

The Pipeline Controller should be trained to interpret alarms correctly and in a timely manner or work with internal or external resources to evaluate the alarm. The CPM system should be implemented so the alarms are readily recognizable.

• Abnormal Functions. The Pipeline Controller should be trained to recognize and react to the abnormal function of a CPM system as well as the abnormal function of the SCADA system. The loss of either should elicit certain predefined actions intended to preserve pipeline integrity. Targeted response actions should be thoroughly analyzed and scripted for prompt, efficient action.

For example, if the CPM system becomes non-functional or severely degraded due to field equipment or SCADA failure, the Pipeline Controller should be trained to employ other leak detection methods to compensate for the inadequacies of CPM. Alternatively, the Control Center may need to define what interval of time the CPM can be non-functional and what action needs to be taken. Short term solutions may consider manual line balance and over-short and pressure /flow monitoring. Actions might include tightening of pressure and flow alarm parameters.

• Other Leak Detection Techniques. The Pipeline Controller should be trained in how to employ the results of other leak detection technique such as 3rd party reports, SCADA deviation alarms etc so that a CPM system is not considered to be the only means of detecting leaks. The Controller should know what procedures to follow and reactions to make for other methods.

Response prepared by: Don Scott, TransCanada

4-7

Data Request:

Please provide procedure information sufficient to demonstrate procedures are in place to shut down the pipeline immediately in the event there is a question or concern any data is received that may suggest there is a release of product to the environment.

Response:

Procedures for immediate shutdown of the Keystone XL pipeline will be developed and will be in place to cover two situations:

a) the occurrence of a large leak that is greater than approximately 25% of the line flow rate. This size of leak causes a severe and obvious degradation of the hydraulic profile of the pipeline. The Pipeline Controller will notice this change in operations through SCADA monitoring and will initiate an immediate controlled shutdown of the pipeline.

b) the situation where a leak alarm occurs in conjunction with another "leak trigger". The procedure would contain these words or details: In the event an operator receives an alarm, regardless of severity, in conjunction with an additional leak trigger, the actions will be the same: Shutdown and isolate the pipeline as per Isolation and Segmentation Standards – Emergency Shutdown.

Leak triggers would normally include:

- Sudden unexplained drop in upstream discharge or downstream suction pressure.
- Sudden unexplained change in throttle or VFD percent synchronous.
- Pump falling off on low suction in combination with an increase in upstream flow rate.
- Pump Station locking out in combination with an increase upstream flow rate.
- A Leak Detection System (LDS) Alarm from one of the four additional leak detection systems.
- An anomaly in pipeline balance (Volume In vs. Volume Out) over 2 hour window greater than 5 %.
- Third Party Call-in

Response prepared by: Don Scott, TransCanada

4-8a

Data Request:

Please provide the pipeline surge protection model or other information that demonstrates that the calculations from the transient model showing the maximum surges along the pipeline from the failure of one of the devices mentioned below , unexpected shutdown of a pump station or the unexpected closure of a pipeline valve will not overpressure the pipe. Also, please provide information on any other overprotection methods in place to protect the pipe from overpressure in surge conditions.

SCADA system software at the OCC

a. Suction based discharge pressure algorithm

Response:

Overpressure protection of the Keystone XL pipeline considers two aspects: steady state pressure profile; and surge pressures.

The suction based discharge pressure reduction (SBDPR) algorithm is calculated based upon the steady state pressure profile of the pipeline. The SBDPR calculation is continuous and the values therefore change as the pipeline conditions (e.g. suction pressure) change. The algorithm defines a relationship between the suction pressure at a downstream station and the discharge pressure of the pump station that is immediately upstream. For example, a combination of a high discharge pressure with a high suction pressure could create a midline pressure that would exceed the maximum allowable pressure (MOP) at that location. The SBDPR forces the reduction of the allowable discharge pressure so an overpressure cannot occur anywhere in that section of the pipeline. The SBDPR algorithm resides in the SCADA system in the OCC (Operations Control Centre).

A transient hydraulic model is used to calculate possible surge pressures (for example caused by events such as pump station shutdown or unexpected valve closure) and the calculated surge pressure is overlaid on the steady state pipeline pressures. Specific control algorithms or additional hardware is then added to the pipeline to ensure that the combined pipeline pressure does not exceed 110% of MOP at any pipeline location.

Response prepared by: Don Scott, TransCanada

Addressing surge pressures only, the magnitude of the surge pressures that could occur on the Keystone XL pipeline are calculated by use of Advantica SPS (Stoner Pipeline Simulator) transient hydraulic simulation software. This modeling software is licensed from Stoner. The configuration of the software and the interpretation of the outputs is specific to the pipeline being studied and the set of conditions that are being reviewed. Because of its proprietary nature, Keystone is not able to provide the pipeline surge calculation model.

The surge pressure design for Keystone XL Pipeline is underway but has not been completed. Using the example of an unexpected valve closure, there are two ways to handle the possible surge: prevention; and/or mitigation. To prevent an overpressure, the SCADA system, when it determines that a valve is in-travel from an open state, will shut down the pipeline upstream of the valve closure. To mitigate possible valve closure overpressure, the motorized valve operator will be programmed to close slowly for the last part of its travel. This slower closure reduces the moving fluid speed over a longer period of time and minimizes the surge to a value which when added to steady state pressure will not exceed the 110% MOP pressure that is allowable by the pipeline code.

Response prepared by: Don Scott, TransCanada

4-8b

Data Request:

Please provide the pipeline surge protection model or other information that demonstrates that the calculations from the transient model showing the maximum surges along the pipeline from the failure of one of the devices mentioned below , unexpected shutdown of a pump station or the unexpected closure of a pipeline valve will not overpressure the pipe. Also, please provide information on any other overprotection methods in place to protect the pipe from overpressure in surge conditions.

SCADA system software at the OCC

b. Suction based discharge pressure reduction algorithm

Response:

See response to 4-8a above.

Response prepared by: Don Scott, TransCanada

4-8c

Data Request:

Please provide the pipeline surge protection model or other information that demonstrates that the calculations from the transient model showing the maximum surges along the pipeline from the failure of one of the devices mentioned below , unexpected shutdown of a pump station or the unexpected closure of a pipeline valve will not overpressure the pipe. Also, please provide information on any other overprotection methods in place to protect the pipe from overpressure in surge conditions.

SCADA system software at the OCC

Logic in the stations PLCs

c. Flow based discharge pressure deduction algorithm

Response:

Please refer to the answer provided in 4-8a for information on the model and surge pressures.

The flow based discharge pressure reduction (FBDPR) algorithm is calculated based upon the steady state pressure profile of the pipeline. The FBDPR calculation is continuous and the values therefore change as the pipeline conditions (e.g. flow rate) change. The algorithm calculates the hydraulic profile of the line based upon the flow in the pipeline (measured by a flow meter at each station) and the characteristics of the fluid in the pipeline and uses that profile to infer the suction pressure at downstream stations. If the algorithm calculates that an overpressure could occur in the section of line considered by the FBDPR, it forces a reduction in the station discharge pressure to a value which would prevent overpressure anywhere in the section being protected. The FBDPR algorithm resides at the station where the flow is measured. It is, therefore, independent of SCADA and the communications infrastructure.

Response prepared by: Don Scott, TransCanada

4-8d

Data Request:

Please provide the pipeline surge protection model or other information that demonstrates that the calculations from the transient model showing the maximum surges along the pipeline from the failure of one of the devices mentioned below , unexpected shutdown of a pump station or the unexpected closure of a pipeline valve will not overpressure the pipe. Also, please provide information on any other overprotection methods in place to protect the pipe from overpressure in surge conditions.

SCADA system software at the OCC

Logic in the stations PLCs

d. Station control valve control to prevent pipeline over pressure

Response:

The station PCV (pressure control valve) reduces station discharge pressure by throttling pressure that is in excess of the set point discharge pressure at the station. It is a device that controls the steady state pipeline discharge pressure. The response time of a PCV is normally slower than the traveling velocity of a surge pressures so PCV's are not used to block or reduce a pipeline pressure surge.

In the case where a PCV fails, it will usually fail in last position. But if the last position is not adequate to maintain the pressure below the in-force allowable pressure, the overpressure protection system will reduce the speed of the last in series pump (if there is a VFD installed) or shutdown the last in series pump (or cascade additional pumps or shutdown the entire station if necessary) to ensure that the safe pressure maximum is not exceeded. The overpressure protection set points is dictated (either through SCADA or encoded in the station the PLC).

Response prepared by: Don Scott, TransCanada

4-8e

Data Request:

Please provide the pipeline surge protection model or other information that demonstrates that the calculations from the transient model showing the maximum surges along the pipeline from the failure of one of the devices mentioned below , unexpected shutdown of a pump station or the unexpected closure of a pipeline valve will not overpressure the pipe. Also, please provide information on any other overprotection methods in place to protect the pipe from overpressure in surge conditions.

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e. Speed control of motors with VFD to prevent pipeline over pressure

Response:

The station VFD (variable frequency drive) pump speed control equipment reduces station discharge pressure by reducing the speed of the pump until station discharge pressure matches the set point for the discharge pressure at the station. It is a system that controls the steady state pipeline discharge pressure. The response time of a VFD is normally slower than the traveling velocity of a surge pressures so a VFD is not used to block or reduce a pipeline pressure surge.

In the case where the station VFD fails, the pump that is being controlled by the VFD will shut down. But if the discharge pressure being produced at the station is above the in-force maximum pressure (either provided through SCADA or encoded in the station the PLC), the overpressure protection software at the station will shutdown the last in series pump (or the entire station of necessary) to ensure that the safe pressure maximum is not exceeded.

Response prepared by: Don Scott, TransCanada