

**North Dakota Public Service Commission
TransCanada Keystone Pipeline, LP
Case No. PU-06-421
Late Filed Exhibits**

**September 26, 2007
Page 1 of 2**

Late Filed Exhibit T-36

Data Request:

Provide Report on External Leak Detection Systems.

Response:

Attached is a report from Accufacts Inc. entitled "Recommended Leak Detection Methods for the Keystone Pipeline in the Vicinity of the Fordville Aquifer" (Report). The Report was prepared by Mr. Richard B. Kuprewicz, of Accufacts Inc. and provides a third party independent review of external leak detection systems and recommendations for pipeline leak detection in the vicinity of the Fordville aquifer.

Mr. Richard B. Kuprewicz is president of Accufacts Inc., a pipeline consulting firm based in Washington State providing independent pipeline analysis services. He brings over 34 years experience in the energy industry offering special focus on appropriate pipeline design and operation in areas of unique population density or of an environmentally sensitive nature.

Mr. Kuprewicz provides neutral third party analysis to assist decision makers in reaching appropriate and informed conclusions regarding pipelines, including their risk assessment and management. He has represented numerous parties concerning sensitive pipeline matters. The vast majority of these clients are public citizens, or representatives of local city, county, state, or federal governmental agencies, or organizations that need highly specialized expertise regarding critical pipeline system matters.

Mr. Kuprewicz is currently serving as a representative of the public on the Technical Hazardous Liquid Pipeline Safety Standards Committee (THLPSSC), a committee defined by U.S. federal law, whose members are appointed by the Secretary of the Department of Transportation to advise the federal Pipeline and Hazardous Material Safety Administration (PHMSA) on proposed liquid pipeline regulations. He is also a member of the Washington State Citizens Committee on Pipeline Safety, a position appointed by the State Governor to advise local, state and federal organizations and agencies on all aspects of pipeline matters.

A copy of Mr. Kuprewicz's resume further describing his qualifications and experience has also been attached.

Late Filed Exhibit T-36

Keystone is in agreement with the findings and conclusions provided within the Accufacts report. The Report confirms that the measures currently proposed by Keystone in the vicinity of the Fordville Aquifer are adequate and there is no need for external leak detection measures in the area.

As testified by Keystone, systems to incorporate accumulated gain/loss trending as recommended by Accufacts Inc. will be implemented.

Recommended Leak Detection Methods for the Keystone Pipeline in the Vicinity of the Fordville Aquifer

Prepared for

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

by

Richard B. Kuprewicz
President, Accufacts Inc.
kuprewicz@comcast.net
September 26, 2007

Accufacts Inc.

“Clear Knowledge in the Over Information Age”

Executive Summary

Accufacts Inc. was commissioned by TransCanada Keystone L.P. (“Keystone”) to independently review and recommend possible leak detection approaches for the proposed pipeline segment located in the vicinity of the Fordville aquifer in northeastern North Dakota (see Figure 1 on page 10). The Fordville aquifer is in an area of unconsolidated glacier deposits and is an important water supply source. Accufacts was also asked to comment on developments concerning possible pipeline “real-time” computer-based external leak detection methods often considered for some “ultra-sensitive areas” where low-rate or seepage releases could be problematic^{1, 2}. Accufacts advises that real-time computer-based external leak detection for the Keystone Pipeline in the vicinity of the Fordville aquifer is unwarranted as this pipeline segment is not located in an ultra-sensitive area.

Because of various factors (e.g., distance from the Keystone Pipeline, low gradient of the terrain between the pipeline and the aquifer, soil conditions, as well as characteristics of the crude oil blends), low-rate or a seepage leak is not a legitimate threat to the Fordville aquifer. Keystone’s current design approach utilizing internal computer-based leak detection efforts (computational pipeline monitoring, or CPM) is more appropriate for this location. Real-time computer-based external leak detection is intended to more quickly identify low-rate releases, and the additional complexities associated with such systems are not justified for the protection of the Fordville aquifer.

A properly implemented CPM leak detection system is better suited to identifying high-rate pipeline releases that, even though a low probability, might reach the boundaries of the Fordville aquifer in unusual conditions. The CPM system should clearly incorporate separate alarming to rapidly identify high-rate releases, and include long term accumulated gain/loss balance computer trending alarms to help identify lower rate releases that can generate slowly expanding underground release plumes that might spread from the pipeline right-of-way with time.

A competent oil spill response plan should outline key contingency steps to protect/recover aquifers that may be impacted from a pipeline. Keystone’s oil spill response plans are advised to recognize all aquifers that they might affect and clearly outline the critical steps that would be taken to limit spill impact as well as remediate the aquifer, if ever needed, from a release.

¹ Real-time computer-based external leak detection systems monitor conditions outside of a pipeline, usually for hydrocarbon, and differ from other external non real-time inspections such as visual or instrumented patrols of pipeline right-of ways, which have other limitations.

² “Ultra-sensitive area” is a term coined by this author to describe those few areas where a low-rate or seepage pipeline release could reach a sensitive area, have serious consequences, and could not be actively remediated. Ultra-sensitive areas are usually a very small subset of a prudent high consequence area evaluation for pipelines, though the term is not defined in pipeline regulation.

Background

The author estimates that less than 0.1% of the approximate 200,000 miles of liquid transmission pipeline in the U.S. currently incorporate real-time computer-based external leak detection systems in some ultra-sensitive areas where site specific considerations such as fluid, soil and hydrology justify such protection from low rate or seepage releases. Usually such external systems are considered for pipelines that actual cross ultra-sensitive areas (e.g., qualifying aquifers). Essentially, all liquid pipelines utilizing centralized supervisory control and data acquisition, or SCADA, computers include some form of CPM.³ CPM is ideally suited for quickly identifying high rate pipeline releases associated with rupture or large holes such as major punctures.

Real-time computer-based external leak detection systems are intended to more quickly identify slow rate or seepage releases than conventional right-of-way inspections, patrols, or CPM. Such real-time external systems should be considered as complementing CPM leak detection in those few ultra-sensitive areas where the environment can quickly spread low rate releases. These systems may be justified in a few areas that can have high consequences because of the number of sensitive receptors (i.e., people) or the potential to critically impact the environment. Lowering CPM leak detection thresholds, especially as a percentage of throughput in an attempt to quickly capture these lower rate releases, usually generates too many false alarms. Lower rate leaks or seepage releases often occur below the “noise” level of CPM leak detection systems making prompt or rapid determination of these releases difficult. Fortunately, in most locations the slower spread rate of low-rate or seepage release plumes, even in many ultra-sensitive areas, allows for a longer determination time before serious consequences occur. In most locations a CPM accumulated loss/gain trending balance is sufficient to identify such slow releases before they can become a concern. A key objective in any leak detection approach should be reliable determination without generating false alarms that can cause the operator to lose confidence in the system. Excessive false leak alarm (“alarm overload”) is a recurring and epidemic problem in the ever-increasing world of computer controlled or computer monitored transmission pipelines.

Over the last two decades sensor technology has advanced, led mainly by the efforts related to storage tank contamination of groundwater supplies, from both above ground and underground storage tanks (“USTs,” e.g., gas station system failures). The author cautions that the field application of such technical advances to limited or fixed land sites such as USTs, terminals, refineries, or chemical plants is orders of magnitude easier than the actual field scale up for linear pipeline systems spanning many miles. For example, unlike tank farms, most pipeline right-of-ways do not have fenced boundaries that restrict or limit public access or activities. There are many complications with pipelines that make effective

³ Current U.S. federal pipeline safety regulation does not require computer monitoring or computer operation of a pipeline, but those single phase liquid pipelines that do utilize internal computer based leak detection must meet the minimum requirements of 49CFR195.444 CPM leak detection that requires the operator to follow American Petroleum Institute (API) publication 1130, “Computational Pipeline Monitoring for Liquid Pipelines – Second Edition,” November 2002.

application of real-time computer-based external leak detection to pipelines challenging. One is: "What is the ideal location for the sensor placement near a pipeline?" Such a location decision can be very site specific.⁴ It is the opinion of this author that real-time computer-based external leak detection for pipelines is still in the early stages of field development.

Given the hurdles associated with scale-up to pipelines, real-time computer-based external leak detection developing technologies may be utilized to supplement computer-based internal leak detection, or CPM, in a small number of specific ultra-sensitive locations of very limited mileage. In these few specific locations, failure to quickly identify low-rate or intermittent seepage releases could have serious consequences, such as those sites that can't be actively remediated. Examples of such special sites would be a pipeline located in a difficult to mitigate, recharge area of high flow unconsolidated aquifers, or in a karst aquifer.⁵ Such unique environments usually are reflective of areas where oil spill remediation/cleanup cannot be timely and effectively applied and more rapid release identification is warranted because of the potential for released oil to swiftly reach or spread, especially within such unique aquifers.⁶ Only a relatively small number of pipeline miles are in areas that justify remote monitoring by real-time computer-based external leak detection systems. A large segment of this country relies on aquifers as a national resource. Most pipelines cross aquifers though many of these aquifers are not threatened by these pipelines because of local conditions that limit impacts and/or are amenable to proper recovery from remediation.

The Pipeline Release Paradox

The higher the rate of release (ruptures generate the highest rate of release) the greater the likelihood that the release can be remotely and quickly identified by CPM systems. The paradox is that the lower the rate of release, the longer the time required to remotely identify a release, and such identification is not always certain. This last statement is true whether the remote identification is by computer-based internal or external leak detection approaches. Regardless of the release rate, no remote system developed to date is capable of immediately identifying a release. Timely identification of higher rate releases by CPM is controlled by the laws of fluid mechanics that transmit various signals moving up or down a pipeline at the speed of sound within the fluid in the pipeline. This identification/recognition time can be several minutes for long transmission systems dictated by the location of sensing equipment along the pipeline.⁷

⁴ For example, depending on soil and local hydrology, placement of sensors below the pipeline may be very inappropriate.

⁵ Karst aquifers are a relatively small percentage of aquifers in the U.S., and, because of their unique structure and fast underground flow, are essentially impossible to mitigate once they have been contaminated by oil.

⁶ It should be noted that not many aquifers meet these unique conditions.

⁷ For most hydrocarbon liquid pipelines the speed of sound is approximately 4000 ft/sec.

For pipelines that could affect ultra-sensitive areas in which computer-based external detection is applied (usually supplementing CPM systems), detection is frequently controlled by mass transport phenomena that can substantially extend the time it takes for a liquid or vapor to reach a detector (even located close to a pipeline), if it ever does. In applying any pipeline leak detection method the pipeline operator must balance the confidence that a particular leak detection system will properly alert an operator to a real release, while minimizing, and ideally, eliminating false alarms that can distract or undermine the operator's confidence in the leak detection system(s). Because underground migration rates are slower, they extend the period before a hydrocarbon plume becomes problematic. Therefore, a longer time for detection of a low-rate or seepage releases is acceptable.

Computer-Based External Leak Detection Approaches

In discussing major areas of external leak detection development, the author by no means is suggesting that advancements in external leak detection should be limited to only four approaches considered and discussed as many factors influence the successful field application of various advancing technologies to a specific pipeline segment. The four approaches presented represent the extensive field experience and opinion of Accufacts Inc. In any developing technology concerning pipelines and public safety, this author is guided by four core principles established over several decades of experience involving pipeline siting, design, operation/maintenance, emergency response, and environmental remediation in some of the most sensitive areas of the world: 1) the approach reliably works in the field as expected or claimed (field application and theory can be two entirely different situations), 2) the technology must be cost effective compared to other reasonable alternatives, 3) the technology cannot be overly complicated or complex (increases likelihood of breakdown or failure), such that it hinders the safe operation of the pipeline (such as generating numerous false alarms to get one true alarm), and 4) the system must not create the illusion of safety (fail to work when needed) creating overconfidence in the system's capabilities.

The vast majority of real-time computer-based external leak detection approaches utilize direct indication where the fluid or its vapor contacts a sensor or receptor to trigger identification of a possible release. The receptor or its pickup is usually continuous, running parallel to the pipeline and sensor placement in relation to the pipeline can be critical. Each approach discussed below varies in the technology used to identify the hydrocarbon release and to identify the location of the release. There are usually limits to the length of a pipeline segment that can be reliably monitored by computer-based external leak detection. The author's specific comments are restricted to systems that are intended to monitor pipeline segments for lower rate or seepage releases 24/7 as most pipelines operate, for all practical purposes, around the clock.

Fiber Optic Monitoring

This technology uses fiber optic cable carrying a light signal through it and falls into two slightly different approaches to determine a leak. One approach coats the fiber optic with a sensitive polymer coating that permits light to leak out of the fiber in the presence of certain hydrocarbons. Another approach, instead of using a light leaking coating, uses the changes

in the refractive index of the cable due to temperature or strain changes to determine a possible leak. In both methods, light transmission as compared to a reference light source develops a refractive index that permits a microcomputer to keep the system calibrated and to determine the leak location when a specific type of change is noticed. This technology has the potential to morph beyond leak detection, such as third party or pipeline security, though such objectives should not be confused with a leak detection priority.

Advantages - Direct confirmation of hydrocarbon by contact with a sensor. Can be installed as continuous cable or spot probes. Technology should permit longer pipe segments, reducing segmenting. Can be tailored to various hydrocarbons to avoid false leak alarms. Provides rapid identification of leak location once cable is contacted by hydrocarbon. Low operating cost once installed. Intrinsically safe source with sensor cable not at risk of electrical short-circuiting.

Disadvantages - Current application for pipelines should be classified as experimental. Microcomputer must incorporate calibration of system. High installation cost with associated high probability of failure from unproven technology.

Advice – Do not consider fiber optic monitoring a viable technical approach. This technology is not warranted in the Fordville Aquifer area

Hydrocarbon Electric Sensing Cable

Various suppliers of these systems utilize a continuous sensor cable that has advanced in capabilities in oil selection, water exclusion and possible recovery after hydrocarbon contact. Newer generations of dielectric sensing cable surround two conductive paths running parallel in the cable with a polymer that changes conductive properties on contact with certain hydrocarbons, completing an electric circuit while excluding water. Microcomputer circuitry is then utilized to determine the location of the leak within the cable segment.

Advantages - Can be tailored to specific system, and set to avoid false alarms by incorporating cable trigger hurdle hydrocarbon detection concentration. Direct confirmation of hydrocarbon by contact with a sensor. Specifically designed for leak detection applications. Relatively inexpensive equipment costs. Designed for easy multiple segment tie-ins or connection that can span more than a few miles. No field calibration required as system segment is either on or off.

Disadvantages - While usually not a problem, design/installation must ensure no interference with CP protection. Fairly short cable lengths (e.g., 500/5000 feet), requires multiple segments for longer distances. While cable is intrinsically safe, system can be subject to environmental short-circuiting, knocking system off line. Choice has to be made between once use cable that must be replaced if hydrocarbon has been detected, or cable that can be dried out after hydrocarbon contact. Cable installation may need to be hardened for longer lifespan in many field pipeline locations (e.g., placed within slotted plastic piping or shielded).

Advice – Limited pipeline field application for fairly short cable lengths in some ultra sensitive areas. This technology is not warranted in the Fordville Aquifer area.

Hydrocarbon Vapor Monitoring

This approach utilizes the placement of a small diameter specially selective permeable membrane covered perforated plastic pipe or tubing “sampling line” laid parallel to the pipeline (usually over the pipeline) that permits hydrocarbon vapor to pass into the sampling line, while preventing water intrusion. This sampling tubing is usually intended to operate at atmospheric pressure or slight vacuum to permit diffusion of a “leak” hydrocarbon vapor into this line. The sample line is then periodically batch swept with air containing an identifier low concentration tracer gas (e.g., diluted hydrogen below its explosive range) injected at one end of the sample line to calibrate each sweep time through the length of the sample pipe. At the other end of the sample line the air is monitored for hydrocarbon and tracer chemical by an analyzer receiving the sweep. Given the times for the tracer gas and the hydrocarbon vapor signals to reach the analyzer, the location of the leak up the sampler tube can be calculated by the leak detection system microcomputer included with the system.

Advantages - One of the oldest (a couple of decades) computer-based external leak detection methods applied to pipelines. Can be tailored to a specific system and set to avoid false alarms by establishing a trigger concentration. Direct confirmation of a hydrocarbon leak by a measurement. Identifies location of leak. Easy to quickly clear a leak alarm to return leak monitoring system back to service. Fairly low installation cost.

Disadvantages - Pipeline fluid must generate vapor that can permeate the carrier pipe/tubing special membrane. Not a “real time” continuous sampler as it operates in batch mode (e.g., daily sweep cycle). Certain design restrictions place an upper “practical” limit to the length of sampling tube with most being 5 miles or less. Longer pipeline systems may have to be segmented into multiple systems. Accordingly, these systems are more complex with higher operating/maintenance costs associated with mechanical moving parts and consumables (tracer gas). Injection equipment and receiver analyzer must also be placed in modules located on the ground surface at ends of each sample segment.

Advice – Limited pipeline field application in some ultra sensitive areas. This technology is not warranted in the Fordville Aquifer area.

Acoustic Emission Monitoring

This approach takes advantage of the theoretical principle that leaks from pipe emit a specific low frequency sound transmitted along the pipe wall that can be detected. External sensors or transducers capable of picking up this sound are periodically located on the outside of a

pipeline. A microcomputer is utilized to develop a baseline or reference acoustic spectrum map on the pipeline when no leaks are present as well as to monitor changes. Deviations from this acoustic profile are alarmed as a possible leak and the system's microprocessor uses special algorithms to identify the location of the leak. While the technical approach appears sound, this author is not aware of any real pipeline field installations applying this method to low rate or seepage leaks that can be easily cloaked by greater hydrocarbon pipeline operating noise.

- Advantages - Appears simpler and more economical to install than present external leak detection systems. Low maintenance cost as system is passive. Real time-monitoring and quicker time to leak detection (doesn't rely on transport of liquid or vapor to a sensor) as signal moves along the steel pipewall. Not affected by local water table hydrology changes.
- Disadvantages - Not all releases may be identified. Approach more likely to generate false alarms as determination is by inference, not direct hydrocarbon detection. "Tuning" of leak detection system and algorithms to pipeline location required, which always gets this author's attention concerning confidence in pipeline field installations.

Advice – Do not consider acoustic emission monitoring technical approach. This technology is not warranted in the Fordville Aquifer area.

Keystone Pipeline Key Parameters

The proposed Keystone Pipeline in North Dakota is a 30-inch crude oil liquid transmission pipeline rated for 1440 psig "Maximum Operating Pressure, or MOP." The pipeline will be operated liquid full (non slack line). The pipeline is designed to move "batches" of blended bitumen and synthetic crude produced from oil sands in Northern Alberta.⁸ Keystone Pipeline expects to transport crude oil with a minimum °API gravity of 19. One of the critical operating parameters influencing the leak detection system thresholds will be variation in the composition of the crude oil blends entering the pipeline as crude oil specifications will change with the seasons. The pipeline will be operated in a "tightline" mode with a minimum of intervening storage tankage along the pipeline. Tightlining simplifies the challenges associated with leak detection.

Accufacts has reviewed Keystone's CPM leak detection approach and finds that it should easily be capable of quickly identifying high rate releases in the vicinity of the Fordville aquifer. Keystone will also incorporate accumulated gain/loss computer trending balancing and separate alarming to assist in identifying possible low rate or seepage releases over a

⁸ Bitumen is the very heavy tar like oil directly produced from Canadian oil sands and consists of the heavier higher carbon hydrocarbon compounds that must be blended with lighter oil or processed to synthetic crude for the material to flow in an unheated liquid transmission pipeline. Synthetic crude is bitumen that has undergone special refinery processing to significantly change its composition by reducing its carbon content while increasing its hydrogen content, resulting in a substantially different crude oil.

period of time. These low rate releases are not a bona fide threat to the aquifer but such trending is prudent in any pipeline operation. It is worth noting that emergency and operational response to possible rupture alarm will be markedly different from that associated with a much lower rate, possible accumulated loss trending leak alarm, and Keystone's procedures will reflect this appropriate response difference.

Figure 1, on page 10, represents an exhibit provided by Keystone and their environmental consultant ENSR, presenting an important perspective for the analysis of the Keystone Pipeline segment and the Fordville aquifer. The overlying grid lines in this drawing are one-mile squares and the brown contour lines are in meters. A review of the elevation profile for this pipeline indicates the pipeline elevation differences will not greatly contribute to the release volume in the event of a major pipe rupture failure anywhere along the Fordville aquifer. Figure 1 shows that main channels between approximate pipeline Milepost ("MP") 45.8 to MP 48 require evaluation as a possible release threat to the Fordville aquifer recharging area (identified as "losing" area in Figure 1). In the unlikely event that oil reaches the recharge zone of the aquifer, the low flow rate within the aquifer would limit oil migration into the aquifer, especially into the zones of the water wells indicated in Figure 1 that serve the City of Fordville. Additional data provided by Keystone indicates that this segment of the pipeline is bracketed on the upstream side by Pump Station ("PS") # 15 (at MP 33.1), and on the downstream side by a check valve (V-47 at MP 49.7), and PS # 16 (at MP 77.7). The pump stations contain remotely operated block valves commanded by the control center that can isolate the pipeline segment.

A release on the pipeline segment (MP 48 to MP 58) that might be considered a possible risk to the "gaining," or discharge zones, of the Fordville aquifer can be responded to by conventional spill response and cleanup, as oil reaching these areas will not enter the aquifer. Oil reaching these areas is essentially treated as a surface water spill which is substantially different than a below grade contamination response.

Even though there is a very low probability of a pipeline release, Keystone's oil spill response plan should address key steps that might be required should a pipeline release reach an aquifer. Such contingency plans will further reinforce the point that oil spills in most aquifers can be remediated to maintain or restore such aquifers to their important water supply service.

Pipeline Release Scenarios Considered

High-rate releases - either ruptures or large leaks

High-rate pipeline releases, such as ruptures associated with massive pipeline failure defined by fracture mechanics, or high-rate leaks usually associated with large holes, produce signals that can be easily picked up by a competent CPM leak detection system. These signals are transmitted up and down the pipeline at the speed of sound within the fluid, which is approximately 4000 ft/sec depending on the hydrocarbon and temperature. There is a correlation for CPM systems between the rate of the releases and the time to determination. The larger the release, the shorter the time to determination. It will not take much time for

the CPM to detect a high mass flow release especially given the relatively close proximity of PS # 15 and 16, with their associated pipeline monitoring equipment located at these stations. Problems often occur on CPM leak detection systems when leak detection alarm thresholds are turned down or lowered in an attempt to identify smaller rate releases. Oftentimes, the noise within the system causes the CPM to generate too many false alarms causing a serious loss of confidence in the CPM that can set up control room operating personnel remotely operating the pipeline for failure. Given the nature of these crude oils and the batch type operations of the pipeline, this author would advise Keystone to keep their leak detection approach simple (even if Real Time Transient Modeling is utilized), and warn them to avoid setting their major release alarms too low. The operating noise from the complications associated with batch blended crudes could set the system up for too many false alarms if the alarm thresholds are set too low.

Low-rate releases - either low-rate leaks or intermittent seepage

Low-rate releases are associated with small holes or cracks and, given the distance from the aquifer (at least 3 linear miles from the pipeline at its closest point), this author concurs with ENSR's basic conclusions that threat to the Fordville aquifer from slow rate releases is essentially non-existent, not only for subsurface release migration threats, but also for such small releases that might break to the surface and be carried along by rain or snow generated runoffs.

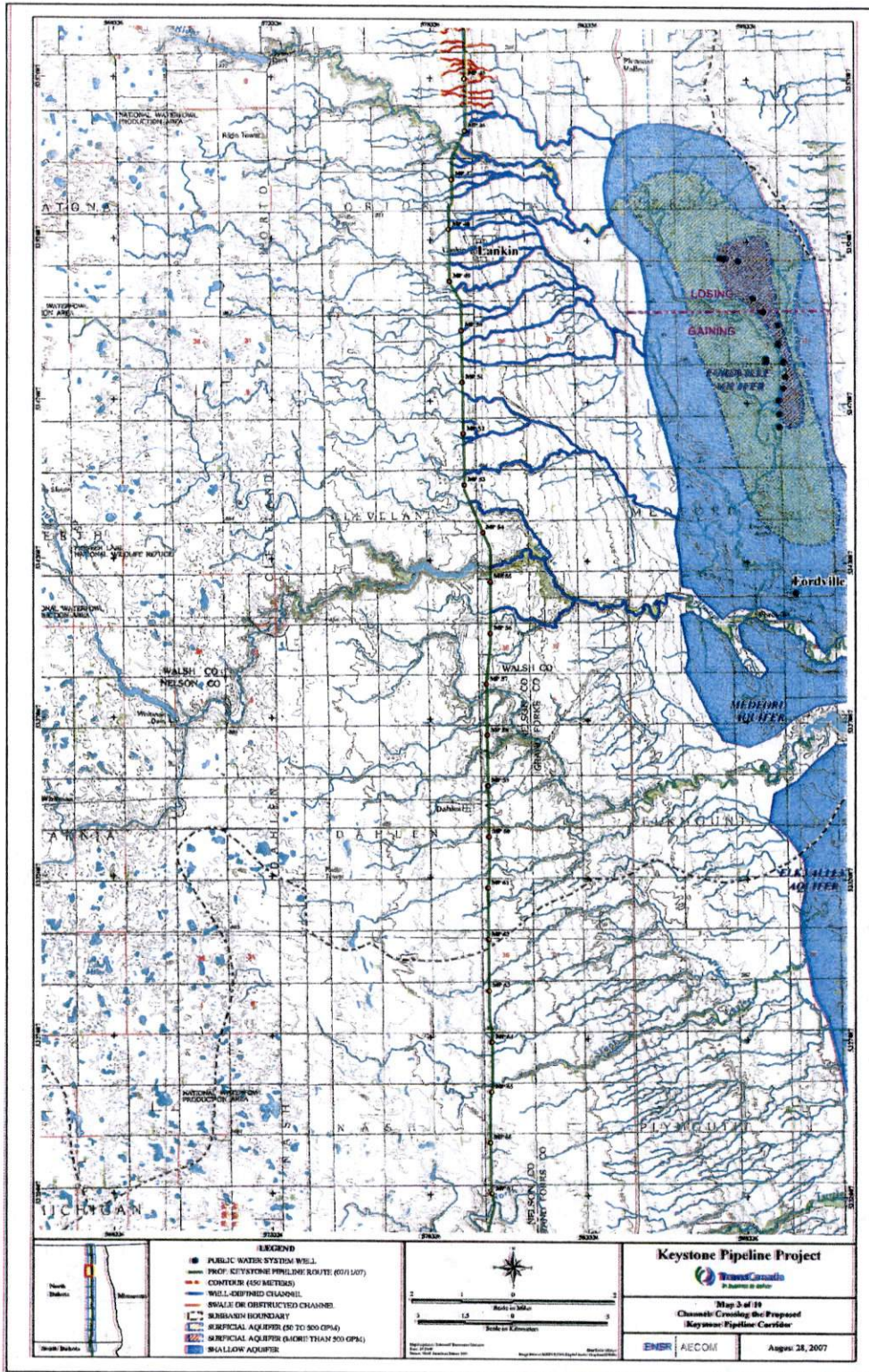
In the event of such a low-rate leak, the pipeline should have time to determine such an event before it becomes a major consequence. To assure prudent monitoring for slow rate leaks, this author would advise that the Keystone Pipeline CPM incorporate trending accumulation balances that are quite capable of reliably determining such releases over time. Note that for the accumulation balance trends, the highest precision measurements associated with custody transfer/meter prover measurement is not necessary on this segment, as long as the precision range for the segment is determined by Keystone and incorporated into the computer generated trending plots for this tightlined pipeline section.

Conclusions

Accufacts advises that real-time computer-based external leak detection for the Keystone Pipeline in the vicinity of the Fordville aquifer is unwarranted as this pipeline segment is not located in an ultra-sensitive area.

Because of various factors (e.g., distance from the Keystone Pipeline, low gradient of the terrain between the pipeline and the aquifer, soil conditions, as well as characteristics of the crude oil blends), low-rate or a seepage leak is not a legitimate threat to the Fordville aquifer. Keystone's current design approach utilizing internal computer-based leak detection efforts (computational pipeline monitoring, or CPM) is more appropriate for this location. Real-time computer-based external leak detection is intended to more quickly identify low-rate releases, and the additional complexities associated with such systems are not justified for the protection of the Fordville aquifer.

Figure 1 – Proposed Keystone Pipeline/Fordville Aquifer



Richard B. Kuprewicz

EXPERIENCE

- 1999 - Present** **ACCUFACTS INC., Redmond, WA**
Pipeline Consultant
Specialize in gas and liquid pipeline investigation, auditing, risk management, siting, design, operation, maintenance, training, SCADA, leak detection, management, and emergency response. Consultant to various city and state agencies, and pipeline industry on pipeline regulation, operation, and design, with particular emphasis on operation in unusually sensitive areas of high population density or environmental sensitivity.
- 1993 - 1999** **Alaska Anvil Inc., Anchorage, AK**
Consultant
Technical process consultant for various clients on oil production facilities, refining, and transportation pipeline design/operations in Alaska. Experienced in federal and state pipeline and OSHA Process Safety Management regulations.
- 1991 - 1993** **ARCO Transportation Alaska Inc., Anchorage, AK**
Pipeline Consultant
Senior Technical Advisor on operation and troubleshooting of Trans Alaska Pipeline System, following the "Exxon Valdez" incident.
- 1989 - 1991** **ARCO Transportation Co., Long Beach, CA**
Manager of Gas Pipeline Projects
Responsible for planning, design, government interface, and construction of new gas pipeline projects as well as gas pipeline acquisition/conversions. Closely involved with Washington UTC and Office of Pipeline Safety during permitting/construction/operation of a new 16-inch gas pipeline from Canada.
- 1985 - 1989** **Four Corners Pipeline Company, Long Beach, CA**
Vice President and Manager of Operations
Managed operations of crude oil and product pipelines/terminals operating in western U.S. Responsibilities included: a cross-country crude oil pipeline, extensive product pipelines operating in the Los Angeles Basin, additional common carrier crude pipelines in California, marine and truck terminals, as well as Regulatory Compliance/Spill Response and Telecommunications/SCADA organizations supporting operations.
- 1981 - 1985** **ARCO Products Company, Carson, CA**
Manager of Process Services
Operated Refined Product Blending, Storage and Handling Tank Farms, as well as Utility and Waste Water Treatment Operations for the third largest refinery on the west coast.
- 1977 - 1981** **ARCO Products Company, Carson, CA**
Manager of Planning and Evaluation
Coordinated short and long-range operational and capital planning and expansion for two west coast refineries.
- 1973 - 1977** **ARCO Products Company, Carson, CA**
Operations Supervisor/Process Engineer
Operating Supervisor and Process Engineer for various refinery complexes.

EDUCATION

Pepperdine University, Los Angeles, CA
MBA, 1977

University of California, Davis, CA
BS Chemical Engineering, 1973
BS Chemistry, 1973

Richard B. Kuprewicz Additional Background

I have testified or given depositions in the following previous pipeline cases:

- 1) Municipality of Anchorage (MOA) versus ENSTAR Natural Gas Co., et al., in which I testified in deposition on behalf of defendant ENSTAR Natural Gas Co. on August 7, 2001.
- 2) Atlantic Richfield v. Allianz Insurance, et al., in which I presented deposition testimony on behalf of defendant Allianz on May 6 and 7, 2002.
- 3) ANR Pipeline Company v. Arents, et al., in which I provided deposition testimony on behalf of the defendant Arents on July 23, 2002.
- 4) Hepp, et al. v. Conoco, Inc., et al., in which I presented deposition testimony on behalf of plaintiff Hepp on October 1, 2002.
- 5) Hoekstra v. Guardian Pipeline, LLC in which I presented deposition testimony on behalf of plaintiff Hoekstra on July 30, 2003.
- 6) Cenex Pipeline, LLC vs Thiel's Welding, Inc. and Underground Boring Specialties Inc in which I presented deposition testimony on behalf of defendants Thiel's Welding, Inc. and Underground Boring Specialties Inc on October 26, 2005 and on August 7, 2006.

Richard B. Kuprewicz Additional Background

The following is a list of my publications in the public domain:

1. "An Assessment of First Responder Readiness for Pipeline Emergencies in the State of Washington" prepared for the Office of the State Fire Marshall, by Hanson Engineers Inc., Elway Research Inc., and Accufacts Inc., and dated June 26, 2001.
2. "Preventing Pipeline Failures" prepared for the State of Washington Joint Legislative Audit and Review Committee ("JLARC"), by Richard B. Kuprewicz, President of Accufacts Inc., dated December 30, 2002.
3. "Pipelines - National Security and the Public's Right-to-Know" prepared for the Washington City and County Pipeline Safety Consortium, by Richard B. Kuprewicz, President of Accufacts Inc., dated May 14, 2003.
4. "Preventing Pipeline Releases" prepared for the Washington City and County Pipeline Safety Consortium, by Richard B. Kuprewicz, President of Accufacts Inc., dated July 22, 2003.
5. "Pipeline Integrity and Direct Assessment, A Layman's Perspective" prepared for the Pipeline Safety Trust by Richard B. Kuprewicz, President of Accufacts Inc., dated November 18, 2004.
6. "Public Safety and FERC's LNG Spin, What Citizens Aren't Being Told" jointly authored by Richard B. Kuprewicz, President of Accufacts Inc., Clifford A. Goudey, Outreach Coordinator MIT Sea Grant College Program, and Carl M. Weimer, Executive Director Pipeline Safety Trust, dated May 14, 2005.
7. "A Simple Perspective on Excess Flow Valve Effectiveness in Gas Distribution System Service Lines" prepared for the Pipeline Safety Trust by Richard B. Kuprewicz, President of Accufacts Inc., dated July 18, 2005.
8. "Observations on the Application of Smart Pigging on Transmission Pipelines" prepared for the Pipeline Safety Trust by Richard B. Kuprewicz, President of Accufacts Inc., dated September 5, 2005.
9. "The Proposed Corrib Onshore System An Independent Analysis" prepared for the Centre for Public Inquiry by Richard B. Kuprewicz, President of Accufacts Inc., dated October 24, 2005.
10. "Observations on Sakhalin II Transmission Pipelines" prepared for The Wild Salmon Center by Richard B. Kuprewicz, President of Accufacts Inc., dated February 24, 2006.

Richard B. Kuprewicz Additional Background

11. "Increasing MAOP on U.S. Gas Transmission Pipelines" prepared for the Pipeline Safety Trust by Richard B. Kuprewicz, President of Accufacts Inc., dated March 31, 2006. This paper is also published in the June 26 and July 1, 2006 issues of the Oil & Gas Journal and in the December 2006 issue of the UK Global Pipeline Monthly magazines.
12. "An Independent Analysis of the Proposed Brunswick Pipeline Routes in Saint John, New Brunswick" prepared for the Friends of Rockwood Park, by Richard B. Kuprewicz, President of Accufacts Inc., dated September 16, 2006.
13. "Commentary on the Risk Analysis for the Proposed Emera Brunswick Pipeline Through Saint John, NB" by Richard B. Kuprewicz, President of Accufacts Inc., dated October 18, 2006.
14. "General Observations On the Myth of a Best International Pipeline Standard" prepared for the Pipeline Safety Trust by Richard B. Kuprewicz, President of Accufacts Inc., dated March 31, 2007.
15. Observations on Practical Leak Detection for Transmission Pipelines – An Experienced Perspective" prepared for the Pipeline Safety Trust by Richard B. Kuprewicz, President of Accufacts Inc., dated August 30, 2007

In addition to the above public domain publications, I have also produced additional numerous reports, letters, presentations, and comments concerning pipeline matters, other pipeline cases, or pipeline investigations, most of which are protected from disclosure under trade secret, nondisclosure agreements, protective orders, or similar agreements or conditions. These documents are no longer in my possession.