PIPELINE TALES

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A Magazine for the Global Pipeliners

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Letter From the Publisher

Dear readers

Happy and prosperous 2023.

We once again thank you for your continued readership and support. We take great pride in publishing various articles about our pipeline industry in this magazine, and we like to think that you enjoy these articles.

In this issue, we are honoring one of our highly knowledgeable Canadian pipeline engineers, Dr. Alan Murray, for his contributions to our industry.

Through this magazine, we promote pipelines and pipeline-related companies with their products and personal tales; and encourage our readers to share their personal stories, adventures, success, and failures.

The digital magazine now reaches over 120,000 readers worldwide, and we thank our readers for supporting our vision of promoting the global pipeline industry.

So please help us to help you. We hope to hear from you soon, as we will publish our next issue in June 2023, and we genuinely appreciate your support.

Hiran Ganguli, P.Eng. Publisher

A Tribute to Dr. Alan Murray

Born in Belfast, Northern Ireland, Alan Murray received his early education there before becoming a student apprentice at a large Industrial Company in the West Midlands of England.

The company sponsored Alan on a four-year Co-op degree course in Mechanical Engineering. He spent six months of each year working in various parts of the company: the Foundry, making large castings; the Jig and tool shop, which made the tools for pressing the chassis of the Rolls Royce Silver Cloud; site work on large power station construction; and finally the Research and Development Division. After graduation, Alan continued to work in R&D, studying heat transfer and the fluid dynamics of combustion products in large steam boilers.

He then moved to the company's Nuclear Power group to work on heat transfer problems associated with operating advanced gas-cooled reactors. The company's process cooled reactor vessels by circulating carbon dioxide gas at high pressure and flow rates. This process had the awkward tendency of causing the shell containing the reactor to vibrate and anything attached to it, such as boiler tubing, to fall off. The company encouraged Alan to study the vibration of thin shell structures as his Ph.D. dissertation. Unfortunately, during his study absence, and assuredly unconnected with it, the Nuclear Power group went bankrupt. He was fortunate to find a new sponsor, the British Ship Research Association (BSRA). Alan's research refocused on determining the dynamic response of ship structures to wave and propeller-induced vibration.

Alan has been fortunate in his career to have benefitted from a few lucky breaks, including a bridge collapse in Australia. This disastrous event led to his thesis supervisor being called to be one of the expert witnesses to the related Court of Inquiry. His supervisor asked Alan to deputize for him at a high-powered meeting of the Ship Research Association. Those attending the meeting must have assumed Alan to be some hot shot, as afterward, the Chief Naval Architect of Harland Wolff, then the largest shipbuilder in the world, offered him a job.

Alan spent several enjoyable years helping design ships and offshore drilling platforms before returning to his alma mater, The Queen's University of Belfast,

as a young lecturer. Alan was fortunate to have a few very able research students and joined his former supervisor in developing a very successful research team engaged in extracting energy from Ocean waves. It was the world's only commercially successful wave energy project until recently. It brought renewable power to the island of Islay in the Hebrides, powering its famous distillery.

After seven very satisfying years on the faculty, Alan's family moved to a new life in Calgary, Canada, when Alan accepted an offer of employment with the Offshore R&D department of Petro-Canada. They arrived in Canada in the summer of 1982, just in time to buy a house before prices collapsed, so the Murrays settled their fate.

Alan's work was interesting, involving, among other things, determining the behaviour of small pieces of ice, "bergy bits," in waves and developing an experiment to simulate the collision of an iceberg with an offshore platform and measuring the impact load. The former was not too hard, while the latter involved finding an island off the Labrador coast and towing an iceberg into it. Alan's daughter saw some of his project sketches, and when he told her what they were, she remarked with the wisdom of a seven-year-old, "that will never work!" Fortunately, Plan B involved working with one of the kindest and smartest people Alan has known, Charlie Perry, and they successfully snagged and re-direct by towing a mid-sized iceberg to a target. It fell to another group to do the impact testing.

In the meantime, Petro-Canada was undergoing many upheavals, so Alan moved to Det norske Veritas (DnV) and returned to the ship and offshore structures. The Cold Climate Technology group at DnV provided a stimulating environment - a happy mix of research projects and real-time investigations, including participating in the Royal Inquiry into the Ocean Ranger disaster.

True to form, Alan's career took another change after seven years when, by happenstance, he met an ex-colleague who was working in the System Planning department at a large pipeline operating company. The ex-colleague and his team had been rewriting a sizeable piece of hydraulic simulation software to model the company's growing pipeline network. He asked Alan to join the group. Alan knew very little about pipelines, though not a stranger to heat transfer and fluid flow. Fortune smiled again in the form of Bob de Wolff and John Vander Put, Alan's System Planning colleagues, to whom Alan owes a great deal; they taught him a lot. System Planning proved to be a great place to learn the workings of a significant pipeline business.

Fate dealt another hand when a colleague drew Alan's attention to an internal posting in Field Services. Alan thought he was crazy, but maybe the interview experience would be enjoyable. He was amazed to be asked by Blair Beckham and Frank Husband to manage the company's Pipeline Services department, with a geographic reach from Oyen to High Fate

dealt another hand when a colleague drew Alan's attention to an internal posting in Field Services. Alan thought he was crazy, but maybe the interview experience would be enjoyable. He was amazed to be asked by Blair Beckham and Frank Husband to manage the company's Pipeline Services department, with a geographic reach from Oyen to High Level. Blair gave Alan two hours to decide to accept the job offer. When Alan said, "Yes!" Blair told him that whatever had happened in the past in Pipeline Services or during Alan's tenure would be Alan's responsibility! Alan had a bad start, with severe life-altering accidents to two new colleagues occurring during his first six weeks.

Nonetheless, Alan's three years in Pipeline Services were the happiest of his career. He got to work with great people, the salt of the earth, hard-working, straight shooters (and a few rascals too).

It was a time of a major expansion coinciding with the latest company initiative, Business Transformation (BT). A part of Alan's remit was in helping senior management determine if the company should continue to do its pipeline hot work and other services or contract these to third-party contractors.

After the BT assignment, the company appointed Alan as the Manager of Goods and Services, looking after Pipeline Services Transportation, Accounts Payable, Procurement, Contract Services, and Asset disposal. It quickly became clear that significant savings in project costs come from effective purchasing and contracting procedures. Alan was fortunate to have excellent staff and team leads to take the department to top-quartile performance in our industry.

Alan's seven-plus-year itch provoked him to switch jobs a few years after a merger with a national pipeline company. He started with the National Energy Board, now called Canada Energy Regulator, as their Chief Engineer and Chief Safety Officer. Alan maintains that it was a privilege to become a public servant and view things from the broad public interest perspective rather than strictly business. Providing technical advice to the Board Members and helping staff grow their careers was truly rewarding. It was a great place to end his formal working life after the seemingly obligatory seven years!

"I have been fortunate to have been a member of two professional societies since graduating. It has allowed me to engage in lifelong learning and volunteer to organize conferences and workshops, write and review papers, and edit Proceedings. It has provided a platform for me to instruct courses and to encourage the participation of young people to join our industry. I have been truly blessed….. Alan Murray."

Dr. ALAN MURRAY – REMINISCING

By Bill Somerville

I was fortunate to work with and for Alan in the late 90s at a pipeline company based in Alberta, two engineers in a Procurement department!

Alan is someone I greatly admire. He is a brilliant engineer with a great sense of humour, genuine empathy, and care for his managers, team members, and people in general.

If I had a question or an idea to bounce off Alan, I thought it would take only five minutes; most often, luckily for me, it would extend to half an hour or longer.

We would talk about everything and anything else other than the subject matter that prompted the visit to his office. And we laughed and laughed. Several times throughout working together, people on the floor would come down to his office (the door was usually open) and ask us not to laugh so loud! I was happy working with Alan.

In one instance I remember, we were planning to ship about six tonnes of pipe from Japan to Vancouver, and we had received the method proposed for storage on the vessel. We wondered if the scheme would be acceptable to prevent any damage to the pipe in transit; Alan did a quick calculation and firmly stated it would be fine, considering wave frequency, voyage duration, etc.

On another occasion, I was fortunate enough to co-present with Alan on a topic I have now forgotten for a group of students. His first introductory line was something to the effect of "I usually ask at the beginning of a presentation if everyone can hear me, but one time, a man in the back shouts out 'yes I can hear you, but I would be pleased to switch places with someone who can't." The laughter erupted, and he proceeded with his entertaining and insightful bit, and I had to follow that!

Alan always had that sparkle in his eyes; a little Irish merriment always seemed to inhabit his soul, positively impacting those around him. During his stint as Director, the department continued to improve its practices, beefed up the focus on supplier quality, and improved the team's performance.

I left the company in late 1999 with Alan supporting my voluntary termination package application. Our careers diverged after that, and we lost contact, but I fondly remember working with Alan.

ALAN MURRAY

Darcy Fabro, Calgary, Canada

II had the opportunity to work with Alan Murray for about four years. Alan always came across as a highly professional leader in the Supply Chain Management area. He always thought strategically, which meant looking at how we did things and how we could do them better. As the group manager, he was instrumental in developing and implementing a complete business transformation for our group.

Alan always was good at giving credit for a job well done and always recognized individuals as individuals. He would encourage us on projects and provide feedback on his thoughts. Alan also tried to motivate us to think outside the box and challenge us to implement our ideas for a better workplace. One thing I always

enjoyed about working with Alan was his sense of humour, which helped contribute to a more relaxed working environment

ALAN MURRAY – MY MENTOR

By Hiran Ganguli

If you are looking for a leader with understanding, respect, and empathy, look no further. We have Alan Murray, and I have known Alan since the mid-1990s. A perfect gentleman with a passion for elevating others to their potential.

Alan offered me a job in his department to lead seventeen people in Accounts Payable. I had no idea why he chose me, a pipeline project manager, to lead that group. Later, I gratefully realized Alan gave me the job to hone my soft skills. It was the best job I had, and the results were phenomenal.

Alan and I are still in contact and communication. In our magazine, I proudly showcase Alan, a brilliant engineer, teacher, and mentor.

ALAN MURRAY

By Larry Klassen

Alan and I worked together briefly, but he made an impact. As a manager, he is a kind, gentle soul who tends to ask more questions to make you think than give answers. Always entertaining and exciting discussions. At the time, I attempted to shake up the norms and dynamics concerning our interactions with the steel market. In this, Alan, Robin Read, and I had many good discussions about strategies and tactics to get us the best possible outcome.

I also found Alan had superior soft skills. One day I was exasperated about dealings with someone in our group, and Alan took me aside for a few calming words. All he said was, 'Think about Impact vs. Intent,' which made me stop and think. These few words really stuck with me!

Dr. ALAN MURRAY

By: Mike Yoon

I first met Dr. Alan Murray when he attended the pipeline transient analysis course I organized for Nova hydraulic engineers. He was a system planning engineer for natural gas pipelines, overseeing the project upgrading a gas pipeline simulator. Coincidently, I was one of the developers of the simulator many years before, so we created an instant rapport with each other.

Later, Dr. Murray co-authored Pipeline Design & Construction: A Practical Approach with Dr. Mohitpour and Dr. Golshan. The book is still one of the most widely used pipeline books ever since it was published and updated several times. As a civil engineer by training, his specialty is pipeline construction and system integrity. He authored a few more books and numerous reports about those subjects. After he left Nova and later TransCanada, he became the chief engineer at Canada Energy Regulator (nee National Energy Board) until he retired in

2012. His integrity as the chief engineer set an excellent example for the future engineers on the Board and others.

Many Nova engineers got involved in organizing an Offshore Mechanics and Arctic Engineering (OMAE) conference in Calgary in 1992, and the pipeline is one of several symposia of the conference. Dr. Mo Mohitpour was the Calgary conference chairman, and Alan and I organized a pipeline symposium and another OMAE pipeline symposium in Glasgow in the subsequent year. After reviewing the conference's success, Dr. Mohitpour realized a great need for a pipeline conference, particularly the onshore pipeline conference in Calgary.

We were founding members and worked together to organize the first International Pipeline Conference (IPC). The first IPC was in 1996, and then every other year. It has been a tremendous success ever since, drawing pipeline engineers from more than 40 countries. Alan was the co-organizing committee chairman of the third IPC held in 2000. The pipeline section of OMAE went through an identity crisis within the American Society of Mechanical Engineers (ASME) Division partly because of the success of the pipeline section and partly because of the demise of the Ocean Engineering Division. Alan spearheaded the Pipeline System Division (PSD) creation out of OMAE while OMAE merged with the Ocean Engineering Division. He became the first chairman of the PSD, creating a genuinely international division that drew many pipeline specialists as part of executive committee members from several countries, such as Great Britain, Brazil, Norway, and Japan, in addition to the US and Canada.

Alan loves to learn new subjects and teach pipeline courses, particularly pipeline construction, and integrity. He taught these subjects and regulatory frameworks in many countries in the world. As part of a new initiative at the PSD, we developed a visiting lecturer program. The PSD covers the traveling expenses of a lecturer who donates his time and expertise to engineers in several countries. He was elevated to Fellow Grade from ASME in 2008 for his contributions to pipeline construction and integrity

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Vancouver, Canada

Grid-GuardHD Plus: A Case Study

Application:	24” pipeline
Location:	Big Lake, Texas
Product:	Grid-GuardHD Plus, 82”x72”
Pipeline Owner:	DCP Midstream
Date of Installation:	Aug 1, 2018
Date of Excavation:	Dec 18, 2018

JDR Enterprises of Alpharetta, Georgia manufactures Grid-GuardHD Plus rock shield. Grid-GuardHD Plus is an 11mm extruded polyethylene with a geotextile fabric heat laminated to one side. HD Plus rock shield is de-signed to provide ultimate protection during backfill operations, and to act as a slip sheet around the line after bur-ial. HD Plus is available for any pipeline diameter.

The Challenge:

DCP Midstream was seeking to add a new rock shield that would provide maximum protection to new and existing pipeline operations. The challenge was to find a new rock shield that would provide ultimate impact protection, but also help to maintain the integrity of tapes and coatings used on the pipeline. Traditional mesh rock shields can have the potential to set into tapes and/or other external wraps, sleeves, etc., thereby contributing to soil stresses on those tapes, etc. DCP was seeking a rock shield that would help to alleviate those concerns.

The Test:

In order to determine the performance of Grid-GuardHD Plus on a live pipeline, DCP Midstream in-stalled 30' of HD Plus on an in-service, 24" pipeline during scheduled maintenance on a section of line containing two holidays. The line was buried for approximately 4 months at a depth of 12'. The Grid-GuardHD Plus was installed over a FBE coating as well as Polyguard 600 liquid adhesive and RD6 tape.

The Performance:

After excavation of the line, DCP representative and Corrosion Supervisor, Jim Wynn was on hand to do a thorough examination of the coatings and tapes over which Grid-GuardHD Plus was applied. Mr. Wynn stat-ed "the rock shield was removed and the coating underneath looked to be in perfect condition". DCP and Polyguard representatives were looking for wrinkles and/or stresses on the Polyguard tape. None were found. Per Mr. Wynn, "What makes this new rock shield unique is the fact that it incorporates a felt product on the side that goes next to the pipe. This allows the rock shield to slip on the pipe thereby reducing any soil stress that might otherwise cause the rock shield to dig into the tape causing wrinkles or holidays."

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- Safeguards coatings in the event of soil shifting.
- Forms a barrier against rocks or other sharp objects when piping is being laid in trenches.
- Flexible, relatively lightweight, and easy to install.
- Maintains flexibility even at lower temperatures.
- Durable without any loss in cushioning characteristics.
- No dielectric properties to block cathodic protection.

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Cross Country Canada Supplies & Rentals is our Canadian partner and distributor who has had immense success with the Grid Guard HD-Plus product on Canadian large diameter pipeline projects.

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Let's Talk Safety

By Sandy Dunkley

Alexander (Sandy) Dunkley has worked in the Canadian safety industry for 24 years, 20 years as a full-time safety person, and four years as a job steward.

Introduction

I am very opinionated and passionate about safety. I have been an HSE Manager and contract safety advisor and currently work as a contract HSE Manager for a company.

There have been significant changes in the safety industry during my time. There are many different safety designations, and each designation thinks a company needs to be safe. There is much competition between these designations, but that is another opinion piece.

Let's Look at What is Wrong With the Safety Industry

First of All, safety has become paperwork-heavy. It is almost bureaucratic and so complex that workers can't even pass gas without a permit or work procedure.

Too many safety people get caught up and bogged down with the paperwork. As a result, they can't do the one thing they need, absolutely NEED to do, get out in the field with the workers. You can't do Safety from the office.

What's Happened

There are Field Level Hazard Assessment (FLHA), Field Level Risk Assessment (FLRA), Job Hazard Analysis (JHA), Job Safety Analysis (JSA), and Task Hazard Assessments (THA), and there is bound to be more, depending on the day's flavor.

Then there are inspections, vehicle inspections, tool inspections, PPE inspections, equipment inspections, site inspections, ground disturbance inspections, fall protection inspections, scaffold inspections, and ditch inspections, and that's not the end of it; I have even seen a port-potty inspection (Hey George! How come there's a confined space permit and entry log on the porta-potty door?)! There are inspections for everything depending on how far you want to go.

Then there are meetings, Toolbox Meetings, Tailgate Meetings, Tailboard Meetings, Weekly Safety Meetings, Monthly Safety Meetings, Joint Worksite Health and Safety Committee Meetings, different Project Meetings, and Kick-Off meetings, which are a necessity.

Then there are the various incident investigations, TapRoot, Swiss cheese, DNV, 5 Whys, probably more than I have used, and various company incident investigations.

Then there are orientations, company orientations, client orientations, training requirements, and maybe D+A testing requirements.

Then come the cards, Behavior cards,

whether Hazard IDs, BBS cards, PSR cards, or whatever the company uses at that time.

How about procedures? Safe Work Procedures, Safe Work Practices, and Industry Best Practices and Legislative Requirements, and of course, the safety people must fill out or enter the paperwork to be handed over to the client at the end of the project.

Companies are not at ease, especially if incidents are under the provincial or federal Occupational Health & Safety (OH&S) jurisdictions. They feel the need to protect themselves and their workers. As a result, the importance of documentation and the work required is increasing. Hence, the companies provide tools to their workers, supervisors, and management to help them protect their asses.

As I said before, this also means that the safety person spends most of the time bogged down in paperwork in the field office and not in the field.

We Need to Get Back to Safety Fundamentals First and Foremost

Safety needs to be in the field. You can't do safety from the office. Safety can help workers with issues and help find solutions to those issues. Safety people must be passionate about what they do. If safety spends over 20-30% of the time doing paperwork and attending meetings, something is wrong.

Also, Safety people must be outgoing and able to talk to workers as equals, not talk down to them.

Education

There is a lot of emphasis on education in the safety industry. Education is good but remember, education is heavily theoretical, and nothing beats experience.

New safety people entering the industry must be mentored and not turned loose to the wolves.

Paperwork - Keep It Simple Stupid!

Don't introduce paperwork that the workers won't complete; it does nobody any good.

Don't make paperwork so complicated workers don't understand it. People will cut corners.

If workers aren't filling out the paperwork, ask why? Don't wring your hands and say I don't understand why they won't.

Training

Everyone, including the supervisors and management, must be trained and competent in their tasks. Everyone needs orientation, new people need mentors to help them grow into good workers, and the same goes for safety.

Procedures, Practices, and Permits

Procedures and practices must be directly related to the work, and permits must be in place before work begins.

Meetings

Keep meetings to a minimum, and remember your safety people must be in the field, not attending two or three

meetings daily. More incidents happen in the afternoon after lunch, before the shift ends, or early morning when work starts, and safety people must be available in the field with the workers.

Safety Culture

There are many ideas about developing a safety culture, and people get paid for helping a company develop a safety culture. It would help if you had your safety people in the field developing relationships with the workers and supervisors. Safety and Supervisors must work with the workers to help change bad habits and instill new ones in workers, and they cannot do this by being stuck in the office.

These are only partial examples of what I think is wrong with the safety industry, and I may be inaccurate; it is an opinion.

The above article is my opinion and does not express the views of Pipeline Tails. As usual, I am always open to discussion on LinkedIn

- Sandy Dunkley

Veblen Effect

Abstract

A Veblen good is a luxury good whose demand increases as its price increases, which contradicts the law of demand, where the price decreases as the demand increases. The Velben goods represent status symbols in our societies and become desirable to certain people.

When Julius Caesar was 23 years old, he understood the power of Velben goods, a term coined by Thorstein Veblen two centuries later. Ceaser was sailing across the Aegean Sea when Sicilian pirates captured him and asked for 20 talents or 620 kg of silver, worth about $600,000 in ransom. Caesar told them they were ridiculous and must ask for a ransom of 50 talents of silver worth about $1.5 million.

The pirates became overwhelmed since their captives tried to negotiate the ransom as low as possible. But they thought if Ceaser would be that stupid, why argue? They let Caesar's men go back to Rome to raise the money.

Instantly in Rome, Caesar became famous. Nobody asked for such a vast sum of ransom before, and he must be extraordinary, and he must be incredibly important. That ransom demand put Caesar on the political map.

The Veblen effect creates a mindset in consumers who think that the goods must be worthy if the price is higher. These products include Rolex, Cartier, Bentley, Rolls-Royce, Aston Martin, Louis Vuitton, Christian Louboutin, Harrods, and Cristal Champagne.

Caesar had successfully made himself a Veblen good by setting his value more than anyone in Rome. And the fallacy was that no one in Rome knew this was Ceaser's creation without input from others. So they all believed that Ceaser was a very important man, so his men had little trouble raising the ransom money. They returned to the island and freed him.

As a now important and famous man, Caesar played another game. He built a team of soldiers, hunted down the pirates, took back all the money and everything else they had pillaged, and then executed them all. Caesar was now both wealthy and famous.

Slowly, using his confidence and brains, Ceaser became ruler of Rome, presided over the golden age of the Roman Empire, and expanded it from Spain to Germany and Britain to the Middle East.

Caesar knew that reality begins in the human mind, the most critical piece of land to stake a claim. One can stake a claim in the mind by creating a perception. And one can create that perception by controlling the context. If one can control the context, one can control the mind. And, if one can control the mind, one can manipulate reality.

Compiled from various sources

STEP energy services

Pipeline Drying Methods

By: Joseph Burns, Team Lead Nitrogen and Industrial Services

Introduction

Following a successful pipeline hydrostatic test, removing the residual water from the pipeline is necessary before introducing products into the system. Residual moisture within a pipeline can present a unique set of costly challenges for the contractor, with corrosion and hydrates posing a particularly serious problem. To prevent moisture-related issues, pipeline contractors can choose from various drying methods, typically dry gas or methanol washing.

The dew point is continuously monitored during drying as moisture is removed from the pipeline until the system reaches the target dryness criteria. In Canada, natural gas pipelines are dried to a dew point of -40°C, whereas petrochemical pipelines may be required to be dried to a dew point as low as -60°C.

When a drying operation is correctly executed, the results will protect the integrity and reduce maintenance costs throughout the pipeline's lifecycle. The key to selecting the right drying strategy is a combination of project and client specifications and expertise in designing the most economical and technically feasible solution. This article will explore using various dry gases for drying a pipeline and highlight the selection criteria for achieving an effective pipeline drying.

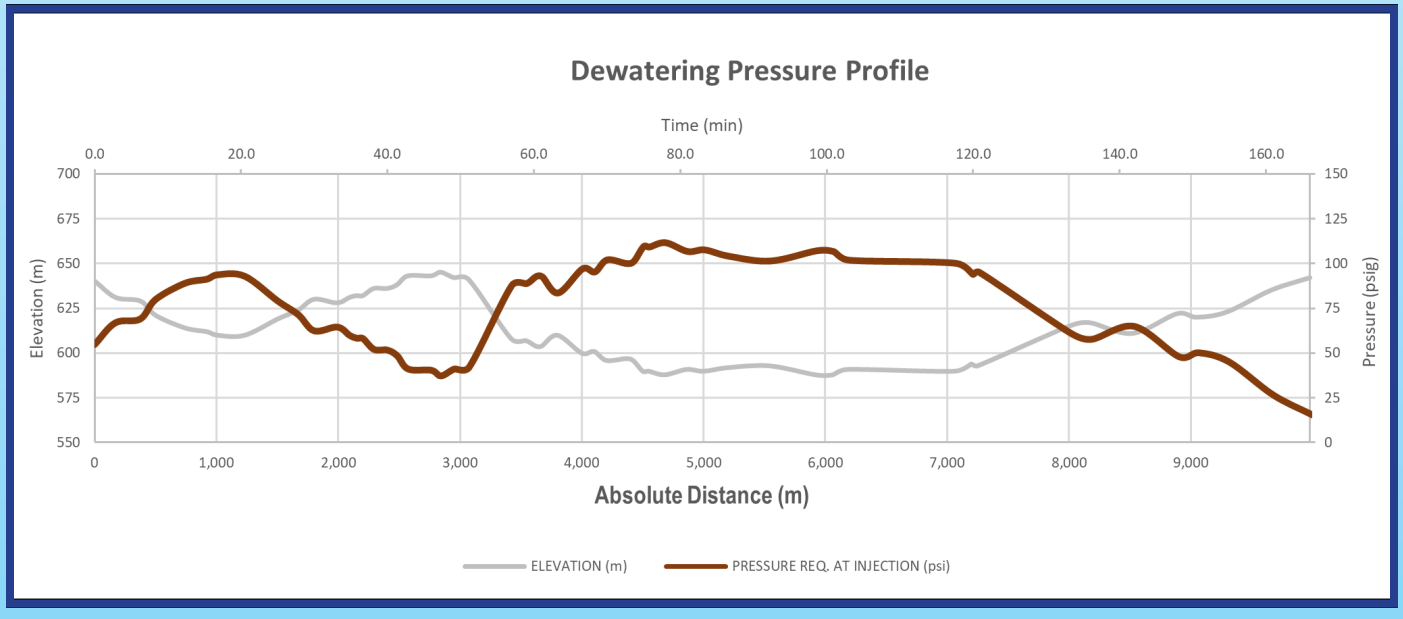

Figure 1. Elevation profile and required injection pressure for dewatering a pipe.

Dewatering

Following a successful hydrostatic test, a series of bidirectional pigs are usually propelled through the line using air or nitrogen gas to remove the bulk of the liquid water from the pipeline system. The pigs provide an interface between the hydrotest water and the displacing medium to sweep out all low points.

Additional foam pigs will then be displaced until they are no longer effective. In preparation for drying, the contractor can run a wire-brush pig through the line to remove any water-bearing debris

Drying With Dry Gas Theory

Pipeline drying is a mass transfer process that injects dry gas into a pipeline. Dry

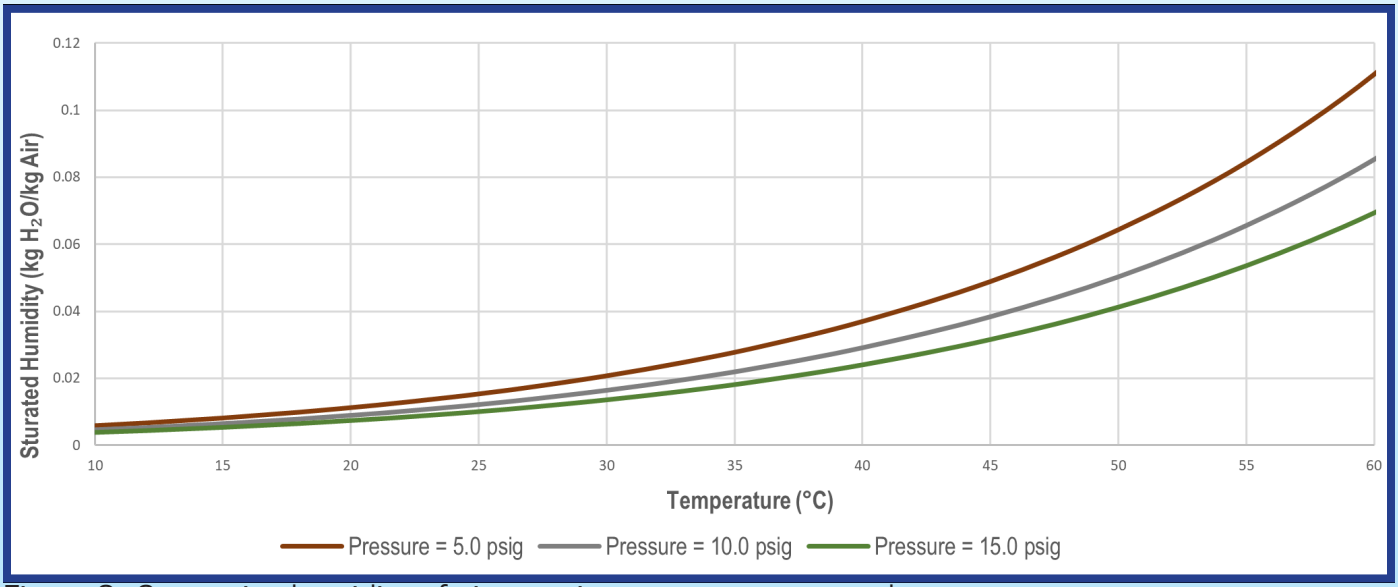

Figure 2. Saturation humidity of air at various temperatures and pressures.

Dewatering a pipeline segment can require a significant amount of power, especially on long pipeline segments or segments with a substantial elevation change, such as a horizontal directionally drilled river crossing. In such cases, the contractor may need specialized equipment to:

- Overcome the hydrostatic head of the water column in the pipeline.
- Create a differential pressure required to move the pig train.
- Overcome the pressure loss due to friction to displace the water column from the launching point to the receiving end

gas flowing over a wet surface will pick up moisture and eventually reach saturated equilibrium at the temperature and pressure within the system. The efficiency of gas drying depends on the initial dew point and flow rate of the drying medium and the pressure and temperature of the system.

Convective mass transfer is required to obtain higher rates of drying. To achieve convective mass transfer, the bulk motion of the drying gas displaced through a pipeline must be in the turbulent flow regime. Suppose the drying gas passing over the wetted pipe walls is in the laminar flow regime. In that case, the

mass transfer of liquid water to the gas phase will be by molecular diffusion, a much slower mass transfer process than turbulent diffusion and will need longer drying times.

The contractor must keep the back pressure in the pipeline to a minimum because a higher back pressure will decrease the saturated humidity of the drying gas. When that happens, the drying gas will lose its water-holding capacity, resulting in longer drying times and higher gas volumes.

The system's temperature should be as high as possible to maximize drying efficiency. An increase in water temperature increases the vapor pressure, thereby increasing the driving force for the mass transfer process.

Dry gas, when injected into a pipeline, both injection and venting points get dried simultaneously. Dry gas introduced at the upstream end is at its lowest dew point (i.e., driest state) and will therefore have the highest driving force for drying. The injected dry gas will quickly pick up water from the upstream pipe wall, and the drying front will move down the line toward the venting point. Due to hydraulic friction in the pipeline, the pressure inside the system will decrease as a function of horizontal distance, allowing for higher water saturation of the gas phase. This effect increases towards the venting point, which results in a secondary drying front moving toward the upstream end of the pipeline. Eventually, the two drying fronts will meet somewhere in the middle resulting in a dehydrated pipeline system.

Drying With Compressed Air

Compressed air drying involves using a series of oil-free air compressors to displace atmospheric air through a desiccant dryer before it enters the pipeline system. The desiccant dyer typically consists of two pressure vessels filled with desiccant that use a cyclic process to dry the air. As the atmospheric air passes through one of the desiccant beds, absorbing the moisture, the air becomes dry with a dew point as low as -60°C.

The desiccant in the pressure vessels can only absorb a finite volume of moisture before it must be regenerated to dry out the desiccant. When the desiccant in the first pressure vessel becomes saturated with water, the valves on the dryer will switch and direct the atmospheric air to the second tower. At this point, the first pressure vessel will begin regenerating, and this cycle repeats throughout the entire drying operation.

The main advantage of using air for pipeline drying is the endless supply of the drying medium (atmospheric air); however, if the contractor does not manage the desiccant quality accordingly, it could result in higher dew points and longer drying times. Air compressor systems also do not typically offer the contractor variable temperature and rate control and can be pressure limited.

Drying With Nitrogen

Nitrogen is an inert gas that comes as a cryogenic fluid with a purity greater than 99%. Before the liquid nitrogen enters

the pipeline system, it passes through a heat exchanger, which vaporizes the liquid nitrogen into a gas with a consistently reliable dew point of -70°C. A positive displacement pump injects nitrogen gas into the pipeline system.

The main advantage of nitrogen gas is that it has a consistent and reliable dew point that does not rely on any drying processes. In addition, using nitrogen gas for drying activities provides an inert atmosphere inside the pipeline system for product feed into service. An inert atmosphere also protects against internal corrosion if the line remains dormant for an extended period before placing the line into service. Nitrogen pumping equipment also gives the user full control over the flow rate and the gas temperature at the pump outlet, which allows for a more versatile operation.

Conclusion

A drying campaign is a crucial step in the commissioning process of a pipeline and will also reduce lifetime maintenance costs. Pipeline drying removes the residual water left in the pipeline after the hydrotest to decrease the moisture concentration within a pipeline system to an acceptable level. The drying prevents the formation of hydrates & corrosion, which affects the quality of the products delivered by the pipeline.

The process of pipeline drying typically begins by dewatering the system using a series of foam pigs with varying densities to remove the bulk of the liquid water. Multiple foam swabs are then propelled through the pipeline to absorb as much liquid film from the pipeline walls as possible, continuing until moisture removal efficiency is negligible.

To further dry the system to the requirements, dry gas can be injected into the pipeline system using mass and energy transfer principles to decrease the humidity in the pipeline. In most cases, pipeline drying uses dry air or nitrogen gas. In comparing dry gas methods, dry compressed air has proven effective in large-scale projects in remote locations. Whereas drying with nitrogen has proven more cost-effective on smaller-scale projects with a readily available liquid nitrogen supply. For optimal project outcomes, consulting with a pipeline drying professional will drive efficiencies and decrease the overall cost of the drying operation.

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LET'S GET TO THE IDEAS.

Selecting Value Adding Key Performance Indicators (KPI)

A White Paper with Red Marks

By Akhilesh Manchanda, P.Eng., ASQ CMQ-OE

Management Systems *focus*

ADDRESSING THE NEED TO SELECT AND TRACK KEY PERFORMANCE INDICATORS (KPI) ON PIPELINE CONSTRUCTION PROJECTS.

In the published article, "Dysfunctional Consequences of Performance Measurements" by V.F. Ridgway cited, "What gets measured gets managed – even when it's pointless to measure and manage it, and even if it harms the purpose of the organization to do so". In the world of project management, we also believe, "what gets measured gets done" to focus on intended deliverables aligned with agreed schedule. We shall apply a balanced approach to select meaningful KPI while considering processes & resources optimization.

Many organizations establish key performance indicators to sense the pulse and drive remedial actions. Pipeline owners' imperative performance goal is to have zero pipeline or facility leaks; Pipeline construction contractors are expected to focus on processes that build a reliable asset to achieve the goal. The article provides info on following questions:

How are leading, lagging and real-time performance indicators defined? What type of KPI should be selected and why? How can a prime contractor consistently deliver meaningful project outcomes that are aligned with client's long-term goals?

Picture source: KPI-Key-Peformance-Indicator-Project-Management-Online.jpg

Key Performance Indicators (KPI): A set of specific quantifiable measurements used to monitor and improve performance.

What is a leading performance indicator?

Metric/info that has a capability to predict future success or failure of the established process such as BBO (Behaviour Based Observations), proactive competency reviews, training, surveillance and assessments.

What is a lagging performance indicator?

Metric/info that has a capability to demonstrate outcome of performed process(es) such as client's satisfaction, weld repair rate.

What is a real-time/current performance indicator?

On-going monitoring of the data/info that is immediately required to correct the course of action such as speedometer while driving, heart rate/PQRS wave and oxygen levels while performing surgery, oven temperature while curing elastomer in a cavity pump stator.

KEY STEPS TO SELECT AND USE KPI

1. Establish a clear understanding of the client asset's purpose and tangible goals.
2. Review strategy and existing processes, understand organizational financial and reputational risks such as, what's the risk to the organization if client's goals are compromised!
3. Engage leadership and middle management to review past performance through data analytics such as Microsoft Power BI, Tableau tools. Analyze the info against the strategy and intended results.
4. Determine business imperatives and focus areas, and define objectives aligned with vision/mission.
5. Identify processes that shall be monitored and improved, engage process owner(s), and collect info.
6. Define relevant and actionable quantitative and qualitative metrics to monitor performance.
7. Develop specific and challenging leading and lagging KPI with process owner(s) and visualize success.
8. Formally communicate and train resources, show them a path to accomplish established KPI.
9. Establish a mechanism to collect, analyze and report information at predefined process stages and intervals such as daily, weekly, monthly, quarterly, or annually.

Getting the most from Key Performance Indicators

KPI should be established in alignment with client's goals, prime-contractor's financial and reputational imperatives, they should be based on factual figures, easy to follow and should help to drive decisions to move forward. Health & Safety performance indicators such as TRIF, LTF, Number of Near Miss, Medical-Aid, Fatality, VIR, (lagging), and Number of safety meetings, behaviour-based observations, JHA, FLHA, and Inspections performed (leading) are typically used, however, following list provides some additional examples to be considered:

Focus Area	Performance Indicator	Type	Expected Benefits
Training	No. of QHSE Training Performed/ Total Planned	Leading (%)	Competent Workforce
Bending	No. of bends rejected/Total bends performed	Lagging (%)	Monitor machine accuracy
Welding	No. of welders qualified on required WPS/Total welders required on the project	Leading (%)	Minimize rework/repairs
Welding	Girth Weld Repair Rate (WRR) & Structure WRR	Lagging (%)	Input to investigate process
Coating	No. of applicators qualified on required coating procedure/Total applicators used on the project	Leading (%)	Consistently acceptable coating application
Coating	Coating Repair Rate	Lagging (%)	Input to investigate process
Environment Spills	Preventive maintenance performed on the heavy equipment as recommended by the manufacturer	Leading (Ratio)	Minimize spills on the Right of Way (ROW)

Abbreviations: WPS: Welding Procedure Specification, TRIF: Total Recordable Incident Frequency, LTF: Lost Time Frequency, VIR: Vehicle Incident Rate, JHA: Job Hazard Assessment, FLHA: Field Level Hazard Assessment,

"Well thought, meaningful performance measures are vital to accomplish organizational objectives and client's satisfaction." AKHILESH MANCHANDA, P.Eng.

SMARTER KPI DEPLOYMENT

Establish a deep understanding of Client's requirements and ultimate goals, engage the client early on to determine success parameters.

Develop strategies and objectives supported by technology to track performance indicators.

SIMPLIFIED KPI ALIGNMENT FRAMEWORK

1. Engage client and understand the overall purpose and goals of the asset.
2. Determine, how are our vision and mission aligned, and are we capable to contribute towards accomplishment of client asset's purpose and goals?
3. Establish objectives, preferably SMART (Specific, Measurable, Attainable, Relevant and Time-bound), and circle back with the client, improve if required.
4. Review existing processes capabilities and established objectives, engage relevant personnel, develop, and deploy KPI, establish a mechanism to collect the information at specific stages.
5. Analyze collected data, summarize variance, and inform internal personnel.
6. Celebrate success of achieved KPI, or identify gaps/areas to minimize variance, arrange approvals, plan, and discuss improvement assignments, work with process owners, start over at step number 1 to continually improve processes.

CAUTION:

1. Sometimes it's challenging to clearly understand client's needs and expectations, avoid assumptions, and have an agreed contract on requirements.
2. Avoid linking KPI with bonuses or incentives, KPI reporting should be for internal distribution unless contractually required by the client.
3. Avoid using best practices or benchmarking for KPI selection, leverage inherent information and take targets to achieve next level at the process level.
4. Avoid aiming too many KPI at the same time, think of cascading effect of processes and deploy a meaningful KPI at the right stage of the processes.

Akhilesh Manchanda is a professional engineer registered with APEGA and ASQ Certified Manager of Quality & Organizational Excellence. He possesses leadership experience in management systems' development and deployment, personnel competency management, enterprise digital transformation, and layered process auditing; he works with Midwest Pipelines Inc. as Management Systems Specialist, and with NAIT as CED Instructor. In this White Paper, he shares his ideas and recommendations to assist quality practitioners engaged in management systems' implementation. He does not represent any insight from his employers in this white paper.
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The British Columbia Oil & Gas Commission Gets An Expanded Mandate and a New Name

By: BCER Communications

Exciting changes are coming to the British Columbia Oil and Gas Commission as we begin our 25th year of operations. Established in 1998, the organization is British Columbia's single-window life-cycle regulatory agency and has been protecting public safety and safeguarding the environment through the sound regulation of energy activities in the province for the last quarter of a century.

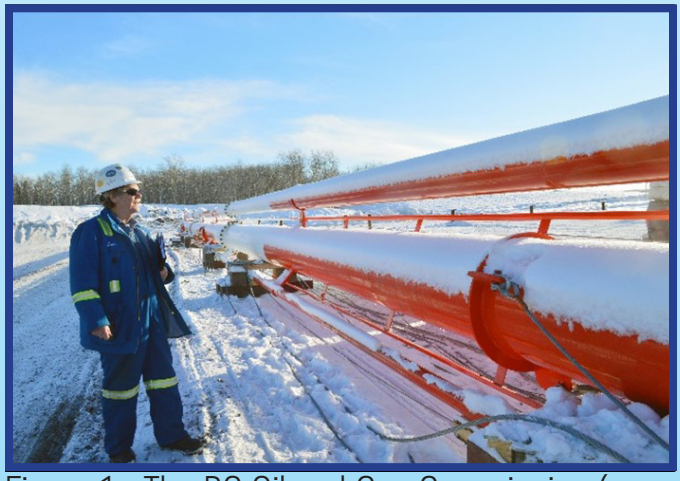

Figure 1. The BC Oil and Gas Commission (soon to be the BC Energy Regulator) regulates more than 50,000 kilometers of pipelines within British Columbia. Roughly 73% of these pipelines transport natural gas, while approximately 11% carry oil – the remainder carry water, other gases, or liquids

In the fall of 2022, the British Columbia Legislature passed Bill 37, the Energy Statutes Amendment Act, which will expand our organization's mandate and brand us with a new name: The British Columbia Energy Regulator (BCER).

In addition to our current responsibilities concerning oil, gas, and geothermal development, BCER will become the single-window, life-cycle regulator to produce hydrogen, ammonia, and methanol; and have an expanded role in carbon capture and storage. The Province of British Columbia has identified hydrogen, methanol, and ammonia as essential to working towards a net zero economy. All are useful as fuel sources, and methanol and ammonia can also act as hydrogen fuel carriers. They can be

Figure 2. BC Energy Regulator staff undertaking an educational tour of a hydrogen blending facility in Fort Saskatchewan, Alberta. With Bill 37, the Regulator will oversee hydrogen activities in British Columbia.

produced in many ways, including from non-fossil fuel sources, such as clean electricity and fossil fuel sources, often in conjunction with carbon capture and storage.

As officially set out in Bill 37, BCER will *"regulate energy resource activities in a*

manner that protects public safety and the environment, supports reconciliation with Indigenous peoples and the transition to low-carbon energy, conserves energy resources and fosters a sound economy and social well-being."

Figure 3. Fort Saskatchewn Hydrogen blending facilities

In granting us greater responsibility, the British Columbia government recognized our staff has the technical skills, experience, and knowledge required to regulate complex facilities. Our team has experience with and adopting complicated technical standards and regulations and adjudicating permit approvals related to land, water, air, and archaeology. We also have broad experience with many aspects of safety oversight, a proven restoration timeline framework, and an established orphan fund.

"The BCER name reflects a renewal of our organization and is a testament to all the incredible work our staff has accomplished over the past twenty-five years and sets us up for future success in the years ahead," said our CEO Michelle Carr.

We are excited to move forward with a renewed mandate and new name that will better reflect our latest functions, align with the range of parties we regulate, modernize our look, and demonstrate our commitment to reconciliation with

Figure 4. BCER Commissioner and CEO Michelle Carr, appointed in November 2021, will lead the organization as it moves forward into the next phase of its existence

More info: Bill 37, the Energy Statutes Amendment Act. https://www.bclaws.gov.bc.ca/civix/document/id/bills/billscurrent/3rd42nd:gov37-1]

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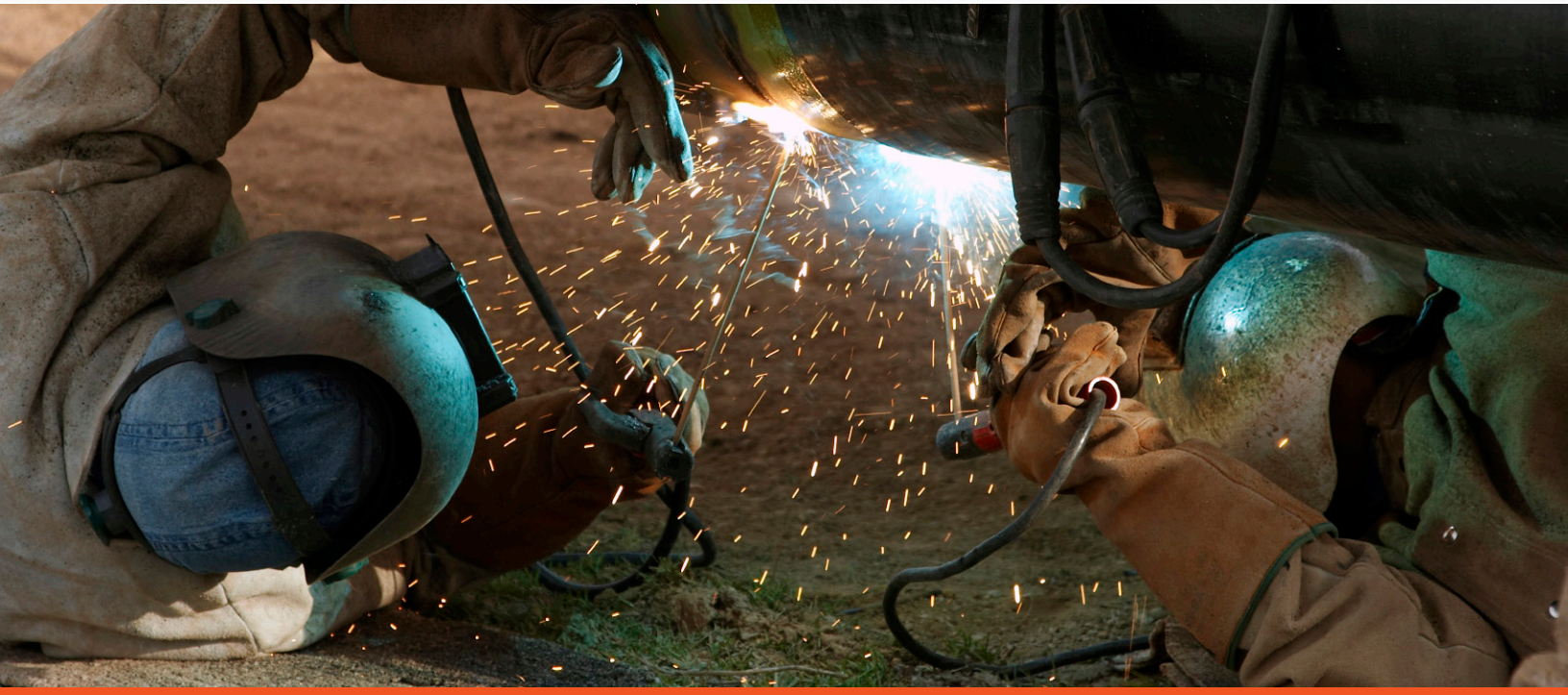
Records are Reliable, Traceable, Verifiable and Complete

Materials Management

- Track and trace all material items for the life of the facility
- Confirm materials are installed at correct location
- Automate the pipe tally
- Ensure materials are available, complete, correct, and quickly accessible
- Ensure that records and documentation are traceable, verifiable and complete



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Construction Management

- Integrate material information with the construction process
- Task Management Qualification verification and records retention (Welder Qualifications)
- Plastic pipe fusion (Pedigree)
- Manage major activities and record progress
- Capturing and geo-referencing field data with attendant documentation
- Integration of requirements for notifications (crossings and stakeholder requests)
- Traceability and verification of installed location of all components

PIPETALKER™ - The newest ground-breaking RFID technology designed for pipeline integrity management

Integrity Management

- Construction information is integrated with the IM System
- Managing and tracking Integrity Operations (HCA management)Manage major activities and record progress
- Manage major activities, retain data and capture photo with compass
- Track maintenance and activities in real time and view service manuals
- Integrity Digs and new pipe changes are updated in real time
- Display ILI run results on the map

Engineering procurement, construction QA/QC and material traceability

Plant Construction Management

- Material geospatial traceable with pictures and compass
- Spool pieces traceable on-site
- Records retention
- Transparency
- Auditability
- Ensuring Compliance adds value to the assets

Key to traceability

RFID enables reliable, traceable, verifiable and complete record retention for lifecycle of the asset and any up to date changes in real time

RFID

- RFID Tags ensure data integrity and speed up compliance data acquisition
- Sign condition can be verified by capturing an image and RFID tag information
- The exact locations of signs and other assets are geo-referenced on the map
- Sign Survey status is displayed in real time

Out of this world Tracking and Traceability capabilities!

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- Hydraulic system components
- Well control system components
  (BOPs, choke manifold parts, valves, chokes, control system components)

Task Management. **Tracking & Traceability.** **Join QA/QC Retention.**

My Entry into the Pipeline Hydrostatic Testing

By: Hiran Ganguli

It was 1987, and I had just started working for a Calgary-based pipeline operating company. My first assignment was to work with the project manager (Bill Luk) and senior engineer (Julio Daneri) on a 120 km, 12" diameter pipeline named Logan Creek in northeast Alberta near Mariana Lake, several kilometres south of Fort McMurray.

The Logan Creek Lateral was a fast-tracked project that started in July 1987 and would be in service by April 1988. Halfway through the project, the company sent the project manager and senior engineer to Columbia to negotiate a pipeline contract. As a result, I was the one left to oversee the project.

I was new to the pipeline projects, but our supervisor, Rupert Hooper, put me in charge, partly to see if I was up to the task and confident enough to handle the challenge. I never had to learn so much about pipelines so quickly. Along with all the technical jargon, knowledge, and specifications, I realized that I would need to build a rapport with the various departments involved as they would be critical to successful project completion.

While learning about the pipeline industry, I also had to catch up on my project management skills. It turned out that project management encompassed more than just managing a project's scope, schedule, and cost; it was about adequately overseeing the people on the project. The more emphasis I put on people, managing the project became that much more effortless. This strategy has helped me execute complex and challenging projects throughout my career.

As the Logan Creek Lateral project progressed, so was my learning. The pipeline contractor was on track, and management was happy. Rupert told me to prepare all the hydrotesting calculations as I would conduct them in the field. I had no idea where to start when it came to hydrotesting. Julio was back from Columbia by this time, and I asked him to teach me how to do hydrotest calculations. He painstakingly taught me how to fill out the hydrotest calculation forms.

We divided the 120 km pipeline into nine test sections, and I learned how to calculate test pressures. I quickly realized that manually calculating the test pressures was not easy. We had no automated calculation sheets, and best practices required me to stamp, sign and date each calculation sheet and get another professional engineer to check, sign and date it. My co-worker Randy Wight double-checked my work and taught me even more about hydrotesting. Anytime we changed a test section's upstream or downstream points, we had to redo the calculations for that section and the two sections on either side connected to it. Randy was also going

SUMMARY OF (YIELD PLOTTED) HISTORICAL HYDROSTATIC TEST DATA FOR NPS 30 PIPE TEST SECTIONS

TEST DATE	PIPE O.D. (mm)	PIPE W.T. (mm)	SECTION LENGTH (metres)	SECTION VOLUME (m3)	LEAK TEST				YIELD TEST				CALCULATED WATER VOLUME (litres/km/100 kPa)	PERCENT DEVIATION EXPECTED vs ACTUAL	TYPE OF WATER
					START PRESS (kPa)	FINISH PRESS (kPa)	ACTUAL WATER REQ'D (litres)	ACTUAL WATER (litres/km/ 100 kPa)	START PRESS (kPa)	FINISH PRESS (kPa)	WATER REQ'D (litres)	ACTUAL WATER VOLUME (litres/km/ 100 kPa)			
14-Oct-90	762.0	8.4	22,780.0	9,935.5	6,000	8,280	7,640	14.71	8,300	11,180	9,752	14.86	37.97	61.3%	COLD
14-Oct-90	762.0	8.4	25,469.0	11,108.3	6,000	7,800	6,782	14.79	7,810	10,950	11,890	14.87	37.97	61.0%	COLD
15-Oct-90	762.0	8.4	8,692.0	3,791.0	6,200	8,130	2,603	15.52	8,145	11,230	4,131	15.41	37.97	59.1%	COLD
26-Oct-90	762.0	8.4	10,491.0	4,575.6	6,400	8,400	3,281	15.64	8,400	11,460	4,940	15.39	37.97	58.8%	COLD
28-Oct-90	762.0	8.4	9,282.0	4,048.3	6,300	8,300	2,870	15.46	8,315	11,300	4,286	15.47	37.97	59.3%	COLD
30-Oct-90	762.0	8.4	8,483.0	3,699.9	6,200	8,300	2,793	15.68	8,400	11,400	3,695	15.58	37.97	58.7%	COLD
19-Nov-90	762.0	8.4	10,225.0	4,459.6	6,200	7,720	5,663	36.44	7,800	10,900	11,755	37.08	37.97	4.0%	COLD
19-Nov-90	762.0	8.4	6,266.0	2,732.9	6,200	8,520	7,187	49.44	8,600	11,700	8,566	44.1	37.97	-30.2%	COLD
26-Nov-90	762.0	8.4	12,242.0	5,339.3	7,000	8,420	7,081	40.73	8,500	11,500	15,630	42.56	37.97	-7.3%	COLD
26-Nov-90	762.0	8.4	8,842.0	3,856.4	6,000	7,810	6,600	41.24	7,900	10,900	11,288	42.55	37.97	-8.6%	COLD
07-Dec-90	762.0	8.4	11,576.0	5,048.9	6,100	8,470	10,595	38.62	8,600	11,600	13,075	37.65	37.97	-1.7%	COLD
09-Dec-90	762.0	8.4	7,784.0	3,395.0	6,200	8,500	7,410	41.39	8,600	11,500	9,740	43.15	37.97	-9.0%	COLD
NOTE:	THIS TABLE SHOWS THAT THE ACTUAL WATER VOLUME WAS DIFFERENT FROM CALCULATED VOLUMES IN ALL CASES.														

to be my mentor on-site to show me how to conduct hydrotests in the field physically.

In mid-March of 1988, Randy and I drove one morning to Lac La Biche in northeast Alberta. I would be there for the next 3-4 weeks completing the hydrotesting of the nine test sections. Our field office was in Alpine Lodge, where all the company inspectors stayed.

After reaching Alpine Lodge in the evening, we met our Chief Inspector, Bruce McGunnes, and his lovely wife, Mabel. Bruce took out a few bottles of whisky, placed them on the kitchen table, and told us, "Pour your own poison." That was my first lesson in the field. Since then, whenever my wife hosts a party, I tell my guests to pour their own poison!!

Randy and I headed to the job site the following day to test section No. 1. Bruce warned us that the hydrotest supervisor, "Dutchie," would not be easy to deal with. We met this big 6'6", 250 lb man in grubby work clothes at the site. He was loud, agile, and hard-working and did not care for engineers from the office overseeing the tests. Being calm and composed, Randy handled Dutchie nicely, but I kept my mouth shut because I feared him.

Randy taught me to do one hydrotest, stayed for the next test section, and left for Calgary. I was on my own and had to deal with Dutchie! I soon realized that Dutchie was a softie and a lovely person, and he was also a great mentor. Over the following weeks, we became true friends. He was from the Netherlands, and I was from India. Dutchie used to tell me, "Hiran, I came to Canada with two wooden shoes, and you came with a bagful of curries. I worked my butt off, and you also do that to establish

yourself." I followed his advice throughout my working career and never regretted the decision. Dutchie was an icon in Alberta hydrotesting industry, and it took me several years to discover his real name was Ivan Sluys!

Returning to Calgary, I became interested in pipeline hydrotesting.

My first self-imposed assignment was establishing a standard table showing how many liters of water were needed to raise the pressure inside a one km pipeline by 100 kPa. Until then, we had no idea what to expect in the field while pressurizing a test section. I created a spreadsheet for the various past hydrotests and was astonished. Below is a table for the 30" diameter pipeline test sections. The yellow column shows that a 1 km, 30" diameter test section would need 37.97 liters of water to raise the pressure inside by 100 kPa. However, the various tests took anywhere between 15.86 to 41.4 liters.

Did it mean that all these hydrotests were done incorrectly?? Later, I realized that the engineers had done the hydrotests correctly, and the discrepancies were from having incompatible flow totalizers and flow turbines.

My next assignment was to understand the Methanol Wash procedures. After hydrotesting a pipeline, the contractor will dry it by sending a slug of highly concentrated methanol down the line so that any remaining water will not freeze being mixed with the methanol. While observing the methanol wash, I asked the inspector what ensured the residual water had sufficient methanol and would not freeze. The inspector dipped a rag into the liquid that came out of the test section and ignited it with his lighter. The rag burst into flames. That was the proof!! This theatrical method did not convince me, and with Rupert's support, I developed a Methanol Wash specification to ensure sufficient methanol was left in the residue and would not freeze. Many companies in the Alberta pipeline industry have used this specification.

For the next several years, I tested numerous pipelines for various companies. I also developed a comprehensive hydrotest spreadsheet (see below) and shared it with our pipeline industry.

I have been operating a pipeline training company in Calgary for several years. We now have over 1,200 students taking our various pipeline courses in-house and online.

I shall always be indebted to Randy Wight and Julio Daneri for introducing and teaching me about pipeline hydrotesting.

Piasha Pipelines

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piashapipelines@gmail.com

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Piasha Consulting	PIASHA CONSULTING - HYDROSTATIC TEST PRESSURE CALCULATION SHEET						Sheet Updated:	Nov-04-2019
PROJECT NAME:	ABC Pipeline					TEST DATE:	December 8, 2019	
PROJECT AFE#:	C19017	AER,CER #:	N/A		SECTION#:	1	REV#:	0
LTO#:	TBD	TEST#:	1	FILL WATER SOURCE:		Lake		
FLOW U/S POINT (UP) Name & Chainage (m):	Upstream Point		0+000.0	FILL WATER TYPE:		Water	(water or water/methanol mix?)	
FLOW D/S POINT (DP) Name & Chainage (m):	Downstream Point		9+288.0	TEST CLASS:		1	(Choice of 1 to 4)	

NOTE : Green Shaded Values are Input Data — **Product in Pipeline: Sweet Natural Gas**

PIPE DATA	PRODUCT FLOW DIRECTION '----->>>>				FLOW U/S POINT to FLOW D/S POINT		
PIPE OD (D) =	219.1	(mm)	8.63	(in)	FLOW U/S POINT (UP) CHAINAGE (m) =		0+000.0
LINE PIPE WT (t) =	4.00	(mm)	0.157	(in)	FLOW D/S POINT (DP) CHAINAGE (m) =		9+288.0
PIPE GRADE (S) =	290	(MPa)	42	(ksi)	LOCATION OF TEST POINT & BUS?	UP	0+000.0
MOP =	8,450	(kPa)	1,226	(psig)	LINE PIPE STRESS LEVEL =		0.798
PRESSURE @ 110% SMYS =	11,648	(kPa)	1,689	(psig)	Check AER D56 - Section 6.6.25 - Stress Level, Clause 44)a)iii)		
PRESSURE @ 100% SMYS =	10,589	(kPa)	1,536	(psig)	PUT HW PIPE AT TEST SECTION ENDS?		N/A
PRESSURE @ 80% SMYS =	8,471	(kPa)	1,229	(psig)	HW PIPE WALL THICKNESS (mm) =		5.33
PRESSURE @ 1.25 x MOP =	10,563	(kPa)	1,532	(psig)	H/Wall PIPE GRADE (MPa) =		290
PRESSURE @ 1.10 x MOP =	9,295	(kPa)	1,348	(psig)	HDD X-ING IN TEST SECTION? (Yes No)		No
SECTION LENGTH (m) =	9,288	(m)	30,472	(ft)	Squeeze Water Volume (litres) from 0 to Commencement Strength Test pressure =		2,554
SECTION VOLUME (litres) =	325,079	(litres)	71,509	(gal)			
0.2% OFFSET (litres) =	650	(litres)	143	(gal)	Squeeze Water-Methanol Volume (litres) from 0 to Commencement Strength Test =		3,109
Squeeze Water volume for 100 kPa pressure rise in test section =			22.9	litres			
Squeeze Water/Methanol volume for 100 kPa pressure rise in test section =			27.9	litres	(ROT) Squeeze Water Volume (l) /1,000 kPa =		260

ELEVATION AND PRESSURE DIFFERENTIALS			CHAINAGE					
FLOW U/S POINT (UP) =	961.00	(m)	0+000.0	HP - UP =	29.0	(m)	284	(kPa)
HIGH POINT (HP) =	990.00	(m)	3+813.0	UP - LP =	61.0	(m)	598	(kPa)
LOW POINT (LP) =	900.00	(m)	33+191.0	HP - LP =	90.0	(m)	882	(kPa)
FLOW D/S POINT (DP) =	950.00	(m)	33+191.0	HP - DP =	40.0	(m)	392	(kPa)
				DP - LP =	50.0	(m)	490	(kPa)
				UP - DP =	11.0	(m)	108	(kPa)

YIELD PLOT NEEDED? YES (Yes, if the Commencement Strength Test Pressure at Low Point >= **90% SMYS**) - as per Pembina Spec.

YIELD PLOT START PRESSURE								
FLOW U/S POINT (UP) =	6,089	(kPa)	883	(psig)	57.5%	(of SMYS)		
HIGH POINT (HP) =	5,805	(kPa)	842	(psig)	54.8%	(of SMYS)		
LOW POINT (LP) =	6,687	(kPa)	970	(psig)	63.2%	(of SMYS)	Limit (% SMYS) =	80%
FLOW D/S POINT (DP) =	6,197	(kPa)	899	(psig)	58.5%	(of SMYS)		

MINIMUM 'STRENGTH TEST' PRESSURE			1.25 x MOP at High Point					
FLOW U/S POINT (UP) =	10,847	(kPa)	1,573	(psig)	128.4%	(of MOP)		
HIGH POINT (HP) =	10,563	(kPa)	1,532	(psig)	125.0%	(of MOP)	Limit (% MOP) =	125%
LOW POINT (LP) =	11,445	(kPa)	1,660	(psig)	135.4%	(of MOP)		
FLOW D/S POINT (DP) =	10,955	(kPa)	1,589	(psig)	129.6%	(of MOP)		

IMPORTANT!!!!!!! MAKE SURE THE TEST PRESSURES REFLECT THE LOCATION (UP or DP) OF THE TEST BUS/SHACK

COMMENCEMENT 'STRENGTH TEST' PRESSURE (Min 4 - HOURS)						CUSHION as % of Min P (kPa) =	2.75%	290
(The Lesser of Min. Strength Test Pressure + Cushion, and 110% of SMYS at Low Point)							Max. P (kPa)	(% of SMYS)
FLOW U/S POINT (UP) =	11,137	(kPa)	1,615	(psig)	105.2%	(of SMYS)	11,050	104.4%
HIGH POINT (HP) =	10,853	(kPa)	1,574	(psig)	102.5%	(of SMYS)	10,766	101.7%
LOW POINT (LP) =	11,735	(kPa)	1,702	(psig)	110.8%	(of SMYS)	11,648	110.0%
FLOW D/S POINT (DP) =	11,245	(kPa)	1,631	(psig)	106.2%	(of SMYS)	11,158	105.4%

WARNING!!! PRESSURE AT LOW POINT IS EXCEEDING 110% SMYS!! — *WARNING!!! PIPE STRESS LEVEL MUST BE LESS THAN 72%!!*

MINIMUM 'LEAK TEST' PRESSURE			1.10 x of MOP at High Point					
FLOW U/S POINT (UP) =	9,579	(kPa)	1,389	(psig)	113.4%	(of MOP)		
HIGH POINT (HP) =	9,295	(kPa)	1,348	(psig)	110.0%	(of MOP)	Limit (% MOP) =	110%
LOW POINT (LP) =	10,177	(kPa)	1,476	(psig)	120.4%	(of MOP)		
FLOW D/S POINT (DP) =	9,687	(kPa)	1,405	(psig)	114.6%	(of MOP)		

COMMENCEMENT 'LEAK TEST' PRESSURE (Min 4 - HOURS)						CUSHION as % of Min P (kPa) =	2.75%	256
(The Lesser of Min. Leak Test Pressure + Cushion, and 100% of SMYS at Low Point)							Max. P (kPa)	(% of SMYS)
FLOW U/S POINT (UP) =	9,835	(kPa)	1,426	(psig)	92.9%	(of SMYS)	9,991	94.4%
HIGH POINT (HP) =	9,551	(kPa)	1,385	(psig)	90.2%	(of SMYS)	9,707	91.7%
LOW POINT (LP) =	10,433	(kPa)	1,513	(psig)	98.5%	(of SMYS)	10,589	100.0%
FLOW D/S POINT (DP) =	9,943	(kPa)	1,442	(psig)	93.9%	(of SMYS)	10,099	95.4%

CALCULATED BY (Mandatory):	Hiranmay (Hiran) Ganguli, P.Eng.	DATE:	Nov-25-2019
VALIDATED BY (Name & Signature Required):		DATE:	Nov-25-2019

Watercourse on proposed pipeline route

Watercourse Crossings: How should we cross them and why is it important?

By: Michelle Pask

Tips and tricks to help mitigate potential issues with crossing a fish bearing watercourse with vehicles or equipment and pipe

Michelle has been working in pipeline construction since 2007. Over the years she has completed many Projects as a Fisheries Biologist, Environmental Inspector, Horizontal Directional Drilling Inspector and Supervisor of Environment and Compliance for a major large diameter pipeline Project. Her work has brought her all over Canada including Nunavut, BC, AB and MB.

Michelle Pask, R.P.Bio, P.Biol, CPESC

Although regulations surrounding protection of fish and fish habitat have been around since the mid-80's, to this day there are pipeliners working out there that recall when pipes were installed with no thought was given in regards to the fish or if fish were even in the areas of trench. Get the pipe installed and get out, that was the intention. So often, stories are shared on the right-of-way about how they remember when they would just drag the pipe behind and go right through the river while it was flowing with heavy equipment or stories of driving right through the water to get to the other side was pretty common.

In Canada, in 1985 the Federal Fisheries Act was created. With it came a provision in the Act for the protection of fish and fish habitat and pollution prevention. Several updates and changes to the Act over the years, but always the protection of fish and fish habitat remained the same. Still to this current day, we are experiencing a decline in important habitat due to industry, climate change and infrastructure development even with the Act in place.

Why do we want to install pipeline crossings in a manner that protects fish and fish habitat? It's a simple question with a simple answer, to keep species of fish around for generations to come. Yes compliance with regulations and avoidance of fines or jail time is a great answer too, but protection of fish, of water, of habitats should come from within. Each person on a pipeline holds some sort of moral value, whether it be for their families, themselves or for someone else or thing in their lives. Our water, our fish are connected to everyone whether directly or indirectly. Most pipeliners have ties to a recreational activity which involves water or fishing and those reasons alone would be why we as pipeliners want to keep those fish and habitats around for generations to come.

Currently, as with most pipeline projects, a pre-construction fish and fish habitat assessment is conducted in advance of pipeline builds. During this phase of a project, a Biologist will determine the type of watercourse to be crossed and provide recommendations on how to cross it effectively with minimal impact (if any) to fish and fish habitat. Engineers will determine based on feasibility studies (such as geotechnical, historical data/ crossings etc.) the method to cross with the pipe.

A Biologist will support that method with further recommendations to mitigate any impacts to fish or fish habitat. A simple example is for a trenched (open cut) installation would be to isolate the watercourse from flow, remove all fish, control sediment and maintain downstream water quality. It is very important a crossing Foreman is aware of these recommendations provided by the Biologist to ensure fish and fish habitat are protected.

"Rivers are roads which move, and which carry us whither we desire to go."

- Blaise Pascal

There are several ways to cross a watercourse for vehicles and equipment. Methods can include temporary bridge placements, snowfills/ice bridges, fording, culvert or flume pipe, rig/ access matting and logfills. For pipeline crossings, the pipe is either trenched in or installed trenchless. Trenchless methods can include: horizontal augering, micro-tunneling, direct pipe or horizontal directional drilling.

Crossing types for Vehicles and Equipment

As mentioned above, there are several common practices for getting from one side to the other during pipeline construction. Although most pipelines are scheduled to be built during winter, usually the construction continues through summer months as well, with a short pause called "spring breakup". This is when most pipeliners head south for some much needed rest and relaxation with their families or friends. Timing of construction will determine the type of crossing used and for how long it will be used for.

The crossing with the least amount of impact to fish or fish habitat is the installation of a temporary bridge or single

span crossing over the watercourse. The word "temporary", usually means till the end of construction or reclamation, however long that may be. These crossings are built using a lot of geotextile (to protect the water from sediment), a lot of solid timbers (for structure support) and some sort of bridge decking (usually rig matting or actual steel engineered structures). These bridges are almost always set back out of the high water marks (if possible) or back from the top of the watercourse banks.

The most important thing to remember with bridges is maintenance. While physical habitat may not be disturbed

Historical crossing of an unknown river
Source: 2023 Trenchless Technology

(i.e. channel rocks, logs, banks etc.) bridges are prone to sediment release issues and impact to water quality within a watercourse.

Dry or frozen watercourses are the easiest to get through. In winter months, snowfills or ice bridges can be used or in summer if dry, then watercourses can be forded through (keep in mind these are once over and once back). During a ford, watercourse banks must still be protected and methods such as using geotextiles with matting usually help maintain integrity of the banks during crossing. Snowfills or ice bridges must not block flow and must be v-notched or removed prior to spring melt.

Less ideal methods for fish bearing watercourses would include logfills or culvert/flume installations. Approvals likely would be required to install those types of crossings and as with bridges, timing is everything for when crossings are installed.

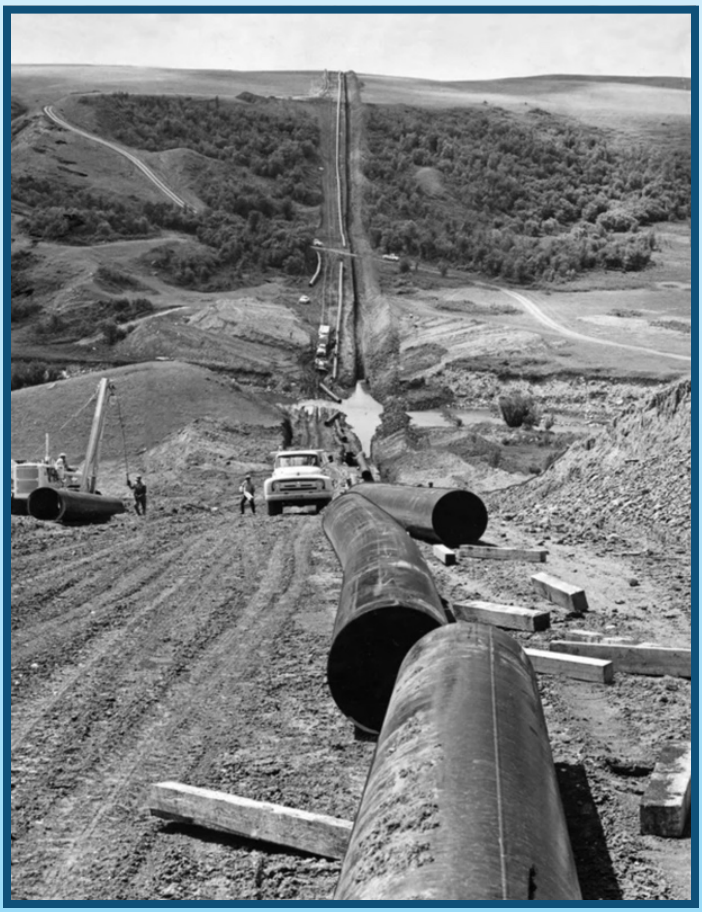
Crossing Types for Pipe Installation

There are two methods for installing pipe; open cut it or trenchless. Open cuts can be a better choice for some watercourses due to a number of reasons. Could be high risk for frac out (release of drilling fluids into the watercourse), geotechnical challenges, topographical challenges, watercourse could be non-fish bearing or can be open cut when fish are not using the habitat at the crossing locations etc. There are many reasons to choose the open cut method. A Biologist will provide recommendations for mitigation (to minimize short or long term impacts from the construction method on fish and fish habitat) to support a crossing Foreman during construction and assist in a successful installation.

Timing (restricted activity periods or instream work windows) is everything when it comes to fish. Project schedules take into account all the watercourses on a route and the timing for instream works. Construction will not open cut

a watercourse when a fish is spawning in the area or block off passage for fish moving through to access areas upstream for too long. These watercourses are put under isolation and pumped around to ensure water is maintained within the downstream portions.

Sediment controls are put in place to protect against dirty construction water from entering the watercourse outside of the isolations. An open cut to a member of the public can be falsely assumed there is no protection of fish and fish habitat, when that is not the case.



Historical open cut crossing through a river with earthern berms upstream, during construction of the Trans Canada Pipeline
Photo source: 1956 Gilbert Milne

The next method is trenchless. As mentioned, there are a few ways to achieve this install. The most common is by horizontal directional drilling (HDD). HDDs are usually low risk for long term impacts to fish or fish habitat but have the risk of an inadvertent fluid release which may impact a watercourse. Commonly called a "frac out", this occurs when while drilling, rock fractures or a formation allows drilling fluids to seep out and sometimes this can occur within a bank or channel of a watercourse.

Horizontal directional drill piloting hole across a large permanent fish bearing watercourse, trenchless method

Mitigation for this is most always included in a contingency plan or drilling execution plan, and while Biologists are not always on site during drilling, they can collect water samples during the process which may help with discovering a fluid release faster.

"You cannot cross a river without getting wet."

- Zulu Proverb

Direct pipe installation provides the least risk for watercourse impacts, but comes with a whole other line of potential issues (not environmental related) and may not always be the best choice.

Watercourse Reclamation

After an open cut, a watercourse must be reclaimed as best as practical to pre-construction conditions. Plans are included for ditching crews to rebuild the bed and banks to what existed prior to trenching. Photographs are helpful before trenching so crews can ensure proper plants, rocks, watercourse bed materials, fish habitat features and gradients are reclaimed in a manner that allows fish to pass through the area or use it for a life process (spawning, rearing or feeding).

Reclamation can be a fairly simple process for watercourse re-builds provided:

- Crews have an understanding of what fish would be in the area and what the habitat would need to look like (design, photos, communication with EI or Biologist)
- A design is provided to rebuild the bed and banks with materials (clean rock of such a size, what species of plants, what materials for coir wraps or bank stabilization required)
- Monitoring of the crossing after water has been flowing through site and after first snowmelt or heavy rainfall.
- Adapting to changes required in a timely manner.

Planning and maintenance is the key to success for final reclamation and pipeline integrity during a watercourse crossing installation whether for a vehicle or equipment crossing or a pipe installation.

Final clean up on an open cut watercourse. Seed and cocomatting installed for soil stabilization. This watercourse was non-fish bearing, but protection of water quality to downstream fish bearing water is just as important.

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