PIPELINE TALES

Issue 4: December 2022

A MAGAZINE FOR THE GLOBAL PIPELINERS

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Letter From the Publisher

Dear reader,

We welcome you to the latest edition of our pipeline magazine. We want to thank you for your continued readership and support. We take great pleasure in publishing this magazine to present you with various articles about our pipeline industry.

We trust you enjoy reading this issue as much as our team enjoyed developing it. In this issue, we honor one of our iconic Canadian pipeline inspectors, John Ness.

Our first three issues of this Pipeline Tales reached over 100,000 readers digitally. We are overwhelmed by such a response from our readers, and we thank our readers for supporting our vision of promoting the global pipeline industry.

Through this magazine, we showcase pipeline projects in Canada and worldwide, promote pipeline and pipeline-related companies with their products and stories; and encourage our readers to share their personal stories, adventures, success, and failures.

We, the pipeliners, take our craft seriously as we pride ourselves in building efficient and reliable pipelines with our smarts, dedication, and hard work.

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

Hiran Ganguli, P.Eng. Publisher

A Tribute to John Ness

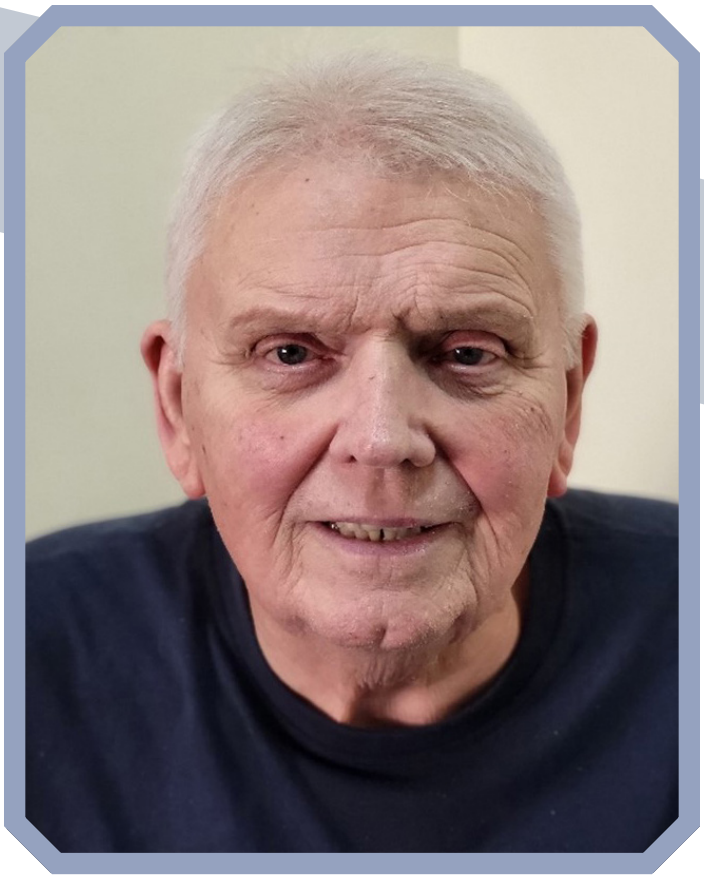
The John I know

By: Diane Upton

In 1975 Alberta Gas Trunk Line (AGTL) hired a survey company 'Canadian Engineering Survey' to work on one of their projects. Towards the end of the project, the Chief Inspector Norm Nelson, hired John to work with Rick Spittal, the Head of Survey. John became a Senior Surveyor and completed a 1,500 km of pipeline on the Artic Pipeline Pilot Project on Melville Island. He also worked on many large-diameter pipelines throughout Alberta and Saskatchewan, including the Alaska Highway Pipeline Project.

Over the years, John progressed from a surveyor to an inspector and then became a Chief Inspector or a Construction Manager. John was in charge of multiple projects over the years. His latest project was working in the TC Energy Head Office in Calgary for four years, doing preliminary work for the Coastal Gas Link Pipeline project and then out in the field when the project kicked off. John had quite a following of inspectors who would go out of their way to get on his projects.

During John's career with TC Energy, he bought a property in 2009 in Oliver, British Columbia, and built himself a winery. John had always dreamt of building a winery, so his love of pipelining and wine led him to name his company Pipe Dreams Winery.



John was the Construction Manager for Nova Corporation and TC Energy for 25 years until he became ill in October 2019. Due to John's illness, he retired from the pipeline industry and sold his winery, both of which he dearly loved.

John was well respected and appreciated by everyone that worked for him, including the pipeline contractors.

John Ness, the Eminent Pipeliner

By: Michael Moschopedis

John's career in the pipeline industry spans more than five decades, gaining unfathomable experience.

John built his career in the pipeline industry on the ground and through hard work. John began as a surveyor and became a Construction Manager

and Technical Specialist through years of knowledge gathering, John began as a surveyor and became a Construction Manager and Technical Specialist. Those who have worked or known John will agree that his dedication to the pipeline family is the greatest any individual can possess. John is a team player who treats all with respect, fairness, and integrity. John has formed many friendships and relationships, and many are honored to be considered his friend.

John has managed many pipeline construction projects in North America. John has worked on thousands of kilometers of pipeline ranging from the muskegs of Northern Alberta, the Canadian Shield of Ontario, and the Rocky Mountains of British Columbia. John's knowledge of pipelines comes from many years of observing and living the execution phases of pipeline construction.

John's recent accomplishment was as the Construction Technical Adviser on the Coastal Gas Link Pipeline Project for TC Energy. The Coastal Gas Link project was routed and planned through arduous years of site visits and kilometers of walking trails and routes to select a constructible pipeline route. John was the primary resource with the knowledge and experience that led that team to success. To this day, John's interest is sparked by the Coastal Gas Link Pipeline Project projects. John was unable to be involved in the execution of the project due to health reasons, but his heart is with the team executing the project.

Those that know John will also know his personal side. Unbeknownst to many, John has a very sophisticated pallet. From enjoying fine wines to elegant dining. Excluding the previous comment on fine wine and dining, John is also known to indulge in volumes of camp food. John's pallet was in dire straits with camp food; however, John needed to maintain his massive frame. John would load his multiple plates of camp food, and the site of such a load caused the team to poke fun at him and ask if he needed sideboards for his tray. Pipeliners tend to have a very sarcastic sense of humor. John would let out one of his bellowing laughs which were one of his trademarks. That John Ness laugh! With his love of wines and food, John fulfilled a lifelong dream of building and owning a winery in the Okanogan. John aptly named his winery Pipe Dreams. Very appropriate for who John is. John ended up selling his winery to simplify his life and is now living a life of retirement.

John is a person for all persons, and it is a pleasure to know the man, the pipeliner, the connoisseur, and the legend.

My memories of John Ness
By: Douglas Brunning

The first time I worked with John was in 1992 on the Meadow Lake Projects near Conklin. I was a young PM and learned much from John who was always eager to share his experiences. John had built a strong Construction Management Team, so the construction went along reasonably well in minus -40°C temperatures. No one could ever beat John to the office, and he would be in the construction trailer by four AM; good thing we did not have cell phones

or tablets in those days; otherwise, you would have received communication way before breakfast. John and others would remember when some patrons of the local establishment went door to door through the camp trailers after closing, looking for some cold ones. I was sleeping when I woke up with a gentleman in my room going through my closet; needless to say, that got my heart rate up.

Another fond memory for my wife Jane and me was a visit to John's winery Pipe Dreams; we received the royal treatment and a site tour. The wine tasted good too.

John is highly regarded in the pipeline industry for his routing capabilities and construction knowledge.

John Ness, my Mentor , My Friend

By: Hiran Ganguli

What happens when a giant (6' 7") shakes hands with a 5' 8" brown guy? A few knuckles break!

That was my encounter with John Ness. I was unsure if I should fear this man and avoid him or try to get close and know him better, so I chose the latter and tried to be his friend.

Things worked out well after that. I lost all my ego and inhibitions of an engineer and took John as my mentor. I had no problem asking John the trivial pipeline construction questions, and without criticizing my ignorance, he taught me patiently.

Our height, weight, or skin colour did not make a difference, and we became friends. John's patience was incredible. I am sure John got mad at people but never showed his irritation to anyone. He was always a patient mentor, teaching us the right things, whether project managers, engineers, surveyors, or project associates.

Then it was John's laugh. You could hear from a distance, and somehow, when he laughed, the entire construction trailer came alive!

I spent some time with John and Dianne in Wabasca, Grande Prairie, and other construction locations. John does not fool around when it comes to meals. We went to a Japanese diner in Grand Prairie, and to our surprise, John ordered a bottle of Saki, warm!!

I am glad I met John; he taught me much about becoming a pipeliner. John is now ill, and I had coffee with him and Dianne the other day. Irrespective of this illness, John is in high spirits. I am going to continue our coffee sessions and keep learning from him

John, One Hell of a Guy - and a Friend

By: Bruce Wells

I met John on August 3rd, 1980. My dad got me a job surveying with Foothills Pipeline, and at that time, John was surveying for Alberta Gas Trunk Line. When I mustered up in that Blackfoot Trail location, I witnessed something one would never believe possible. I met John Ness, Vern Meier, Ernie Lupul, Dan Hushion, Rick Spittal, Corey Krupnik, Bob Hudson, and Dave Johnson. I'm certain I'm missing someone, but that day started a career for me and a line-up of dedicated

surveyors that touched many of you through the years of pipeline construction. While my favorite was Dave Johnson (because he saved me from all the bullying), my second favorite was John. How could one forget his presence (presence, not size)? My third favorite was Meier, but I'd never tell him that.

I worked with John throughout my career. He changed jobs inside the company, and so did I. We were never close as in being in touch with one another all the time but somehow were very close. For those of you that surveyed, you will get this

Ray Boivin, Bruce Wells, John Ness

Here are some of my memories of John:

- John giving me the wrong survey angle. Me turning that angle on the old theodolite and cutting through the nastiest willow brush EVER. John strolling up to me and letting me know that it was the wrong angle. Me ranting and jumping up and down like a lunatic; John just staring at me cool as a cucumber.
- Me breaking into Bruce McGowan's secret whiskey stash in a camp north of Slave Lake. John, Craig Petrick, and I drinking way too much of the whiskey, and John, with his belly, bouncing Craig off the walls of the camp hallway like a ping pong ball.
- Playing pool at the Wainwright Hotel (note the Army Base). John walking up to the table and looking at a couple of guys playing pool and saying, "I want to play pool now." We played pool.
- I am leading Coastal GasLink and saying. I won't do this without John. I owed him much, and he always delivered.
- Lastly and my most endearing memory was rubbing John's feet in the Kelowna hospital and asking him, "John, have you ever had your feet rubbed like this before?". He said no but said it really felt good. We just sat there - not saying that much - but with a quiet understanding that brotherhood is everlasting, runs deep, and is full of care and affection.

John is my Friend
By: Ivan Sluys (Dutchie)

As a hydrotest contractor, I worked with John on quite a few jobs. After hearing he had a winery called PipeDream, I contacted him to find out what it produced and sold. When I called John, Dianne told me John was having health problems.

I have been retired for four years now, only to realize that most of the connections with friends all over Canada working on the pipeline are slowly disappearing.

John and Dianne, good luck and stay in touch.

A friend. Dutchie.

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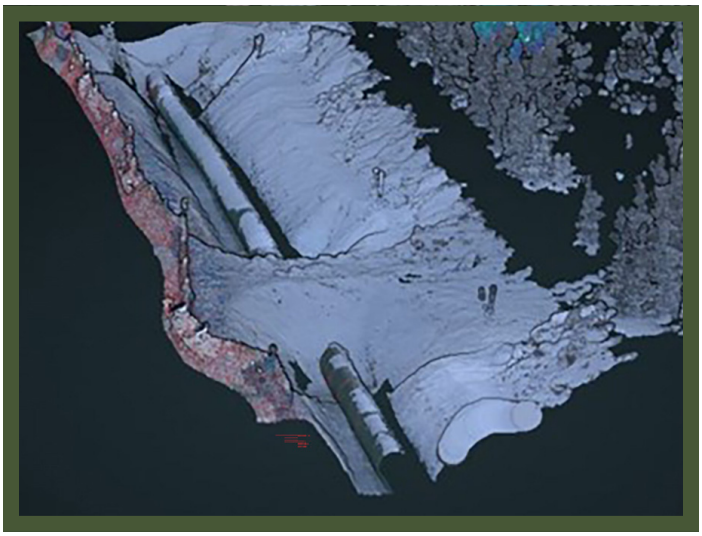
CANADA BEST MANAGED COMPANIES

A Company Tale: Lux Modus

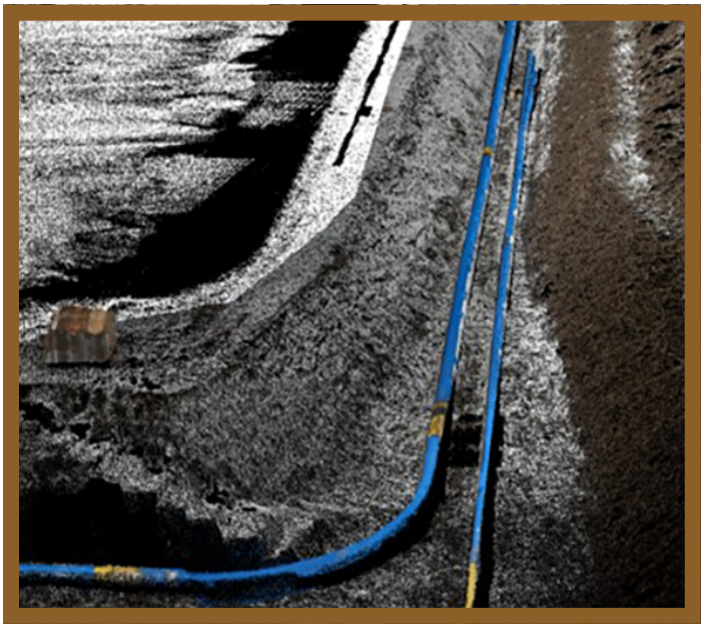
Lux Modus is a veteran-led company created in 2017 to disrupt the 3D mapping industry by breaking down the barriers to entry of collecting, processing, and using 3D.

Developed out of the autonomous vehicle mapping (AV) industry, Lux Modus created Infrastructure Mapping and Autonomy (IMA) to leverage the AV mapping industry's advanced data collection, post-processing,



and feature extraction technology for infrastructure mapping. Since 2017 IMA has provided world-leading geospatial data collection programs, data processing, feature extraction, and 3D modeling projects across various industry verticals.

Lux Modus also leveraged advanced AV mapping technology to create an affordable and easy-to-use 3D data collection platform, so the synergies between the two companies were evident early on. With Lux Modus collecting massive amounts of 3D data and IMA ready to manage those



projects, process the data, and provide value-added mapping, the two companies started partnering on projects.

Lux Modus and IMA have come together to offer the 3D mapping industry a fully vertically integrated data collection and mapping company. Retaining the Lux Modus name, our new 3D mapping company is well-positioned to revolutionize the traditional mapping industry.

Transmission and Distribution Pipelines

Traditional pipeline construction techniques have not kept pace with other industries with respect to data utilization and quality control.

Slow data delivery inhibits timely corrective action, collaboration opportunities, and performance improvement. As a result, Operations and Project Managers are left with an incomplete picture of the pipeline as constructed.

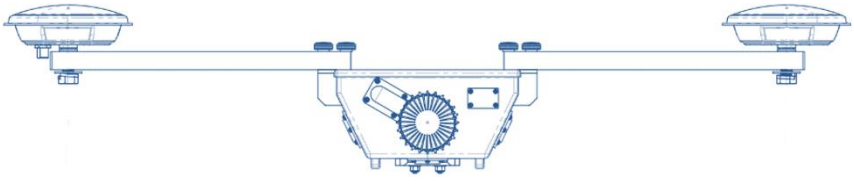
Lux Modus technology is the source of pipeline digital twin, and helps solve these and other challenges, from construction to decommissioning.

Colorized 3D point cloud by LuxGear and visualized in LuxWeb

LuxGear scanning configuration for UTV

Lux solves these challenges by providing:

- Mobile HD LiDAR + HR imagery platform that can be used in extreme environments, on any vehicle, and by anyone.
- Rapid cloud-based data processing and web viewer, eliminating overhead costs for software and training.
- Data availability within minutes to hours, rather than days to weeks.



A 3D Digital Twin is more than point clouds and images. It's GIS and CAD data, ready to be consumed via web maps and desktop or enterprise geospatial systems

Upstream Asset Management

Infrastructure assets are bought and sold every day, but these transactions often occur in the absence of details about the physical asset. The same lack of detail often applies to the day-to-day operations and maintenance of these assets.

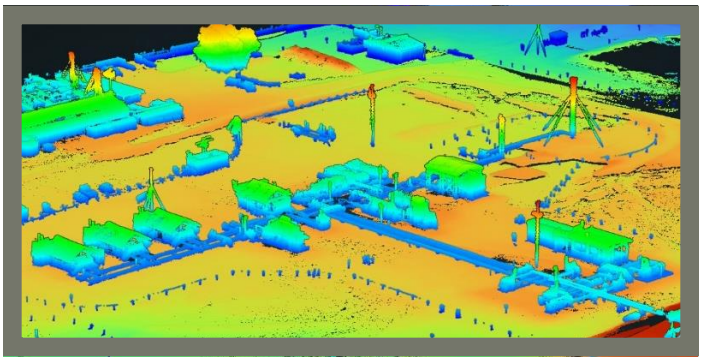
Until now, time consuming and costly field visits were the only way to understand an asset. With Lux Modus technology, anyone can view and analyze each asset without going to the field, from any internet-connected device which further helps satisfy your safety, quality, environmental, and innovation goals.

Don't rely on expensive field visits – capture and share your asset information with Lux Modus

3D point cloud by LuxGear and visualized in LuxWeb

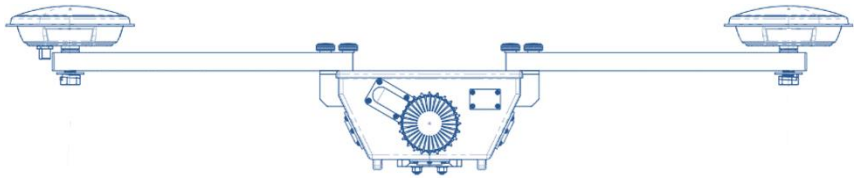
The Lux Modus platform:
Affordable and Easy-to-Use 3D

- Mapping Real-time high-definition 3D mapping
- Ultra-high-resolution imagery and LiDAR
- Data viewable within minutes of upload
- Set-up in minutes by a single operator
- Designed for the harshest environments



3D point cloud by LuxGear and visualized in LuxWeb

- Automated cloud processing
- No special training or software required Low-cost hardware for purchase or lease
- Pay-as-you-go data processing



A 3D Digital Twin is more than point clouds and images. It's GIS and CAD data, ready to be consumed via web maps and desktop or enterprise geospatial systems

Overview

The LuxGear platform is ideaL for:

- 3D infrastructure mapping
- Asset inventory
- Reclaimation/environmental monitoring
- HD semantic mapping
- 3D environment generation for training and entertainment/gaming

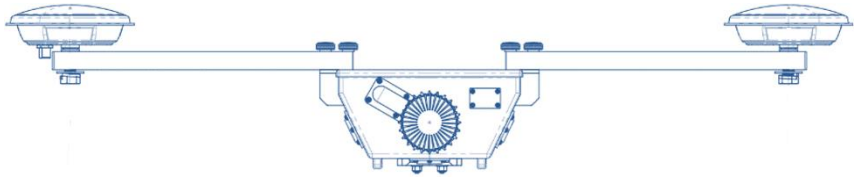
Lux Modus is an advanced 3D mapping technology company focused on democratizing 3D data collection. Our low cost, easy-to-use collection platform is self-contained and can be mounted in several different configurations depending on your mapping needs. Our one touch data capture technology frees the user from having to manage the system while driving the collection area.

Consisting of a high-density digital LiDAR and three 13 megapixel cameras, the LuxGear unit can create super rich contextual 3D maps at a price and speed not previously available.

Users easily mount the LuxGear collection platform on any vehicle, plug in the LuxGear to a power source in the vehicle and hit record to start the data collection.

Once the data collection has been completed, the data is uploaded directly into LuxCloud for processing. All data is instantly processed and colourized and is viewable in our LuxWeb 3D viewer within minutes.

Once base station data is provided the point clouds can be finalized and ready for download. Users only pay for data they use, reducing cost and providing more flexibility to their project needs.



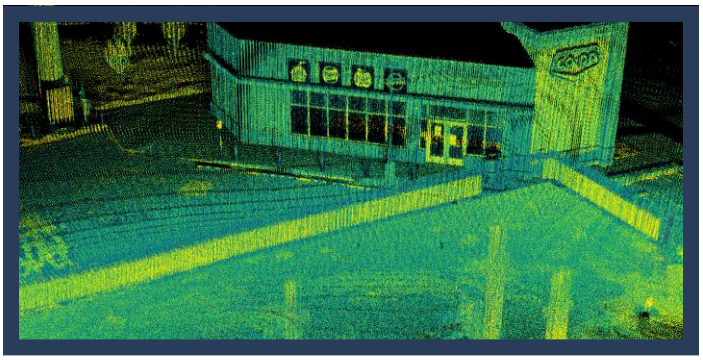
A 3D Digital Twin is more than point clouds and images. It's GIS and CAD data, ready to be consumed via web maps and desktop or enterprise geospatial systems

Democratized 3D Mapping

Lux Modus has brought 3D mapping to the masses through ease of use and affordably. By internalizing data processing and removing the need for users to take specialized training, Lux Modus has made it possible for customers to incorporate 3D mapping into their business. Lux Modus is composed of three core technologies, the **LuxGear** hardware platform, the **LuxCloud** automated data processing pipeline, and the 3D point cloud and imagery viewer **LuxWeb**.

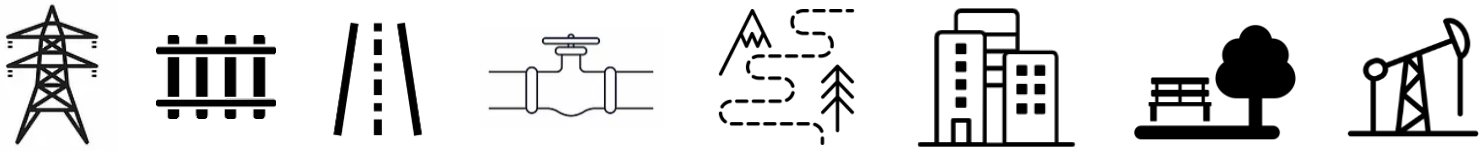
Collect **Compute** **Consume**

The LuxWeb 3D viewer allows users to view the data they collect, tag and comment on each scan, and view all the geo-referenced images. It is also where users complete all their data management tasks.



LuxWeb also offers users a range of measurement and analysis tools as well as giving them the ability to monitor their data collection progress.

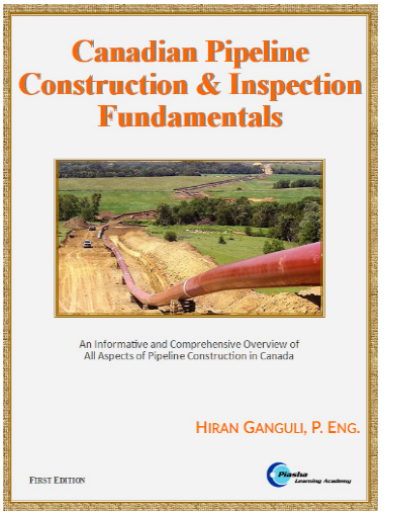
Lux Modus is your ideal 3D mapping technology partner. Whether you are mapping the built environment, corridor infrastructure, or natural areas, the LuxGear platform can capture what you need at the press of a button. LuxCloud will then do all your processing in just minutes, saving you the time and cost of processing data.



CANADIAN PIPELINE CONSTRUCTION & INSPECTION CERTIFICATION PROGRAM (CPCICP)

CORRESPONDENCE COURSE

Course Description



Piasha Pipelines offers a comprehensive **Canadian Pipeline Construction & Inspection Certification Program (CPCICP)** correspondence course to individuals interested in a career in the Canadian pipeline industry. In early 2016, **Piasha** consulted with experienced pipeline construction experts to design this course. However, when we launched this course in late 2016, major Canadian pipeline companies started to support the API 1169 program, which is USA based program with little to do with Canadian pipeline systems. The companies mandated that inspectors pass this expensive course to get jobs as pipeline inspectors in Canada.

The good news is that the companies are now relaxing this mandate and allowing inspectors without API 1169 certificates to work on pipelines. Potential and experienced inspectors now have a practical alternative. They can complete the Piasha CPCICP from the comfort of their homes and will learn much about Canadian pipeline construction at an affordable price. Piasha provides completion certificates to the graduates

Program Synopsis

1. Introduction	8. Clearing of ROW	15. Ditching	22. Pressure Test
2. Regulations & Standards	9. Grub, Strip & Grade	16. Cathodic Protection	23. Caliper Pigging
3. Pipeline Inspection	10. Transport & Stringing	17. Lowering	24. Pipeline Drying
4. References	11. Pipe Bending	18. Backfiling	25. Cleanup
5. Measurement Units	12. Welding	19. Crossing - General	26. Safety
6. Pipe & Pipelines	13. NDE	20. Buoyancy Control	27. Glossary of Items
7. Construction Survey	14. Coating & Jeeping	21. Crossing - Special	28. PL Equipment

Testimonials

"There is so much I learned from this program..." - *Thomas*

"Hiran, thank you very much for the course; there was terrific and valuable content within!" - *Brock*

Program Package:	A 310 page reference book with 28 chapters
Program Start Date:	Anytime
Program Duration:	Six months from the registration date
Program Fee:	Please check - www.piashaconsulting.com

A Technical Article

Controlling water during Pipeline Construction: Why do we want to , and how do we get there?

Tips and Tricks to help manage drainage across a pipeline rightof-way

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

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, British Columbia, Alberta, and Manitoba.

Historically, humans saw the need to control the movement of water. Although not the same, this article will discuss controlling water movement across a pipeline right-of-way (ROW) to divert water for drinking and irrigation. This need led to the construction of aqua ducts and bamboo piping systems and cast iron pipes in the 18th century. Steel pipes were introduced in the 19th century, and rapid growth in the 20th century would see most of those pipelines laid. Water movement was the start of early pipelining needs, and over the years, progressed to population growth and infrastructure development, also requiring natural gas and oil. In the 1950s and 60s, pipelines were booming, and most of the lines we see today in construction are replacements for those old lines.

"By failing to prepare, you are preparing to fail."- Benjamin Franklin

Fast forward to 1987. A sediment fence could not control the dirty water while installing a pipeline through a creek using the open-cut method. It wasn't until the early 1990s that sedimentation and erosion control started to show on pipeline construction projects. The contractors started to use Dam and pump methods instead of open-cut crossings to control water around ditching and installed sediment fences around the right of way. Within the last ten years, erosion and sediment control has made the front pages of new pipeline construction.

Why do we want to control drainage on the pipeline?

There are several reasons. One of the main reasons is to save costs. Most pipelines today are cost-driven, with Environmental Regulations pushing a close second. Of course, there are regulatory implications to allowing dirty water to flow into fish-bearing watercourses, but a project always has a budget in mind. A schedule is also vital to meet the milestones. With schedule comes planning. Usually, pipeline milestones, such as open cuts or trenchless activities, are conducted at certain times of the year, and most are

around some bird, caribou, or frog timing. Many activities are also scheduled around seasons for high rainfall or snowmelt.

You may often hear of "spring breakup" in the pipeline world. Most workers cannot wait for that 'season,' but some never leave the ROW for a break. These crews manage water runoff from snowmelt which is a huge undertaking and expense, and it's essential to do it right the first time during construction. This will reduce the costs of managing the 'dirty' water during the breakup. ROW drainage management usually shows up as a Project Sediment and Erosion Control Plan or Site Specific SECP. Most crews on the line would have no idea what this is, but they will notice the results of one. The Foreman may move a sediment fence and ask crews to replace it later. Those pieces around the ROW form part of the plans. Sediment and erosion control should be all around the ROW in this present day, and if it isn't yet, it should be. So how do we get there?

We often talk of a safety culture around pipelines and buy-in from workers. Still, we fail to discuss the culture around the environment and the importance of managing our sediment runoff and water quality. When we strip a ROW, we create large spans of exposed clays due to rainfall. Soil berms are usually stacked along the workside, with few gaps to allow water to move. Long sections of the ditch are opened with groundwater filling from below and overland flow filling from above, left for crews to find locations to pump the water off to without causing impact to vegetation or other environmental features. How often has a ditch been opened and exposed to a new spring, causing havoc on the ROW?

Last line of defense is a sediment fence

The Foreman or Superintendent should acknowledge a general understanding of the landscape level and how water moves across a site before stripping. It would benefit crews later on when managing water across the ROW. Landscape-level awareness can increase productivity for construction when the proper Best Management Practices (BMPs) are used to control water during a pipeline project's Access and Grade phase.

This can involve:

- Identifying downstream/slope receptors on a watershed level, using sources such as ARCGIS VDP or Google Earth KMZ files or LiDAR (laser imaging, detection, and ranging) (i.e., where does the ROW drain toward)
- Identifying surface water and groundwater sources that have the potential to enter the ROW by conducting walkthroughs in areas before opening access and grade;
- Placing surface soil piles to avoid saturation and potential movements. These could impact environmentally sensitive sites, such as watercourses or wetlands adjacent to the ROW.

Best Management Practices (BMPs)

Now that we know the landscape and how water flows across the site before stripping, Foreman can plan what BMPs they want to use to ensure water flows around or through the site with minimal sediment transport.

Several BMPs are available to control, slow down, divert or filter out dirty water from a pipeline ROW. Several common items are: sediment fencing, straw wattles, geotextile, sandbags, rip rap, coco matting, poly sheeting, and dam & pump methods. There are many options today, and new technology is evolving daily.

It is essential to try and divert any water around a site, if possible, first. Some suitable methods are: perimeter ditching, armoring, check dams, and gradient changing. Grade plans usually incorporate some Erosion and Sediment Control (ESC) work, but it is elementary (unless there is a steep slope). The Foreman will plan the on-the-ground management of water and field fit those BMPs during access and grade.

For example, a site has spring-fed drainage flowing from the workside to ditch across the ROW. A diversion berm with drainage may be used across the ROW called a log-fill (swale with logs to allow water to flow), a flume can be installed under a ramp, or the area can be left unstripped until the installation of the pipe is required. Sediment fencing can be used to direct water away from the ROW as well. Maintenance is vital in all BMP installations. If swales are filled with sediment from traffic, then water will no longer flow clean very quickly, and sediment-laden water will leave the site.

Remember: Sediment fencing holds/directs water, not filters it, and is the last line of defense.

Sediment fencing can be effectively used if installed correctly. Depending on the installation pattern, it can direct water off ROW, slow down water and capture sediment, or delineate an environmental feature as a last line of defense against dirty water runoff.

If routine maintenance is not conducted, improper installation of BMPs, or poor choice of BMPs, this will lead to re-work, increased costs, and possibly regulatory non-compliance.

View of stripped ROW in preparation for open cut, temporary ESC measures (straw, cross ditches, rock armour and seeding)

Maintenance is key.

Temporary measures vs. Permanent measures

There is a difference during pipeline construction for ESC measures. Crews could be daily moving sediment fencing, wattles, pumps, wing walls, sandbags, and pumps. These temporary measures are ongoing throughout construction to

manage water across the site, and these will be removed once permanent measures are installed or vegetation has been established. Permanent measures are built after the pipe is in the ground during the clean-up phase of construction or after a watercourse has had the pipe installed. These measures must be incorporated into the overall design of the ROW, which will address long-term, post-construction sediment, and erosion control.

Example of poorly maintained BMPs and possibly the wrong BMPs chosen to direct water off the ROW before the bottom of the slopes

Finish as you go.

This line of thinking can save in the long run. Leaving large open areas of a trench or exposed slopes for long periods or clearing/grubbing/stripping areas not needed by construction could delay the schedule and cost. Regulatory shutdowns, periods of heavy rainfall, or snowmelts can all contribute to delays by not reducing the amount of exposed soils on a ROW. After completing an activity, such as backfilling, the area should be machine-cleaned as soon as possible and revegetated, even if temporary, until the final clean-up. Access lanes can be maintained with cross-ditching and minimally exposed soils for runoff.

Final clean-up should consider water flow across the pipeline roach and in low areas

Final clean up on a drainage. Seeded and cocomatting installed for soil stabilization.

such as wetlands. Roach may need breaks to ensure flow and water is not impounded on ROW. Slopes should have permanent ESC measures installed and maintained until after the first growing season (or longer as needed or required). Erosion from water can cause issues with the pipe or problems in watercourses with scour and loss of cover.

Maintenance is the key to success for final reclamation and pipeline integrity.

Acronyms:

ArcGIS: A family of client, server, and online GIS (Geographic Information System).
BMP: Best Management Practices
ESC: Erosion and Sediment Control
KMZ: Zip-compressed KML (Keyhole Markup Language) File
LiDAR: Laser imaging, Detection, and Ranging)
ROW: Right-of-way
SECP: Sediment and Erosion Control Plan
VDP: Variable Data Printing

"All water has a perfect memory and is forever trying to back to where it was." - Toni Morrison

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Centrifugal Pumps - Parallel Operation & Motor Sizing

By Nilanjan A Chaudhuri

Pumps in a Process Plant have to operate in parallel more often than not. The most common reason is that having more than one pump in the pumping circuit offers flexibility. If only one pump is used for service and it breaks down, the pumping system or process shuts down. Instead, a two-pump with half the capacity (2x50%) philosophy can be adopted. Here, if one pump breaks down, the other will continue to operate, delivering more than 50% of the output. Although it may sound strange, this statement can readily be appreciated when one learns how centrifugal pumps work in a system.

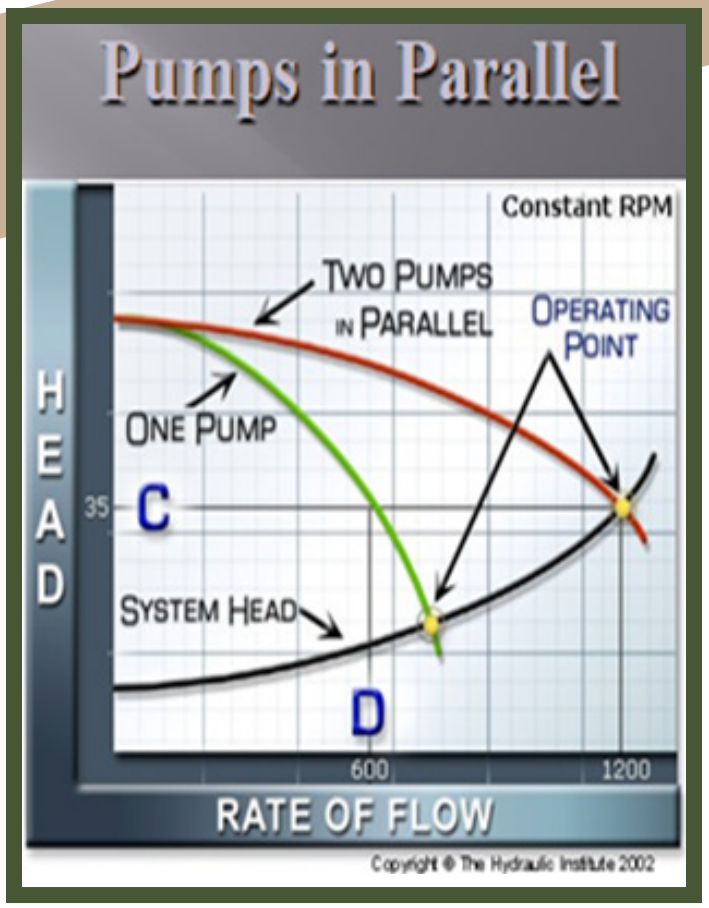

Figure 1 (Courtesy of the Hydraulic Institute)

Figure 1 shows the Head vs. Capacity (Rate of Flow) characteristics of a centrifugal pump and the combined characteristics when two similar pumps operate in parallel. The system resistance curve, which is purely the system's characteristics and has nothing to do with the pump curve, has also been plotted on the same graph.

The system resistance curve comprises the static head in the system and the frictional losses in pipes and fittings, which depends on the flow rate, pipe size, and of course, the frictional coefficient.

The centrifugal pumps in a system always operate at the point of intersection of the pump and system resistance curves. That is where the head developed by the pump and that demanded by the system match with one another.

Figure 1 shows that when one of the two pumps trips, the operating point will shift towards the left, and the pump will deliver a flow rate greater than 50% of the flow rate when both pumps are operating.

However, such a reduction in flow rate may not be considered healthy for the overall process. The third pump with a 50% capacity is often installed, resulting in a 3x50% pumping system. In such a system, one pump is kept in standby mode and is put into service when one of the two operating pumps trips.

A spare pump is, therefore, mandatory in critical systems. The extra pump usually is identical to the main pump. Project specifications often demand 50% sparing, which means that two parallel pumps supply the total flow, with an additional pump as a spare or standby.

At times, the 2x100% or 4x331/3% sparing philosophy is also adopted. The choice depends on desired flexibility, space availability, and the cost of pumps, piping, and valves.

Just as it is clear from Figure 1 that the flow rate in the system is greater than half when one pump in a 2x50% trips, it is also evident that if one pump of equal capacity is added to the system, the flow rate in the system will not be doubled

Thus, purchasing a pump of equal capacity, adding the same to a system, and expecting the flow rate to be doubled is a common mistake by Process Engineers.

The reason for this apparent anomaly is nothing but the fact that if the same discharge piping configuration is used, the system resistance curve does not change and does not allow the flow rate to get doubled. To combat this situation, one has to make the system resistance curve flatter so that the point of its intersection with the combined pump characteristics shifts towards the right.

Physically it will mean replacing the existing pipes and fittings with larger diameter pipes and fittings or installing a parallel piping system to reduce the overall system resistance. In case of space constraint, which does not allow for additional pipes, one has to choose the additional pump carefully so that the combined characteristics can result in the desired flow rate in the system, which can be found by superimposing the same on the system resistance curve.

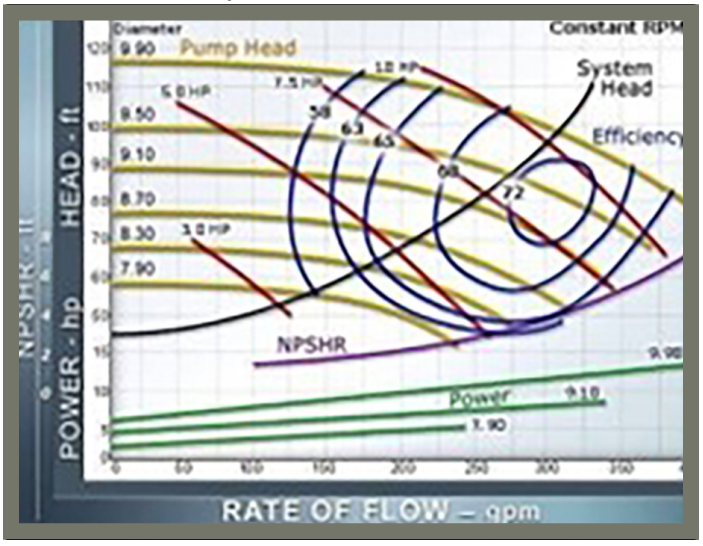

Figure 2

Another solution may be changing the impellers to a larger diameter that will still fit into the pump casing and how the Head-Capacity curve changes with change in impeller diameter has been presented in Figure 2.

A third solution could be increasing the pump speed but that is somewhat uncommon. As NPSH requirements increase with increasing speed, internal recirculation can become a problem. Also, a gear train means added maintenance problems and perhaps a larger driver if used for increasing speed.

The only way, therefore, will be to buy a pump with a proper Q-H curve that will double the flow, as can be verified by plotting the system curve against the head-capacity curves, as stated earlier.

Now, regarding drive motor sizing, the simple rule in selecting a proper rating for the motors is to select ones that:

- Exceeds the pump manufacturer's rated point brake horsepower by a fixed margin or,
- Has the same brake horsepower at the end of the selected impeller diameter curve i.e the highest flow rate against which TDH has been plotted on the Q-H curve by the pump vendor.

However, the driver rating may still be inadequate, even if selected on the basis of above criteria

The designer must also check the BHP requirement for the pump at a capacity higher than 100%. As explained earlier, a single pump will deliver more than 100% when 1 out of 2 in a 2x50% system trips or 2 out of 3 in a 3x3. 33% system trip.

A motor can may therefore get overloaded in such conditions, and the rating should be so selected as to take care of such off-design conditions as well.

This implies that the system designer must check the BHP requirement of the pump at the point of intersection of the system resistance curve and the single pump Q-H curve in a parallel pumping system and then apply a suitable margin on that to arrive at the driver rating.

In addition, the following points too need to be noted:

- The brake horsepower values published by the pump manufacturer on the generalized hydraulic performance curves (TDH, efficiency, BHP vs. capacity) are the basis for the rated point BHP. The data is as accurate as practical for the designated equipment design but does have a tolerance range.

  One of the current industry acceptance test criteria, set by the Hydraulic Institute Standards, permits the Pump Flow Rate and TDH to exceed the design point requirements by as much as 10% and 8% respectively for pumps in the 1KW (1.3 HP) to 10 KW (13 HP) range. Such positive tolerances will obviously have a subsequenteffectonthepumpBHPaswell.

  API-610, i.e., the standard for Centrifugal Pumps for Petroleum, Petrochemical, and Natural Gas Industries, on the other hand, permits a positive tolerance of 4% on Rated Pump Power.

- The performance curve published by the pump manufacturer does not always provide allowances for the power required to turn a mechanical seal loaded to typical process conditions. For a high suction pressure, double mechanical shaft seal pump installation, this can be

a measurable amount and must be added to the horsepower required to move the liquid. Some pump designs may require an allowance of one to two horsepower to compensate for seal losses. Hence, if the generalized performance curve-rating point results in a BHP of 7.5 HP, a motor of 10 HP may be considered for the application with no seal drag-factor allowance

Seal horsepower losses typically impact the installations at or below 25 HP, but they should be considered for all installations.

- The BHP of most pumps in a Process Plant increases with increasing flow through the pump (rising characteristics). This happens since the impeller's specific speed is less than 4,500 rpm, and the

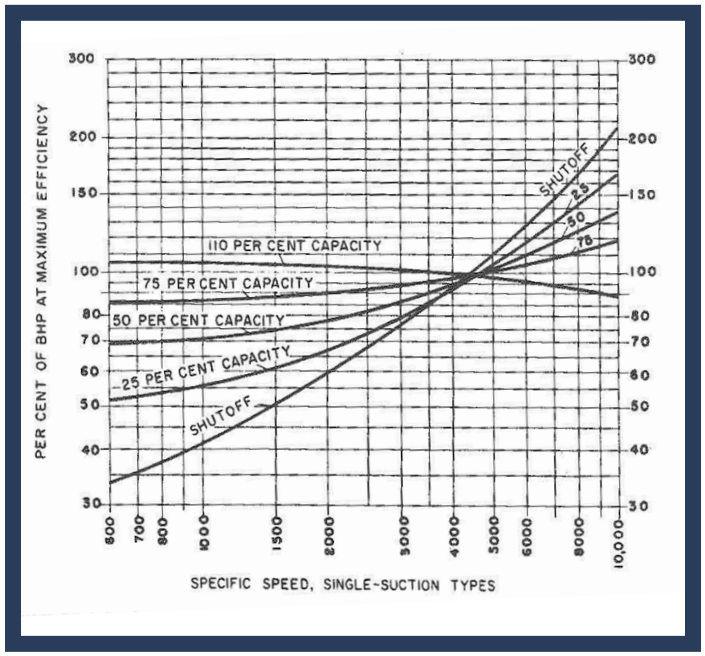

Figure 3

impeller type can be called 'radial' rather than 'mixed flow' or 'axial flow,' which have much higher specific speeds.

Figure 3, reproduced from Figure 18.36 in 'Centrifugal Pumps' by Igor J Karassik and Terry McGuire, demonstrates that clearly.

- Fluid characteristics viz specific gravity and viscosity can also affect the required pump brake horsepower. The designers generally select motors based on rated conditions of the head, flow, specific gravity, temperature, and viscosity. The designers also should evaluate the off-design needs of those fluid characteristics affecting the motor brake horsepower before selecting a driver.

- The designers should also check whether an alternate start-up or shutdown flush liquid is required, which has a higher specific gravity liquid than the rated flow material. Also, one should check the actual liquid viscosity at a lower temperature than rated conditions since it will increase the BHP of the pump. Even though the pump and piping may be well insulated, without heat tracing, the system will be at ambient temperature during a start-up

Table 12 — Power ratings for motor drives

Motor nameplate rating		Percentage of rated pump power
kW	hp	%
< 22	< 30	125
22 to 55	30 to 75	115
> 55	> 75	110

Taking various factors into account, API-610 –Table 12 specifies a minimum margin for motor rating, which decreases as the rated pump power increases. Table 12, reproduced from API-610, defines the stipulation.

API 610 also dictates that the motor should be capable of accelerating the pump to a rated speed at 80% voltage against a closed discharge valve.

Thus there is no simple rule of thumb for sizing the drive motors, and the variables that must be taken into account have been discussed in this article. However, it will be good to remember that oversizing motors to compensate for the conditions that may or may not exist on every installation can result in substantial additional expenditure for the total electrical system

Acronyms:

API:	American Petroleum Institute
BHP:	Brake Horsepower
H:	Head (Feet)
HP:	Horsepower
KW:	Kilowatt
NPSH:	Net Positive Suction Head
Q:	Liquid Flow Rate (US gallons per minute)
RPM:	Revolutions Per Minute
TDH:	Total Dynamic Head

Nilanjan A Chaudhuri is a Mechanical Engineer from the Indian Institute of Engineering, Science &Technology, India, and he also obtained a degree in Chemical Engineering from the Institution of Engineers, India. His career started with Larsen & Toubro Ltd, an Indian conglomerate at Powai Works, Mumbai, India. Later, Nilanjan moved to Development Consultants Pvt. Ltd (DCPL) and worked for Power, Chemical, and Hydrocarbon industries, specializing in Equipment and System Design. Subsequently, he joined Reliance Industries and retired from the post of Vice President. Nilanjan is now continuing with his service in DCPL as an Executive Director.

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A Company Tale:

Geoverra - Canada's Surveying and Geomatics Experts

Geoverra History

In 2020, the geomatics business units of WSP and Altus Group combined to form one of Canada's largest geomatics firms, GeoVerra. With 24 offices across Western Canada and Ontario, GeoVerra provides land surveying, forestry, environmental, and geospatial solutions to diverse clients.

Services & Solutions

When it comes to pipeline projects, GeoVerra is a one-stop shop for surveying, forestry, and environmental solutions. Having surveyed thousands of kilometers of pipelines, we understand the process and the complexity involved.

GeoVerra provides the following services and solutions for the pipeline industry:

Pipeline Construction: GeoVerra provides safe and cost-effective solutions for successfully completing these projects during the pre-construction, construction, and post-construction stages. A few of our services are:

- Pre-legal and control surveys
- Pipeline engineering surveys
- Pre-construction staking and sweeping
- Construction as-built surveys
- Forestry and environmental (construction staking, regulatory approvals, water act, wildlife sweeps, timber salvage planning, and management)
- GIS data management
- Weld mapping and material reconciliation
- Plan registration and disposition filing

Pipeline Integrity: From initial planning to final repair at a single site or several sites, GeoVerra has the technology and experience required for your pipeline integrity projects. We combine client data with our in-house data to map potential repair sites and accurately, safely, and efficiently establish chosen locations in the field.

- Custom portals for virtual site visits
- Plans of entry and scout maps
- Repair plans
- Right-of-way staking
- GIS display and data archiving
- Line locates and sweeps
- Site as-built surveys
- Tool and survey data correlation
- AGM surveys
- Anomaly identification plans
- Dig site plans and field staking

Pipeline Power

Advanced technology is changing the game for pipeline integrity and maintenance programs, and GeoVerran is here for it.

For pipeline owners and operators, the risks are real.

Pressure is mounting: rigorous and complex regulations, price volatility, environmental crusades, and even unpredictable weather and geohazards are writing a new chapter for oil and gas.

But thanks to forward-thinking companies embracing digitalization to manage their assets better and mitigate risks—whether for designing, building, or operating a pipeline—they get to author the future.

Monitoring & Mitigation

Pipeline integrity and maintenance programs are nothing new, but the way we can acquire critical data is.

"More traditional methods for site visits and planning, including deploying large crews on foot, can be challenging," says Mohamed Attia, GeoVerra's Vice-President, Geospatial and Advanced Technology. The planning before data capture is detailed and intense, and the process is slow, with crews taking all the pictures by hand and working carefully to get to hard-to-reach areas.

"We often work with hundreds of kilometres of pipeline under the ground, in the bush or hard-to-access terrain," says Attia. "Sometimes, because of the terrain or type of soil, crews can't access it in the summer." Data capture becomes expensive, time-intensive, and wrought with safety concerns.

Knowledgem Metre by Metre

Unless, of course, Attia and his team enter the picture. What do they do?

Hint: think of fewer boots on the ground.

"We fly UAVs (Unmanned Aerial Vehicles)—drones—along the whole pipeline network," explains Attia. "That way, our client gets a view of everything. The visual is for the whole location, with 360-degree panoramic pictures we deliver through a customized web portal."

GeoVerra's interactive web portals, containing all the data captured, are at the client's fingertips. It becomes the knowledge base not only for these maintenance programs but also for any asset management program.

Shaving for Savings

"We're still sending a crew to get the data," explains Attia. "But this is a two-person crew instead of eight or ten. With this technology, our work can take a week instead of a month, with fewer people."

As for the client? They stay in their office and access the pictures and videos they need...knowing they've experienced a cost savings of around 60 percent.

This value is undeniable: greater productivity, higher system efficiency, and savings from reduced resource usage

In Short Notice

While GeoVerra isn't the only geomatics company using laser scanning, Mobile Mapping Systems, Ground Penetrating Radar, and 360-degree imaging, Attia believes they have one big differentiator.

"We have such high responsiveness," he explains. "It's not uncommon to hear, 'Do you have the resources to do the work on short notice or not?' We have the pre-planning and workforce to be right there."

Attia's team is based in Alberta but works across the country. Current projects are in British Columbia, Saskatchewan, Manitoba, Ontario, and Quebec

The Feedback Factor

"Developing the web portal is about ease for these clients," says Attia. GeoVerra provides an interactive visualization tool so they can plan better, make informed decisions, and set future maintenance and operational programs. The web portals are fully customized and commonly used for applications outside of pipelines.

"Our clients can view everything they want without needing to know about the sensors, how they work, or how we stitch everything together," says Attia. "Like Google Maps, all I need to know is, where's my friend's house? We deliver what they're looking for."

So get in touch, and be that much closer to mitigating risk, meeting compliance, and keeping your most important assets protected, all while saving time and money.

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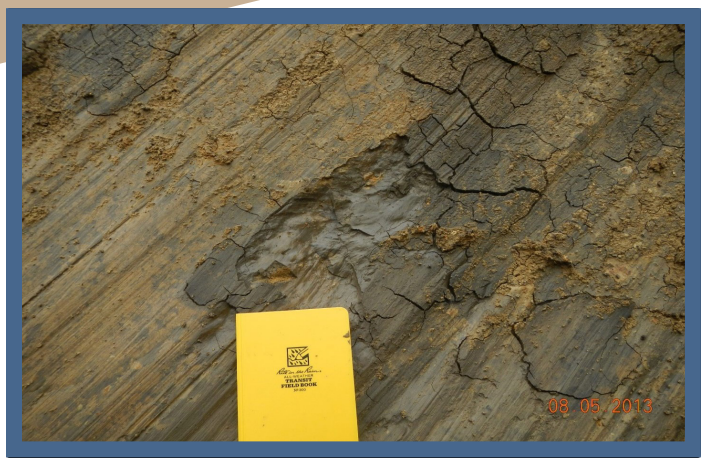
Pipeline Geotechnique No. 1



The Value of Geo Input in Pipeline Design & Operations

By Jim Oswell

Introductory Note

This article is an edited extract from Jim's textbook "Soil mechanics for pipeline stress analysis," 2nd edition; Published by Naviq Consulting Inc., Calgary; 400 pages; ISBN: 978-0-99524410-1-5. The book is available on Amazon.com.

Jim Oswell is a principal geotechnical engineer with Naviq Consulting Inc. based in Calgary, Alberta. He has 40 years of experience with a particular specialty in geotechnical aspects of pipeline design and pipeline-soil interaction.

His work includes providing geotechnical engineering input to pipeline stress analysis, geohazard identification, mitigation, and independent technical review/expert witness services. He has provided senior engineering input and review on pipeline projects in Canada, the United States, Columbia, Ecuador, China, Russia, and Malaysia. He holds a Ph.D. in geotechnical engineering, is a former associate editor of the Canadian Geotechnical Journal and is an elected Fellow of the Engineering Institute of Canada.

What is Geo-Input to Pipeline Design and Operations?

Geotechnical and geological input (geo-input) to pipeline design and operations takes several forms. The basic activities include:

- Terrain mapping and geological hazard mapping of the route
- Geotechnical assessment of Horizontal Directional Drilling (HDD) and related installations
- Input to soil-pipeline interaction studies to assess integrity issues in the initial design pipelines and operating pipeline
- Foundation design of pipeline infrastructure.

Many decades ago, geo-input to pipelines was limited to foundation investigations for compressor and pump stations and related infrastructure.

With the widespread application of horizontal direction drill (HDD) technology in the 1990s, geo-consultants provided geo-input to assess the subsurface condition along the potential drill path of the HDD. In the 1990s and 2000s, the application of terrain mapping for pipeline route selection became more common. While most geo-professionals recognize the value of terrain and geohazard mapping to a pipeline project, particularly in challenging terrain, such mapping is still not commonly applied worldwide.

Benefits of Geo-Input to Pipeline Design and Operations

The value of geo-input is primarily to reduce uncertainty in ground conditions along the pipeline route. This has the benefit of reducing construction costs, avoiding problematic terrain, and improving the operational integrity of the pipeline system. However, pipeline design codes throughout the world seldom address geotechnical issues.

Sweeney (2005) compared various national pipeline codes and their geohazard-related content. Of the codes representing Australia, Canada, China, Britain, the United States, and Russia, as of 2005, the British and Russian codes devoted the greatest content to geohazards (17% and 13%, respectively), while the other codes devoted an average of 1% to the topic. The American code (ASME B31.4-2002) and the Canadian code (CSA Z662-2003) each devoted one page or less to geohazards.

Fortunately, a relatively new international standard now addresses the geohazard management of onshore pipelines (ISO, 2019).

The application of geotechnical and geohazard management practices has been shown to have tangible benefits to pipeline integrity. Sweeney (2017) presents pipeline rupture frequency data due to landslides as a function of geo-input. He categorized the evolution of pipeline design and construction into four periods:

1. Historical practice representing the traditional approach to pipeline design and construction where minimal geo-input was applied.

2. Historical practice as in (1), but geo-input (monitoring and geohazard management) applied in "later years," presumably meaning during operations.

3. Early modern practice where geo-input was applied in the design phase, including routing studies through to the operations period.

4. Current modern practice, the 2000s, with geohazard subject matter experts engaged in all project phases.

Type of geotechnical input	Pipeline ruptures/ 1000 km/year
1. Historical practice	2.11
2. Historical practice with some geo-input during operations	0.56
3. Modern practice with some geo-input during all project stages	0.17
4. Modern practice with expert geotechnical and geohazard input during project stages	0

Table 1. Rate of pipeline ruptures as a function of geotechnical/geohazard input (from Sweeney, 2017)

Table 1 presents Sweeney's analysis showing the significant benefit of incorporating expert geotechnical and geohazard support through the life of a pipeline project. Sweeney (2017) provides a compelling discussion on the efficacy of specialist geotechnical and geohazard inputs to pipeline design and the important role "geo-teams" play in reducing natural hazard impacts on pipelines.

Figure 2. Compressive wrinkle in an NPS 12 (323mm outside diameter) pipeline induced by slope movement

The study of soil-pipeline interaction needs geo-input on one hand and numerical modelling on the other. A typical study assesses the soil loads that lead to over-stresses in the pipeline. Figure 1 illustrates an over-stress issue where downslope soil movement induced a compressive wrinkle in the pipeline.

To improve the soil-to-pipeline interaction analyses, one needs to perform appropriate geotechnical characterization along the route. Special attention should be given to important physical features (e.g., slopes and geological hazards), areas with special soils, such as very sensitive glaciomarine clays, and terrain subject to secondary soil movements (e.g., thaw sensitive, frost susceptible, and liquefiable).

Geotechnical investigations should include the following key tasks:

- Terrain mapping of the pipeline route; characterizing surface geology & landforms; identifying geological hazards, slope gradient, organic soils, shallow bedrock & special features.
- Examination of remote imagery such as LiDAR, air photographs, and In-SAR to identify potential geological hazards (see Figure 2).
- Ground truthing of the terrain mapping. This includes identification of landslide features such as pre-shear soil masses (see Figure 3).
- Geophysical surveys and probing of thick organic deposits and/or the depth to shallow bedrock.
- Field assessments at steep or potentially unstable terrain.
- Through collaboration between the geo-professionals, pipeline designers and pipeline stress analysts, identify locations or features that need site-specific geotechnical investigation for soil characterization to provide accurate input to the pipe stress analyses.
- Drilling of boreholes/probe holes to obtain samples or perform in-situ tests. This is particularly relevant for establishing the conditions of existing pipeline trench backfill. Install instrumentation to monitor identified geohazards, as needed.
- Laboratory testing to develop appropriate engineering properties for

use in determining soil strengths. Tests can be conducted on disturbed and undisturbed samples to provide input for both backfill soils and undisturbed soils.

- Development of appropriate values of soil strengths based on route-specific soil conditions and a clear understanding of any soil-pipeline interaction problem.

- Review of the estimated pipe strains and input to the design team regarding mitigation to address issues where the strain demand on the pipeline from the soils can exceed the strain capacity of the pipeline.

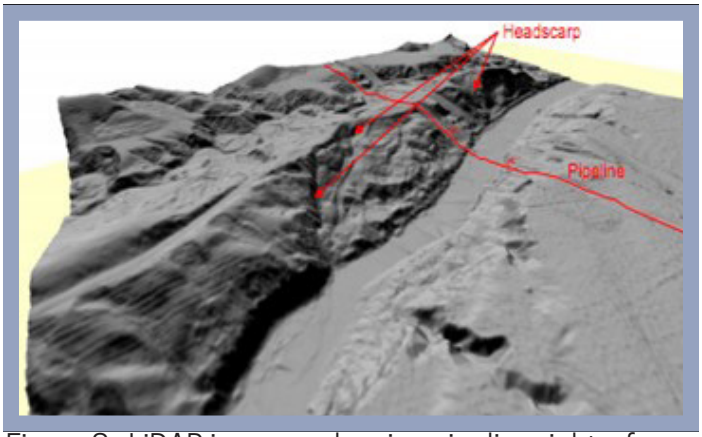


Figure 3. LiDAR imagery showing pipeline right-of-way traversing an active landslide

A real-world consideration for geo-input in pipeline design and operations is the impact of a pipeline rupture. Table 2 lists several pipeline "losses of containment" events and effects, including approximate cleanup costs. (Not all the events listed in Table 2 resulted from geotechnical factors.) One of the most costly onshore pipeline spills was the 2010 Kalamazoo River event in Michigan, which cost over US $1 B to clean-up and remediate.

Not included in the costs in Table 2 are regulatory fees and penalties, reputational costs, heightened hostility from anti-pipeline groups, civil lawsuits and others. The key message from Table 2 is that a fraction of the direct and indirect costs of a pipeline loss of containment event buys a lot of geo-input that would prevent the event.

Figure 4. Pre-sheared, slickened head scarp of a landslide in residual soil. Location is in upper right corner of Figure 5

"Pipeline operators can spend $10,000,000 or more on clean-up after a geohazard-induced loss of containment event. But a fraction of that $10,000,000 will buy a lot of terrain mapping and slope indicators that may prevent that same event."

Advice to Pipeline Operators

Pipeline operators do not need to be reminded of the direct and indirect costs of a loss of containment event. Geohazards tend to be responsible for a relatively small fraction of pipeline integrity events. In Canada, the United States and Europe, the geological direct cause of pipeline incidents are approximately 7.4%, 6% and 15%, respectively.

Location	Year	Product	Effects
Dosquebradas, Colombia (A)	2011	Gasoline	33 fatalities; cleanup costs unknown
Near Peace River, Alberta	2011	Crude oil	$11 M + in cleanup costs
Yellowstone River, Montana(B)	2011	Crude oil	$165 M (a) in cleanup costs
Red Deer River, Alberta	2012	Crude oil	$53 M + In cleanup costs
N. Saskatchewan River, SK (A)	2016	Crude oil	$107 M in cleanup costs
Noble County, Ohio (A)	2018	Natural gas	$5.2 M (b) In cleanup costs
Nixon Ridge, West Virginia (A)	2018	Natural gas	$13 M (c)
Noble County, Ohio (A)	2019	Natural gas	Several injuries, two residences destroyed; cleanup costs unknown

Notes: (A) caused by earth movements; (B) river scour and exposure
(a) $US 135 M; (b) $US 4.145 M; (c) $US 10.43 M
Contact the author for the various sources

Table 2. Examples of pipeline events and effects

While earth movements tend to represent a lower percentage of loss of containment events, these events are often related to slopes, and slopes are very often associated with water courses, and a loss of containment at such a location would have significant environmental impacts. Figure 4 shows the remediation of a pipeline after a slope failure induced a rupture of a crude oil pipeline in South America. Cleanup costs of spills into water courses tend to be considerably higher than terrestrial spills.

Figure 5. Pipeline and slope remediation after a slope movement induced pipeline rupture that leaked crude oil into an adjacent stream.

The adoption of the recent International Standard on geohazard management of onshore pipelines (ISO, 2019) provides a starting point for discussions with pipeline operators. This document lays out a pathway for conducting geohazard assessments for new and existing pipelines. It includes information on geohazard assessments based on qualitative, semi-quantitative and quantitative hazard analyses.

Given a potential geohazard effect on a pipeline, how does one assess the likelihood of a loss of containment? Theriault et al. (2019) provide a technique using single-run in-line inspection tool (inertial measurement unit) data to identify potential geohazard locations (generally limited to landslides and river hazards) along a pipeline. Important outcomes using the method include:

- For pipelines with an estimated total strain < 0.35%, the most likely cause (more than 50% of the time) is of geohazard origin. For estimated total strains < 0.42%, the likelihood of a geohazard cause is more than 90%.
- In the case of horizontal strains, the likelihood of geohazard causation is more than 50% for strains > 0.14% and 100% for strains > 0.36%.
- Bending strains as low as 0.125% (the typical threshold for reporting) can also be associated with geohazards, but are more likely associated with non-geohazard effects, such as tie-in induced strains or other effects.

Tensile strain (%)	PoF (%)	Compressive strain (%)	PoF (%)
<0.5	0	0.5	0
0.5 – 1.5	10	0.5 – 1.76 t/D	10
1.5 – 3.5	25	1 – 2.5 x 1.76 t/D	50
3.5 – 5.5	50	> 2.5 x 1.76 t/D	100
>5.5	100		

PoF = probability of failure (loss of pressure integrity)

t/D = ratio of wall thickness to pipeline diameter

Table 3. Bending strain and probability of pipeline loss of containment (from Honegger et al 2014)

The threshold strains listed above are not likely to initiate a loss of containment, but they represent important indicators to geo-professionals and pipeline operators to consider the influence of possible undetected geohazards. In terms of likelihood of a loss of containment event from geohazards, Table 3 provides a summary of bending strains that can induce failure.

Concluding Remarks

Geo-professionals provide significant value to pipeline design and operations. From routing studies and initial avoidance of geohazards to input to pipeline stress analyses and assistance in interpreting ground and pipeline movement data, we can help make pipelines safer. While the acceptance and growth of pipeline geotechnique is encouraging, all pipeline operators can benefit from geo-input. It is a fact that an appropriate geotechnical program will pay for itself in spades if it avoids one catastrophic loss of containment.

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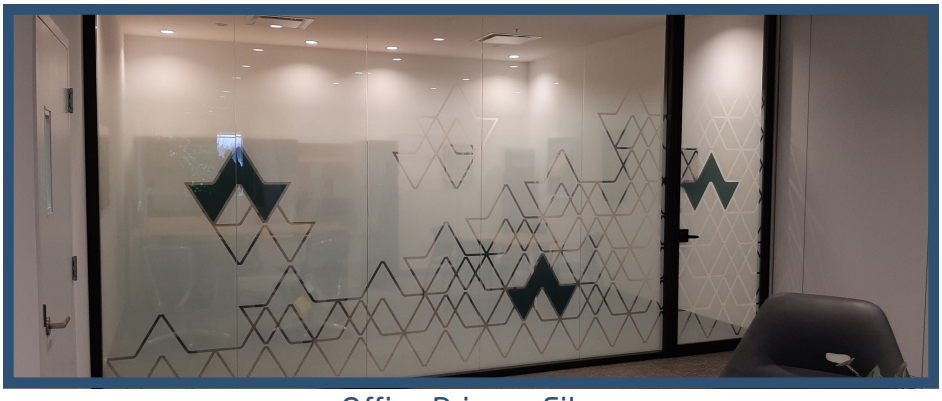

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A Technical Article:

The History of Survey Chains

Compiled By: Hiran Ganguli

About four centuries ago, in 1581, a man-child was born in Hertfordshire in southern England near London. His parents named him Edmund, Edmund Gunter.

No one knew Edmund would become quite a notable man when he grew up. He did his initial schooling at Westminster School and completed his matriculation from Christ Church, Oxford, in 1599. Because of his faith in God, Edmund became a preacher in 1614 and finished his divinity degree to become the rector of Saint George's Church in Southwark, England.

Edmund loved mathematics and was keen on discovering and showing the correlations between mathematics and the world. He applied for the position of professor of geometry at Oxford University when the university started two faculties of astronomy and geometry but did not get the job. However, on March 6, 1619, Gresham College appointed Edmund as a professor of Astronomy, a position he held until his death on December 10, 1626.

Edmund Gunter was a great mathematician. He is best remembered for his inventions of measurement instruments like Gunter's chain, Gunter's quadrant, and Gunter's scale. In 1620, he invented the first successful analog device, which he developed to calculate logarithmic tangents and the terms cosine and cotangent

Gunter's chain

Edmund Gunter invented this chain for land measurement and surveying. The total length of this metal chain is 22 yards or 66 feet or 20.1 m. The chain has 100 links, marked off into groups of 10 by brass rings or tags, simplifying intermediate measurement.

One Link length = 7.92" = 201 mm

One Chain length = 66 ft = 22 yd = 20.1 m

A quarter chain = 25 links = 16 ft - 6" = 5.03m

Ten chains = 10x66 = 660 ft (one furlong) = 22 yd (length of a cricket pitch)

80 chains = 80x66 = 5,280 ft = 1,760 yd = one mile

Gunter's chain reconciled two seemingly incompatible systems: the traditional English land measurements, based on the number four, and decimals, based on the number 10.

Here is the land area measurement in acres:

One acre = 10 square chains = 10 x 66' x 66' = 4,840 square yards or 43,560 square feet.

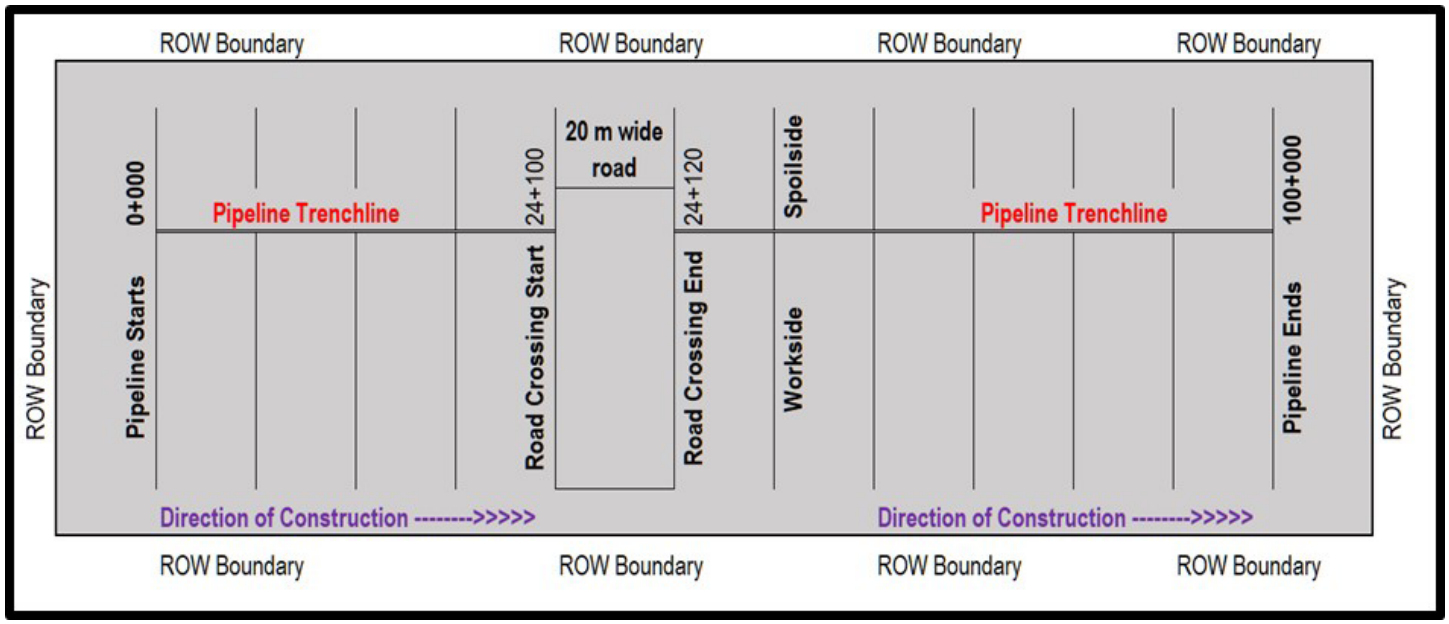
The engineering survey notes use the term "Chainage" for pipeline distance measurements, although the metric system measures the length. Chainage is the cumulative length or the distance traversed by an object along a curved or straight survey line from a fixed start point.

The sketch below shows the length of a 100 km pipeline. Its start chainage is 0+000, representing 0 km plus 000 m; its end chainage is 100+000, meaning 100 km plus 000 m.

The road crossing start chainage is 24+100, meaning 24 km plus 100 m. The road crossing ends at a chainage of 24+120, meaning 24 km plus 120 m, depicting that the road width is 20 m.

Over the years, numerous instruments have been developed to measure distance, direction, vertical and horizontal positions, time, and astronomical locations to keep up with the constantly changing technology of surveying. The older methods and instruments like,

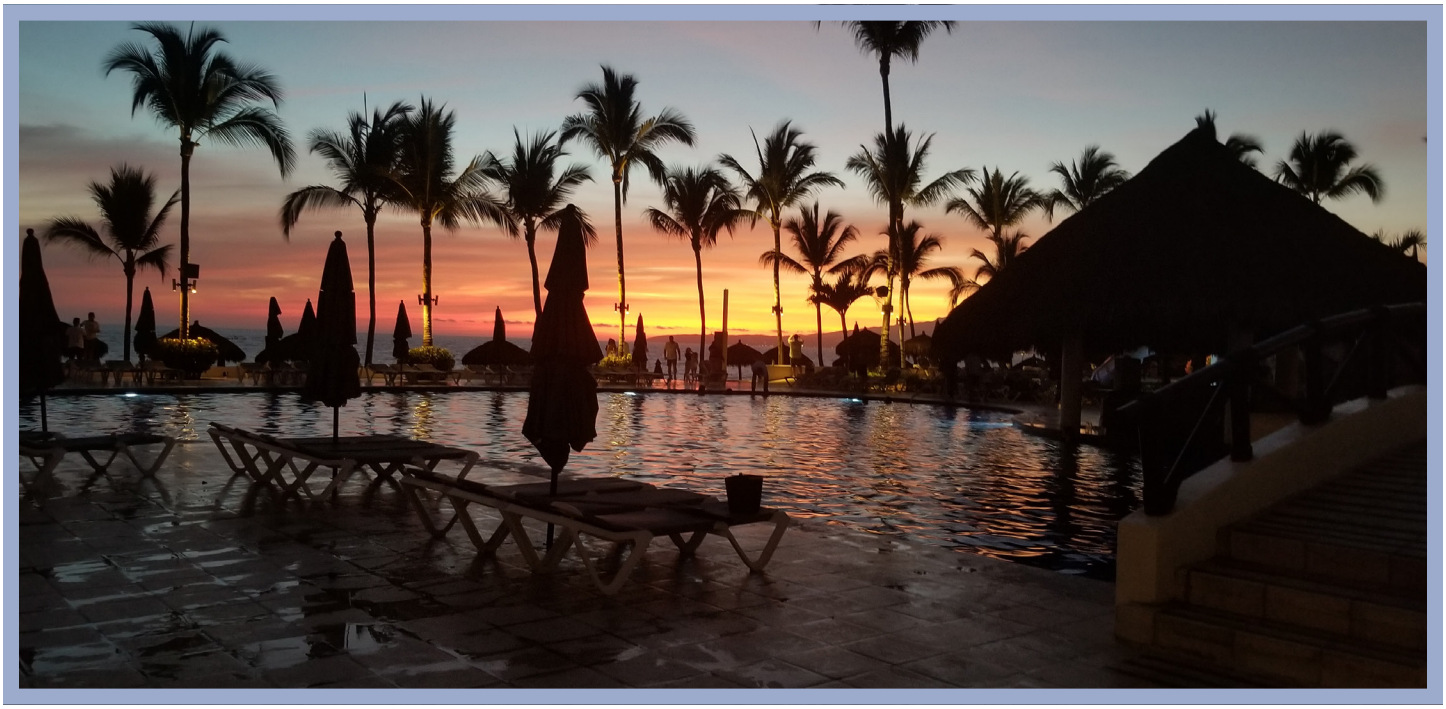
- Chains to measure distance;
- Stadia to measure elevation and distance;
- Plumb bobs to measure verticality;
- Inclinometers to measure grade or slope;
- Levels to ensure perfect horizontal alignment; and, even
- Some of the more advanced Optical



Theodolites and Transits have been superseded by Laser, Satellite Radio, and Computer revolution.

There are some "old school" surveyors still in business. However, to compete and survive in the 21st Century and to keep up with the federal, provincial, and local laws & regulations, high-tech laser-based, Global Positioning System (GPS)-enabled, calibrated chronometers and sometimes astronomically-capable devices are required.

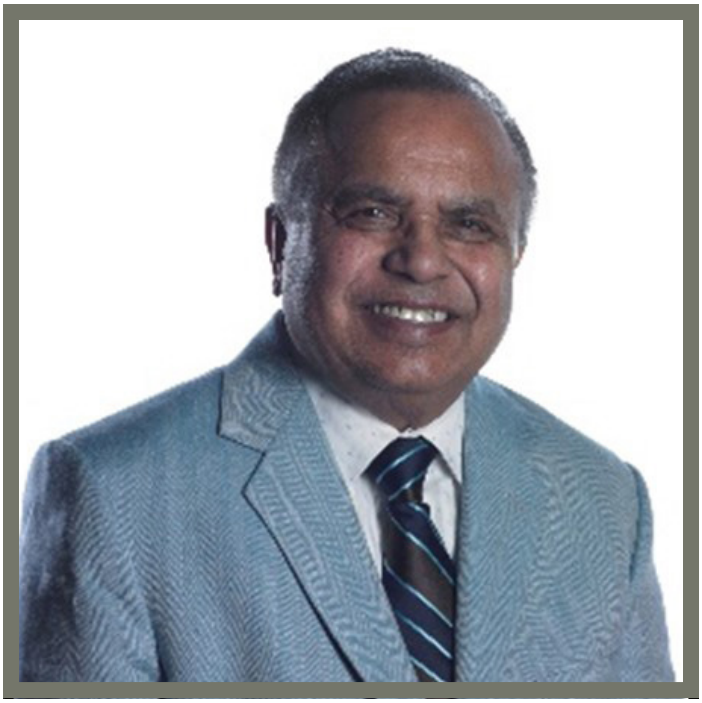
Author's Note: I have compiled this article and the images by consulting the Internet and Wikipedia, and I am using these for public education only.



This is where the pipeliners go to after working through the hard winter months in Canada!

A Company Tale: RRP

Chandra Sarkar, P.Eng. founded **Rapid Response Project Ltd. (RRP)** in 1997 and became its President & CEO. His vision was to create an Engineering, Procurement, and Construction Management (EPCM) Company in Calgary, Canada. RRP entered into a joint venture agreement with VECO, which later became CH2M Hill.



In 2003, Chandra moved away from this joint venture and formed a separate engineering consulting company focused on executing fit-for-purpose projects of the highest quality that are safe, flexible, cost-effective, and completed on time. RRP's consistent dedication to its clients and sincere hard work on every project – has been recognized in the industry as a critical principle in differentiating RRP from all other EPCM companies.

RRP is an experienced engineering company specializing in Project Management, Feasibility Studies, Engineering, Detailed Design, Procurement, Construction Management, Commissioning & Start-up, Optimization, and Operations & Maintenance for oil and gas facilities.

RRP brings the industry advantage of one-stop engineering excellence in all core areas of consulting engineering. RRP believes in adding "WE" back into Consulting Engineering – Where our Team is part of your team. We pride ourselves in satisfying all our client's needs by executing projects of the highest quality that are Safe, Flexible, Cost Effective, and Completed on time and always on budget.

RRP always has and will continue to place the highest priority on completing all projects on time and within budget. RRP is proficient in working within the short seasonal construction window and complex regulatory and land consultation issues in all regions to complement engineering expertise.

The core members of RRP provide engineering, design & project management expertise in all upstream oil & gas projects, including feasibility studies, cost estimates, cost tracking, project scheduling, revamps & grass root facilities. RRP can work within the short seasonal construction window and complex regulatory & First Nations Consultation to complement the engineering expertise.

RRP's scope of services stands on our simple promise. We will execute every project to be safer, more secure, efficient, innovative, productive, and cost-effective than any other EPCM in the industry.

RRP and its subsidiaries make occupational health and safety the primary objective for all project execution levels. RRP affirms its conviction by integrating policies where our overall objective is zero (0) accidents in the workplace and eliminating any source of risk or danger. RRP is pleased to have achieved zero (0) incidents over the last 19 years on all our projects, ensuring our commitment to overall workplace safety and excellence for all project execution levels. As part of this commitment,

RRP has produced and implemented a comprehensive HSSE policy.

Over the last 19 years, RRP's team has had extensive field and operating experiences. The project team incorporates their site experience for each client in our designs to enhance operating excellence. RRP teams always act in the client's best interest and utilize the most experienced personnel based on the project scope. We select teams for every project based on experience that pertains to the project, clients' facilities, and the technical know-how to execute the project. Further, RRP has invested in technology by implementing state-of-the-art EDMS designed for engineering consulting companies. This EDMS system utilizes the most recent technology to streamline all processes in project execution, ensuring through algorithms the project schedules, which reflect "real-time" updates that reflect all aspects of the project deliverable. These reports allow the team to incorporate decisions that could result in shorter project timelines and, thus, under-budget project delivery.

Over the 19 years, RRP continues to have the pleasure of working for multiple domestic and international clients, from

large to midsize and junior companies. Regardless of the client size, our commitment to safety and being on schedule and within budget is universal for every project.

RRP is a company that believes in seeing Women, Aboriginals, and Diverse people in leadership positions. Seeing this group of talented professionals in leadership highlights their contributions and hard work to the oil and gas industry. We have demonstrated that Women, Aboriginals, and Diverse people belong in all decision-making positions, and they have a right to share their voices and be heard.

RRP has a strong belief in the ethics of perseverance and relentless effort. We try to cultivate the same culture in our workforce. Every employee at RRP is not just an operating human code but a name to recognize and a force to reckon with. RRP is a company that respects and celebrates people in whichever different way they are, regardless of their cultural or ethnic background. We embrace our country's multicultural fabric to the core and implement a "no-discrimination" policy in our professional sphere

RRP began implementing Equity, Diversity & Inclusion (EDI) in all aspects of engineering services in 2008 when the Calgary Herald interviewed Chandra, a visible minority himself. It was an impressive interview when Chandra shared his strategy and passion for attracting the Best of the Brightest and retaining Women, Canadian Indigenous people, Africans, and Asians who enter the Alberta workplace every year.

RRP believes in diversity and inclusion and has implemented this from the beginning through its ownership team. No one better than this group understands the implicit bias at every step of operating an EPCM company in the oil patch. Implicit bias is one of the biggest barriers to career development as it happens unconsciously. We must challenge our thoughts, beliefs, and actions to promote a more inclusive workplace. We all can hold an implicit negative bias that must be challenged from within. An awakening within ourselves so we may understand that people are not just an operating human code but a name to recognize and force to reckon with.

RRP is a company that respects and celebrates people in whichever different way they are, regardless of their cultural or ethical background. We embrace our country's multicultural fabric and implement a "No Discrimination Policy" in our professional sphere.

When we come together, we can accelerate equity and collectively create an inclusive and more gender-equal and diverse-equal working world.

Good Old Days of Pipelining

Reflections on Mental Health and Substance abuse in Oilfield Workers

By Mala Moulik

"If you gaze into the abyss, the abyss also gazes into you"

My face started to freeze as I talked to Don, seated in his brand-new GMC 3500 Sierra. He had got the custom Ground Effects package in the colour he had told me about, champagne gold.

"Nice Truck," I complimented as my breath formed a cloud and floated up into the cold air of the muskeg,

"It's even the colour you talked about." Don laughed heartily before he answered, "Oh yes, I got this colour because my wife likes it."

Don was the consultant managing the abandonment of a directional well; the worksite was in Wabasca, Alberta. I was providing medical standby, and it was the first day back after a set of days off. I was assigned to this crew for the past four 4 rotations. I had got to know all the crew members, but I communicated with Don the most.

Don was looking forward to retiring in five 5 years after being in the industry for 30 years. He was a man from a small town in Saskatchewan, entering the industry in his youth as a rig hand. Don worked up the ranks to become a consultant, managing many projects throughout Canada, a "soil of the earth" person. He had bought a farm where his family lived, most notably his wife. Don had a great relationship with his wife; would always make it a priority to talk to her every day and consult her on important personal decisions, such as the colour of his truck.

As my career evolved, I went from providing industrial medical standby to working on a rural ambulance service. I proudly served serviced the Northern Albertan public for three years as a primary care paramedic. I attended to scenes of motor vehicle accidents as well as medical/ mental health emergencies. Also included in that experience were a surprisingly large number of overdoses following the oil price plunge during 2014- 2016. This was due to a lack of mental health support for people experiencing substance abuse exacerbated by the economic conditions. Due to the death of my father and a cherished supervisor, my mental health led me to evolve my role to become an addictions support worker at Calgary Alpha House, a harm reduction shelter offering outreach, detox, and housing services. I worked there for a month at the front desk, signing people in and out of the shelter.

On this particular day, an almost recognizable face had walked in. My fellow staff members greeted this person with familiar warmth like he was a family member. I began to sign him into the system and asked for his name. It was who I had suspected. It was Don. Confused and heartbroken was the expression on my face; Don had recognized me and smiled. I wanted him inside as it was a cold March day in Calgary; I pushed my feelings aside and continued the sign-in process.

Later, on my break, I walked onto the shelter floor to find Don lying on a mat. Here was a man who once told me stories of his rural childhood, about to retire soon from his illustrious oil and gas career to spend the remainder of his life happily with his spouse. The same man was lying on a mat in a wet shelter in Calgary. Don must have sensed I was watching him as he sat up and walked over. Sadness had clouded his eyes; his voice trembled as he spoke.

"My wife died, and my drinking got worse."

I didn't know Don had been an alcohol, albeit a functional one. All it took was this one event to make his entire world crumble. At this moment, I realized that the division between "us" and "them" could

be the matter of death, a slight misstep, or a missed paycheque.

Substance abuse is a known but rarely discussed subculture among oilfield workers. Drugs and alcohol are abused to either increase workplace performance or as an escape or pain relief for long, excruciating days. Pre-existing mental health conditions or new onset of illness originating from loneliness can also cause drug and alcohol abuse. It can be further exacerbated by being in a high-pressure environment perpetuated by poor mental health support for the predominantly male population of the workforce. And even within the industry, the social climate is toxic, with internal stigmatization between positions, crews, and discipline.

Oil workers' lives are consciously and unconsciously influenced by social discourse, particularly about their work, including a sense of place, belonging, and participation in personal, communal, organizational, and social systems (Foucault, 1971). The sensationalized attitude of these conditions (work hard, party hard) can reinforce these stereotypes. It can cause difficulty for these people to receive help due to the stigmas surrounding positive health interventions. An attitude formed to compensate for this toxic masculinity is Frontier Masculinity (Angel, 2014). Angel describes this attitude as "physical and mental toughness, rugged individualism, competition, emotional self-reliance, and unsafe work practices that save time and maximize profit."

Kayla Fishbeck is one of the regional evaluators for the Permian Basin (Texas) Regional Council on Alcohol and Drug Abuse about oilfield workers. She states in an interview that "the consistent story is that contractors and those who have to work long shifts, overnight or going for hours, will use 'uppers' to keep themselves awake

such as cocaine and methamphetamines- and then end their shift with a 'downer' such as alcohol or prescription medications" (Jones, 2018). She also goes on to say that "the most screened drug last year was amphetamines and that was largely in the oilfield."

"I want to be good, do good, be a worker among workers, a friend among friends. But there's also this part of me that is so dissatisfied with everything. If I'm not living on the verge of death, I feel like I'm not really living."— Nic Sheff, Tweak: Growing Up On Methamphetamines.

Amphetamines, also known as "Ice," "Crank," "Meth," 'Jib,' or "Side" (contracted from alpha-methylphenethylamine), is a psycho-stimulant drug that speeds up the

functions of the central nervous system (CNS). Doctors sometimes prescribe these drugs to treat conditions such as attention deficit hyperactivity disorder (ADHD), Parkinson's disease, and narcolepsy. Synthesized first by a Japanese Chemist in 1893, Its early use was for asthma and weight loss. Its most notable use was during WW2 by both Allies and Axis to keep their troops awake. Its use after the war increased dramatically. After 1970, the USA implemented strict regulations about its use, but Canada trailed behind. The legislation of this substance occurred in 2006.

Cocaine was the popular substance for abuse amongst oilfield workers, but its use is decreasing due to meth's lower price point and greater accessibility. Another advantage of using meth in an industrial setting is that it leaves the system within 8-24 hours. This is a vast difference compared to other drugs, such as marijuana, which can be detected 5-7 days after use. Users report Amphetamines to be a highly addictive substance with withdrawals causing symptoms of fatigue, muscle spasms, paranoia, and very intense cravings.

Alcohol is a readily abused substance in oilfield culture. Alcohol is a psychoactive substance with a high abuse potential that affects the brain and human behaviour. Issues with addressing alcohol addiction arise from it being a socially acceptable substance, and what further makes it difficult is its role in Frontier Masculinity. Drinking soothes the long hard workday and is also celebratory behaviour. Withdrawals from alcohol can have profound effects. Most notably, alcohol abuse happens when experiencing periods of loss, loneliness, or confusion. Alcohol toxicity can lead to liver damage, seizure disorders, Delirium Tremens (impairment in social functioning and medical problems), and other serious health complications. Such as seizures leading to death and, therefore, should not be completed without a physician's consultation.

Another commonly abused drug is opioids such as Percocet, Oxycodone, Hydromorphone, and the most dangerous of them all, Fentanyl. Slang for this drug includes "Down," "China White," and "Dillies." These are primarily used to treat pain can also induce euphoria and a sense of tranquility, leading to abuse. There are many complications surrounding opiate use, such as dizziness, nausea, vomiting, constipation, physical dependence, and tolerance. The most dangerous and well-known issue is overdose. In the province of Alberta in 2017, 77% of known opiate overdoses were men, and the most common age group of deaths was 30-24 years. Most of these men were working

as "Trades Transport and Equipment operators," with the primary stressor in their lives being reported life events, including being "laid off from work, legal matters of financial stress" (Marshall, Abba-Aji, Tanguay & Greenshaw, 2021).

Narcan or Naloxone can reverse overdoses. This opioid antagonist is found for free at any pharmacy and is encouraged to be carried by everyone especially on the oilfield site, considering the demographics

reported. A recent complication surrounding overdose is drug- poisoning. The increasing cost of opiates is causing dealers to be "cutting" their drugs with other substances. The most troublesome of these is benzodiazepines since they mimic the same symptoms as opiates in overdose. Unfortunately, Narcan is not as effective in this event. However, administering the medication and giving high-quality CPR are still recommended.

Substance abuse in the oilfield is a very slight (slight?) mental health issue. The treatment must address social, emotional, and societal issues. As mentioned, an important part is the de-stigmatization of males seeking mental health services. This can be created by the community and developing healthy attitudes in the workplace. Recovery programs specializing in men's mental health help with implementing this. Also, supportive recovery initiatives such as Alcoholics

or Narcotics Anonymous are possible for remote workers with the introduction of zoom meetings. Safe supply has also been a new method of helping workers deal with substance abuse. This intervention is when a prescribing doctor dispenses a controlled substance such as Methadone (opiate abuse) or Biphentin (amphetamine abuse). The philosophy behind this is to reduce the harm associated with obtaining drugs (theft and assault) and drug poisoning from using unregulated substances.

In memory of Bimal Moulik. A genius process engineer, a loving father, and gastronomical artist.

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About the Author

Mala Moulik is a Indian Settler living on the lək̓ʷəŋən peoples on whose traditional territory of the Songhees, Esquimalt and W̱SÁNEĆ peoples. She completed her Primary Care Paramedic Program at the South Alberta Institute of Technology. Mala is now working on completing her BSc in Psychology at the University of Essex. Currently holds a role as a Support Worker at the Cool Aid Society, assisting houseless people experiencing addiction to find resources, shelter, and health care. She hopes to complete her education and research new methods of providing decolonized supportive housing with harm reduction principles. The author took all photos.

Managing Incident Investigation During Pipeline Construction

A White Paper with Red Marks

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

Management Systems *focus*

ADDRESSING THE NEED TO MANAGE INCIDENT INVESTIGATIONS DURING PIPELINE CONSTRUCTION PROJECTS TO IDENTIFY MISSING CONTROLS AND ASSURE CORRECTIVE ACTION(S) TO PREVENT RECURRENCE OF THE INCIDENT.

Many pipeline owners and operators use a formalized incident management program particularly for pipeline or facility leaks; the pipeline owner/operator expects prime contractors to support them by implementing a systematic and structured process to investigate incidents during pipeline construction activities.

Why identifying fundamental cause(s) of the incident is vital to prevent recurrence of the incident, have a look at the following publication:

The Importance of Root Cause Analysis During Incident Investigation:
https://www.osha.gov/sites/default/files/publications/OSHA3895.pdf

There are several methodologies, approaches, and techniques for performing investigation and RCA such as Five-Why, Causes and Effect, Current Reality Tree, Interrelationship Diagram, Change Analysis, Barriers/Controls Analysis, Fault/Risk Tree Analysis, 8-D problem solving, DMAIC; based on complexity of the incident investigation, multiple techniques and tools could be applied while assuring competency of investigation/RCA team.

Picture source: https://www.transmountain.com/trans-mountain-expansion-project-contractors

Managing Incident Investigation

What is an incident?

Unplaned or unexpected outcome that affects the pipeline (asset), personnel safety and/or environment adversely.

What is "Incident Investigation Management (IIM)"?

A collaborative approach of identifying incident causal factors, and missing or ineffective barriers by assessing hazards and applied processes with controls in place.

Why is an effective incident investigation vital for an organization?

A process focused investigation approach identifies root cause(s) without blaming personnel, prevents recurrence of the incident, demonstrates leadership commitmemt to continually improve the work environment, and enhances corporate image as a caring employer.

KEY STEPS TO ASSURE EFFECTIVE IIM

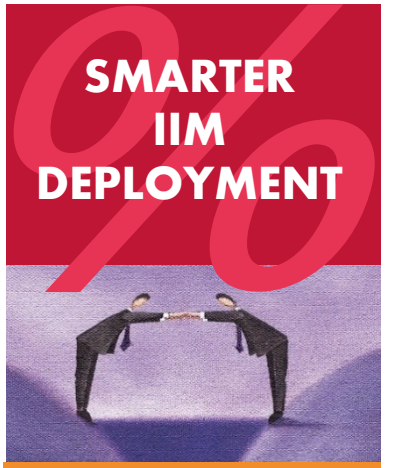
1. Establish trigger or risk-based threshold to determine when RCA shall be performed.
2. Understand the need and importance to investigate and perform root cause analysis.
3. Engage leadership and create awareness by communicating the importance of investigation/RCA and expected success factors.
4. Visit the incident site; assure availability of perishable and non-perishable evidence for required analyses. Collect preliminary statements from relevant parties.
5. Form a self-directed team with cross functional members; select team lead who possesses the required competency to use investigation/RCA tools and techniques.
6. Plan and prepare an investigation plan with list of data/relevant info to be collected, questions to be asked, and personnel including sub-contractor(s) to be engaged.
7. Perform investigation and root cause analysis, summarize findings, and distribute report to leaders.

Getting the most from Incident Investigation Management (IIM) Program

A predefined risk based structured program to manage incident investigation and RCA makes sense; consider ALARP (As Low As Reasonably Practicable) approach to define threshold to perform investigation and RCA.

Engaging people leaders, process owners and workers, and asking the right questions could provide concise and relevant answers to assist the investigation and root cause analysis. The table depicts some examples:

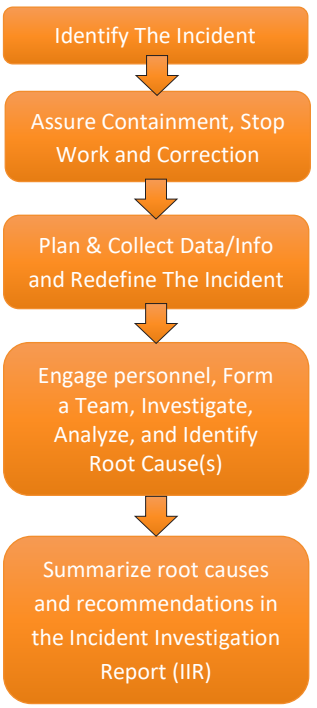
Focus Area/Personnel	People Leader	Process Owner	Operator/Worker
Method(s) Applied	How were the process risks evaluated?	How were performance standards determined?	How were results verified against acceptance criteria?
Machine or Equipment Used	How was required machine/equipment determined?	How were machine/ equipment limitations identified/cautioned?	How was the machine/ equipment performance monitored?
Manpower and Competency Assured	How were workforce and its competency planned?	How was workforce assigned to realize intended results?	How was operator/worker trained? Are they trained on What-If scenarios?
Inspection, Monitoring-Measuring Performed	How were required IMTE assured for the work?	What's the acceptance criteria? How was it used?	Where and how results were verified/saved!
Incoming materials Verified	How were material criteria determined?	How was the incoming material verified?	What was done to review the material prior to use?
Working Conditions/Job Hazard Analysis (JHA)	How were job hazards' mitigations planned?	How were job hazards communicated?	How were cautions applied to assure safety?



Communicate the purpose, establish mutual understanding of the process, and avoid chronic unease of engaged parties by focusing on process barriers/controls and their effectiveness to prevent the incident.

"A collaborative formalized incident investigation approach minimizes probability of incidents and enhances management system's effectiveness." AKHILESH MANCHANDA, P.Eng.

SIMPLIFIED INCIDENT MANAGEMENT FRAMEWORK



1. Identify the incident, categorize, and log it. Determine severity and potential impact; send notification to relevant personnel.
2. Assure containment by highlighting the area, stop work with approval, engage client/owner, plan and implement immediate actions to correct the situation.
3. Use Investigation/RCA trigger, plan and collect data/info, and redefine the incident concisely with estimated impact to pipeline construction activities.
4. Engage personnel, form a team with defined roles and responsibilities, investigate, interview relevant personnel, and analyze info by using brainstorming, RCA tools and techniques to determine root cause(s).
5. Prepare incident investigation or RCA report with executive summary, purpose, scope of investigation, sequence of events, team info, tools and techniques applied, identified root cause(s), consolidated, and categorized recommendations with justifications based on the context and associated risks.

CAUTION:

1. Clearly define the terms incident, event, problem, and issue for the purpose of investigation, and avoid using them interchangeably.
2. Avoid interviewing personnel without a plan/relevant questions; align interviews with the sequence of events and consider recording with consent.
3. Avoid asking leading questions to interviewee and assuming their answers.
4. Avoid rushing to conclude interviewee's statements or causal factors.
5. Avoid using name, gender, race, or ethnic background while summarizing

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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Path Forward for Pipeline Tales

The December 2022 issue completes our first year of magazine publication. We have created and published four issues this year and plan to do the same in 2023. We feel very fortunate to accomplish this endeavor and thank you the contributions for supporting us.

We distribute our magazine, digitally and it reaches the people all over the world. So far, we have reached over 120,000 readers and we expect it will grow. This year we did not charge any contributions from our advertisers. However, from 2023, we will ask for nominal contributions and we will mail this magazine to you on a subscription basis. You can review our advertising policy on our website, **www.piashaconsulting.com / digital media**.

We hope to get your support to grow this magazine to be number one pipeline magazine in the world.

Contributors & Advertisers (December 2022 Issue)

We sincerely thank our contributors, reviewers, and advertisers for supporting our magazine. We hope to see you again in our future magazines

Contributors

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