Oil and Gas Pipeline Field Verification Manual

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Introduction

Operator Rating System (ORS)

The Operator Rating System (ORS) is a revised and renewed approach to pipelines oversight. In 2018, the Auditor General of Ontario made a recommendation to transform TSSA's pipeline oversight program to align with best practices from other jurisdictions around the world, and in line with risk-based regulatory practices. TSSA's internal team worked to build a prototype of the Operator Rating System (ORS) framework through the fall of 2019 into the spring of 2020. During the summer of 2020, TSSA sought feedback on the framework by convening a Pipelines Oversight Working Group. This industry working group consisted of representatives from pipeline operators in the oil and gas sector, pipeline safety and risk management experts and government stakeholders. The working group convened eight times between May and October 2020 and, ultimately, shaped various components of the ORS framework including the format of this manual.

The main purpose of the ORS is to examine and rate the effectiveness of each operator's safety and loss management system (SLMS): a comprehensive set of policies and procedures capturing the operator's design, construction, operation, and maintenance activities. A high-level strategic view of the core components that comprise the ORS is shown in Figure 1.

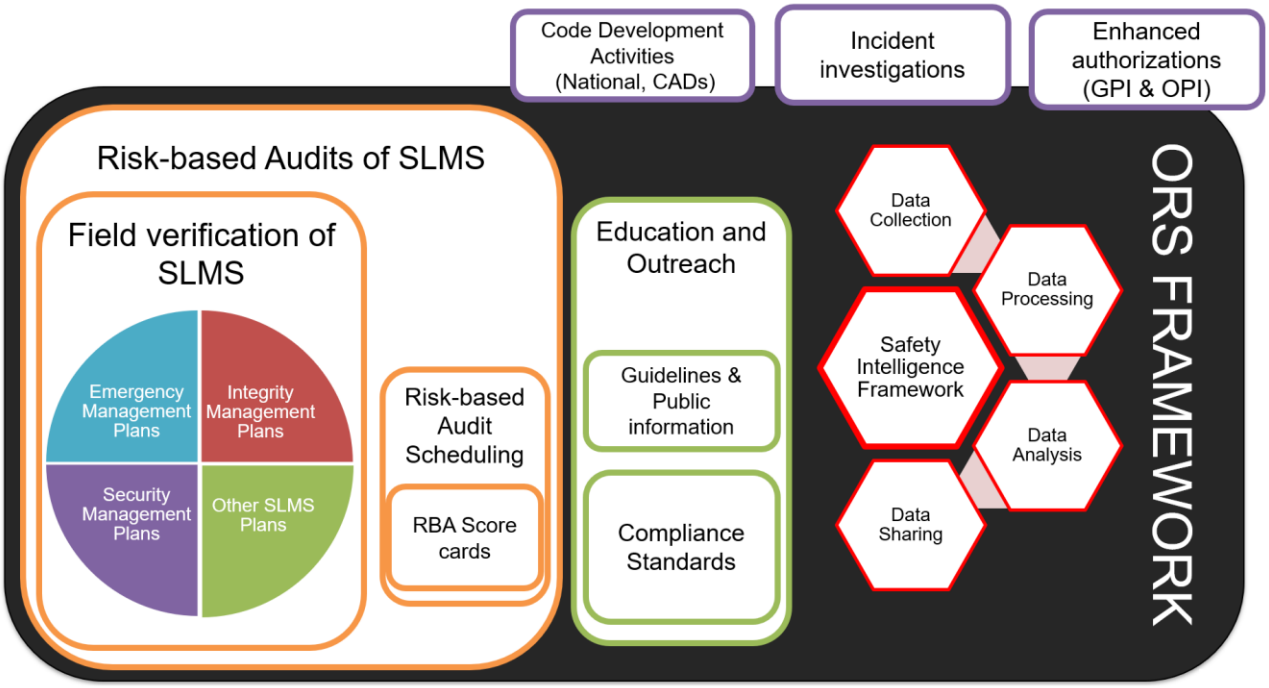

Figure 1 – Operator Rating System Framework

As shown in Figure 1, the main vehicle of TSSA's oversight is the risk-based audit of pipeline operators' SLMS and field verification of the SLMS as a sub-component of the audit. This reflects best practice.

TSSA's research into best practices revealed that other jurisdictions use field inspection and verification of physical assets to obtain insights on whether various policies and procedures outlined in an operator's SLMS are being followed in the field. TSSA has decided to emulate this practice and blend the physical field verification of the pipeline operation assets into the overall audit experience.

This decision to establish a direct link between the audit and the field verification recognizes the fact that, at times, in some pipeline operations great policies and plans set out in the SLMS are not reflected in the field. TSSA wants to ensure that pipeline operators have developed high-quality plans to manage their safety and field verify to ensure their execution.

As noted above, the intent of the ORS is to assess the quality of the operator's SLMS. While TSSA will be performing a more comprehensive audit looking at various aspects of the operator's SLMS, TSSA's eventual goal is to focus on high-risk areas of an operator's management system (i.e. areas which need the most improvement and are most correlated to higher risk). Eventually, this will help TSSA to perform a more focused audit that will be more efficient and fairer with good operators with robust safety and loss management systems being rewarded with less frequent audits. Those operators with a less robust safety and loss management systems will experience more frequent attention from TSSA.

Based on Auditor General recommendation, TSSA performed a jurisdictional scan to determine best practices in terms of inspections of physical assets and the interval of audit programs. Many regulators around the world were scanned and the Canada Energy Regulator (CER) and the Alberta Energy Regulator (AER) were selected as best practice related to inspections of physical assets and the audit interval of the management programs. Audits of pipeline operators by both these regulators are risk based. The AER audit interval is also driven by the result of inspections and other factors. The CER offers both comprehensive and focused audits. TSSA will conduct focused audits after completion of a first round of comprehensive audits and when scores for each program of the operators are obtained.

Audit Scheduling Criteria
Above 80 = 5 years interval of the audit
66-80 = 4 years interval of the audit
50-65 = 3 years interval of the audit
Below 50 = 2 years internal of the audit

Table 1- Audit Scheduling Criteria

Under the ORS, the interval to the next audit will be determined by the total score an operator earns at the end of the previous audit. As shown in the Audit Scheduling Criteria chart above, operators that receive high scores during the audit will be audited every five years and the ones with the lowest score will be audited every two years. This interval based on the score earned during the audit and field verifications, simulates the best practices selected on the jurisdictional scan. This method also aligns with the risk-based approach, where high risk operators will be audited more frequently.

How is Field Verification scored in the overall audit?

As shown in the example ORS scorecard below, field verification is weighted as up to 30% of the operator's total audit score. While, in the past, TSSA's audits focused solely on the examination of management system related documents under the Integrity Management System (among others), TSSA will now assign equal importance to the actual application of these policies, procedures and processes in the field.

As it is both challenging for the regulator and the operator to facilitate examination of physical assets in operation (since pipelines are often buried underground during the operational phase of their life), TSSA has isolated the scope of the majority of the field verification activities to those assets that are most readily accessible. Also, some new construction activities will be checked as part of field verification, based on the type of the operation and availability of the cases to be audited for each operator.

Items	Description	Initial Score	Weight	Final Score
CSA Z662, 3.2	Integrity Management Program	5	30%	14.6
CSA Z662, 3.1.2 f) vii)	Emergency Preparedness, Response, and Recovery;	5	15%	7.5
CSA Z662, 3.1.2 f) viii)	Security Management, CSA Z246.1	6	15%	9
CSA Z662, 3.1.2 f) ix)	Deactivation and Abandonment	5	5%	2.5
TSSA Field verification	Selected locations and items from FVM	7	30%	21
TSSA CAD and Others	CAD and others	6	5%	3
	TOTAL		100%	58

Table 2 - Example of an ORS scorecard

While there are more than 50 different field verification items in this manual, an operator will not be subject to a verification on all of them. In a typical audit, TSSA's audit team will define which parts of the physical assets of the pipeline operators should be checked after the initial audit of the Loss and Safety Management Program (SLMP) and its three sub-programs (Integrity Management Program, Emergency Management Program and Security Management Program). The audit team will decide on a limited number of items to inspect physically and coordinate with the operator on inspecting a random section of the pipeline network to perform the field verification.

Each of the items in this manual has been risk ranked. This risk ranking was created through TSSA's HAZID (Hazard Identification) workshop (a sub-committee of the Working Group) with TSSA and industry risk experts in attendance during the late autumn of 2020. The selected items have been assigned a weighted "risk weight" based on the HAZID workshop experts' risk ranking. Risk rankings are: High, Serious, Medium and Low, in order of importance. The items with a risk ranking as High are also mentioned in Compliance Standards - Pipeline Operators - TSSA (CS). The weight for each category is: High=4, Serious=3, Medium=2 and Low=1. These multipliers for the total number of selected locations will define the total score for field verification in each audit.

In the following example, in an audit of pipeline operator X, 10 locations are selected by the audit team to be checked. Also, four different activities, that are mentioned in the Field Verification Manual, are selected. In the following example, pipeline operator X receives a 0 if it fails to meet the requirement and receives a 1 if it meets the requirements for each location. The risk multiplier factor will be applied to define the total score for the ORS system. The sum of all score will be divided by total score of multiplier x 10. In this example 22/30 x 10 which will be resulted to 7.3 The final score will be a round number between 0 and 10, in this example 7. A final score of 0 indicates that all the items in the field verification failed. A score of 10 indicates that all the items met the requirements.

Location	Description	Section	Risk Ranking	Risk Multiplier	Pass/Fail	Score result
A	Meter protection	CSA Z662-19 [12.4.15.4])	High	4	1	4
B	Meter protection	CSA Z662-19 [12.4.15.4])	High	4	1	4
C	Meter protection	CSA Z662-19 [12.4.15.4])	High	4	0	0
D	Meter protection	CSA Z662-19 [12.4.15.4])	High	4	1	4

Location	Description	Section	Risk Ranking	Risk Multiplier	Pass/Fail	Score result
E	Meter set inside the building should be vented properly to outside	CSA Z662-19 [12.4.15.1 (a)]	Serious	3	1	3
F	Meter set inside the building should be vented properly to outside	CSA Z662-19 [12.4.15.1 (a)]	Serious	3	1	3
G	Meter set inside the building should be vented properly to outside	CSA Z662-19 [12.4.15.1 (a)]	Serious	3	0	0
H	Regulator vent clearance as required by pipeline CAD	FS-253-20 [12.4.15.6]	Serious	3	1	3
I	Backfill material for polyethylene pipe	CSA Z662-19 [12.6.6.1]	Low	1	0	0
J	Backfill material for polyethylene pipe	CSA Z662-19 [12.6.6.1]	Low	1	1	1
	Sum			**30**		**22**
	Final Score to be transferred to ORS system					**7**

Table 3 - Example of a Pipeline Operator Audit

How to Use This Manual

This manual is written in such a way that the inspector or auditor can write a safety order (for "High risk" non-compliances) or a safety task (for lower risk non-compliances) to the operators. For safety orders, TSSA is demanding a correction in the immediate future. For safety tasks, TSSA is recommending that the operator perform corrective action with a follow-up from TSSA set at a future audit/verification date. While the operator will not be ordered to take immediate action, safety tasks (if left uncorrected) could age and be converted into safety orders.

The risk matrix used in the analysis and shown in Figure 2 came from the US military standard MIL-STD-882E, from the Department of Defense Standard Practice: System Safety (May 11, 2012). This Standard Risk Matrix covers hazards as they apply to systems, products, equipment and infrastructure (including both hardware and software) throughout design, development, test, production, use, and disposal.

RISK ASSESSMENT MATRIX				
SEVERITY / PROBABILITY	Catastrophic (1)	Critical (2)	Marginal (3)	Negligible (4)
Frequent (A)	High	High	Serious	Medium
Probable (B)	High	High	Serious	Medium
Occasional (C)	High	Serious	Medium	Low
Remote (D)	Serious	Medium	Medium	Low
Improbable (E)	Medium	Medium	Medium	Low
Eliminated (F)	Eliminated			

Figure 2- Risk Assessment Matrix from the US military standard MIL-STD-882E

For items with risk ranking of "High", that are also on TSSA's Compliance Standards - Pipeline Operators - TSSA, inspectors will issue orders to pipeline operators.

The noncompliance items in the manual are structured as follows:

Manual #	Risk Rank	Description
2.7.5.1	Transmission: Medium Distribution: Medium	Pipe not supported to prevent excessive stresses and axial or lateral friction forces in the pipe. (*CSA Z662-19* [4.9.2.1])

- The **Manual #** is 2.7.5.1
- The **Description** is the noncompliant event statement and associated requirement/rule.
- **Risk Ranks** are indicated as High, Serious, Medium, and Low, in order of importance. Risk ranking is associated with both the distribution network and transmission operation. If only one is mentioned, it means it applies to both types of operations.
- The difference between the ratings for transmission and distribution operations is because they present different hazards and were analyzed separately in the Hazard Identification (HAZID) workshop and risk rank depends on the hazard scenario each one can present. The result is also compared with the incident data from the Pipeline and Hazardous Materials Safety Administration (PHMSA) from the US.
- The purpose of hazard analysis was to understand and objectively analyze the various hazard scenarios (causes and consequences) that could lead to incidents if field verification items (FVI) are found to not be in compliance, with potentially serious health impacts and consequences. The hazard scenarios represented possible conditions related to all field verification items (FVI) and associated pipeline systems, including distribution, transmission and related equipment and processes. Hazard identification analysis methodology (HAZID) was selected as the most appropriate tool to undertake the study due to the scope and the nature of the project. A task working group was formed to carry out this analysis, consisting of industry and TSSA pipeline engineers together with the Public Safety Risk Management team (PSRM) expertise in the application and the facilitation of the HAZID method.
- Pipeline data analysis and quantitative risk assessment was used, with the proposed result to support the results of the HAZID analysis and to be used for prioritization of the FVI using incident data reports. The process is illustrated in the Figure 3 below:

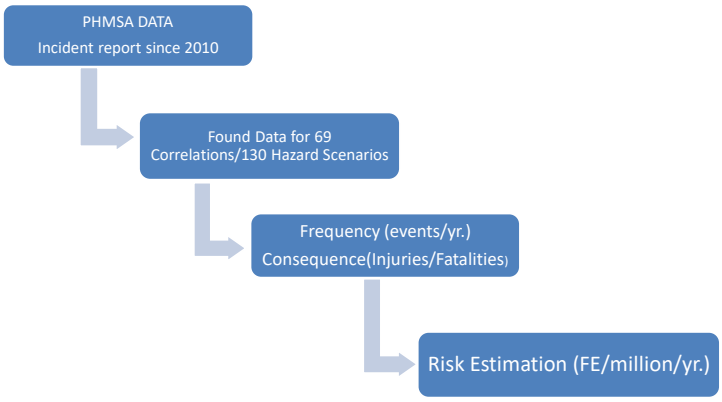

Figure 3 - Process for pipeline data analysis and quantitative risk assessment

Field Verification items

1 Customer meters and service regulators

1.1 Protection

Manual #	Risk Rank	Description
1.1.1	Distribution: High	Meter set is not adequately protected for vehicular traffic. (*CSA Z662-19* [*12.4.15.4*])

1.2 Signage for internal regulators

Manual #	Risk Rank	Description
1.2.1	Distribution: High	Meter set inside the building does not have a sign (*CSA Z662-19* [*12.4.15.1 (b)]*)
1.2.2	Distribution: Serious	Meter set inside the building is not properly vented to outside to prevent uncontrolled release of gas inside the building (*CSA Z662-19* [*12.4.15.1 (a)]*)

1.3 Customer meter set regulator vent is not properly installed

Manual #	Risk Rank	Description
1.3.1	Distribution: Serious	Regulator vent does not have clearance that is required by standard (*Oil-and-Gas-Pipelines-CAD-Amendment_FS-238-18 [12.4.15.6])* Clearance from service regulator vents discharge (m)

Column	I	II	III	IV
Building opening	0.3	1	3	1
Appliance vent outlet	0.3	1	1	1
Moisture exhaust duct (dryers)	1	1	1	1
Mechanical air intake	1	3	3	3
Appliance air intake	0.3	1	3	3
Source of ignition	0.3	1	1	3

Column I applies to natural gas regulators certified under CSA 6.18 standard, incorporating an OPCO system and with a limited relief of 1.5 m3/h.

Column II applies to natural gas regulators certified under CSA 618 standard (if within the scope of the standard) with a relief capacity up to 55 m3/h.

Column III applies to natural gas regulators with a relief capacity over 55 m3/h.

Column IV applies to propane regulators.

Where regulators may be submerged during floods, either a special anti-flood-type breather vent fitting shall be installed, or the vent line shall be extended above the height of the expected flood waters.

2 Appliance Inspection for New or Recent Installations

1.4 Appliance inspection is not done as required by regulation.

Manual #	Risk Rank	Description
2.1.1	Distribution: High	Section 7 of O.Reg. 210/01 and section 16 of O.Reg. 212/01 *Note: Appliances should be inspected before delivering the gas and every 10 years or based on QA program after the first inspection. Appliance should be inspected according to the requirements of CSA B149.1*

3 Construction Activities

3.1 Ditch Preparation, Backfill Procedures, and Rehabilitation

Manual #	Risk Rank	Description
3.1.1	Distribution: Low Transmission Low	Areas disturbed by pipeline construction activities are not maintained in a condition that adequately controls environmental degradation. (*CSA Z662-19* [6.2.1.1])
3.1.2	Distribution: Low	Backfill material for polyethylene pipe is not free of rocks and debris (CSA Z662-19 [12.6.6.1])
3.1.3	Distribution: Low	Polyethylene pipes are not properly inspected for the cuts, scratches, gouges, and other imperfections (CSA Z662-19 [12.6.5.1 and 12.6.5.2])
3.1.4	Distribution: Low Transmission: Low	Operator has not taken suitable measures to prevent damage to the pipe or coating that may occur during backfill or subsequent surface activities. (*CSA Z662-19* [6.2.7.1], [6.2.7.2])
3.1.5	Low	Backfilling has caused distortion (e.g., flattening, ovality, etc.) to the pipe that has been detrimental to the operation of the piping or to the passage of cleaning or internal inspection devices. (*CSA Z662-19* [6.2.7.3])
3.1.6	Transmission: Low Distribution: Medium	Backfilling was not done in a manner that prevents excessive subsidence or erosion of the backfill and support material. (*CSA Z662-19* [6.2.7.4])
3.1.7	Transmission: Low Distribution: Low	Clean up and restoration of areas disturbed during pipeline activities were not restored to a stable condition or maintained to control erosion. (*CSA Z662-19* [6.2.9]) *Note: This statement applies to new construction and repairs, and to new and used materials.*

3.2 Depth of Cover

Manual #	Risk Rank	Description
3.2.1	Distribution: Medium Transmission: Medium	The minimum earth cover for any operating or discontinued pipeline does not meet the greater of the minimum cover requirements specified by *CSA Z662-19* (4.11.1, 4.11.2) <u>*Clarification*</u> *See Pipeline Rules 20(1), and CSA Z662-19, table 4.9:* • *Right of way of a road, including travelled surface of road (CSA):* ***1.2 m*** • *Below base of rail, within 7 m of an outside track (CSA):* ▪***1.20 m*** *(cased)* ▪***2.00 m*** *(uncased)* • *Water crossing (CSA):* ***1.20 m**** • *HVP or CO_2 pipeline, Class 1 location:* ▪***0.90 m****, CSA (normal excavation)* • *HVP or CO_2 pipeline, Class 2,3,4 location:* ▪***1.20 m****, CSA (normal excavation)*

3.3 Crossings (Road/Railway/Water)

Manual #	Risk Rank	Description
3.3.1	Transmission: Medium Distribution: Low	Installation of cased or uncased crossings is not in accordance with *CSA Z662*. (*CSA Z662-19* [12.4.8], table 12.2)
3.3.2	Distribution: Low Transmission: Low	If dimension ratio is greater than 11, depth of cover stress needs to be calculated (*CSA Z662-19* [12.4.7.3])
3.3.3	Transmission: Medium Distribution: Low	Carrier or casing pipe used for open-cut crossings is not laid on suitable bedding material with an even-bearing throughout the length, or is not installed in a manner that prevents the formation of a waterway along them, or is not compacted to prevent settlement. (*CSA Z662-19* [6.2.10.2])
3.3.4	Transmission: Medium Distribution: Low	Pipe is overstressed* during installation at a water crossing. (*CSA Z662-19* [6.2.10.4]) *Examples may include pulling or bending stress. Overstresses may be determined by failure analysis.

4 Pipeline Pressure Testing

4.1 General

Manual #	Risk Rank	Description
4.1.1	Transmission: Medium Distribution: Low	Testing or pretesting of additional piping used to tie in the completed piping was not done before putting line in service. (CSA Z662-19 [8.12.1])
4.1.2	Distribution.: Low Transmission: Low	Before pressure testing of existing piping, an engineering assessment (EA) was not done to determine whether the piping can sustain the proposed test pressure and to establish pressure test limits, so testing does not adversely affect pipe integrity. (CSA Z662-19 [10.3.9.1])
4.1.3	Distribution: Low Transmission: Low	Where an engineering assessment has deemed it inappropriate, pressure testing was still conducted as specified in clause 8. (CSA Z662-19 [10.3.9.3]) *Note: This would be for situations when pressure testing in accordance with clause 8 may cause unnecessary damage and impact; and the EA limits the test to protect the pipeline.* *(There could also be variances to clause 8, provided the EA has deemed them appropriate.)*
4.1.4	Transmission: Medium Distribution: Low	A leak test was not performed on piping and fabricated assemblies that were not considered completely accessible for visual inspection, immediately subsequent to a strength test (minimum pressure of 110% MOP, and as specified in clause 8.2.5). (*CSA Z662-19* [8.7.1.2])* **Piping and fabricated assemblies with any insulation, concrete coating, or other types of coatings are not considered completely accessible for the purposes of a visual inspection.*
4.1.5	Transmission: Medium	A pipeline is tested at a pressure that causes a hoop stress greater than 100% SMYS, and the operator did not develop a test procedure or did not plot a pressure-volume curve starting at no greater than 80% SMYS of the pipe. (*CSA Z662-19* [8.6.1])
4.1.6	Distribution: Medium Transmission: Medium	No contingency plan* for environmental protection is developed as required under *CSA Z662-19* when a liquid test medium other than fresh water is used. ** See CSA Z662-19, clause 8.7.2.2*
4.1.7	Distribution: Medium Transmission: Medium	Except as otherwise allowed* in *CSA Z662*, liquid or gas pressure-test mediums (other than water) were used. (*CSA Z662-19* [8.7.2.1]) **See CSA Z662-19, clauses 8.7.2.2 and 8.7.2.3*
4.1.8	Distribution: Medium	Operator has not taken precautions to minimize the adverse effects on the environment when disposing of pressure-test medium. (*CSA Z662-19* [8.10])

4.2 Pressure and Duration

Manual #	Risk Rank	Description
4.2.1	Transmission: Medium Distribution: Low	Minimum strength-test and leak-test pressures are not met during testing, as per *CSA Z662*. (*CSA Z662-19* [8.7.3.1], table 8.1)
4.2.2	Transmission: Medium	Steel piping in compressor stations, gas pressure-regulating stations, and gas measuring stations was not strength tested to the required pressure or duration. (*CSA Z662-19* [8.7.6.2], table 8.1)
4.2.3	Transmission: Medium Distribution: Low	Strength test pressure on the pipeline or components exceeds test pressure allowed in the applicable standard. (*CSA Z662-19* [8.7.4.1])
4.2.4	Transmission: Medium	Leak test pressure using liquid medium exceeds 100% SMYS. (*CSA Z662-19* [8.7.4.4])
4.2.5	Distribution: Medium	No leak test or leak test pressure exceeds the test pressure specified in the applicable material standard on any component in the test section on pipe being operated at 700 kPa or less. (CSA Z662-19 [8.8.4.1])
4.2.6	Distribution: Medium	Leak test pressure exceeds 1400 kPa on piping operated 700 kPa or less. (*CSA Z662-19* [8.8.4.2])
4.2.7	Transmission: Medium Distribution: Low	Strength, leak, or concurrent test does not meet the minimum duration in accordance with *CSA Z662-19* (4 hour strength and 4 hour leak for liquid test medium; 24 hour for gaseous test medium). (*CSA Z662-19* [8.7.5.1], [8.7.5.3], [8.7.5.4], [8.8.5.1]) *Note: For pipe intended to be operated at pressures less than 700 kPa.*
4.2.8	Transmission: Medium Distribution: Low	A pipeline less than 75 m in length, or a pipeline permanently located above ground, is not tested for a minimum of one hour. (CSA Z662- 15 [8.7.5.2])

4.3 Records and Accuracy

Manual #	Risk Rank	Description
4.3.1	Transmission: Medium Distribution: Low	No records, or incomplete records, of a failed pressure test. (*CSA Z662-19* [8.7.7.5], [8.7.7.6], [8.8.7.4])
4.3.2	Transmission: Medium Distribution: Low	No records, or improper records, of a successful pressure test. (*CSA Z662-19* [8.7.7.6], [8.8.7.5], [10.4.5])
4.3.3	Transmission: Medium Distribution: Low	Pressures during testing are not accurately recorded and identified by recording equipment. (*CSA Z662-19* [8.7.7.2])
4.3.4	Transmission: Low Distribution: Low	The accuracy of the chart recorder was not verified before and after each pressure test, or the accuracy of the other test instruments was not verified periodically. (*CSA Z662-19* [8.7.7.3], [8.8.7.3]) *Note: The accuracy of the chart recorder does not need to be verified through calibration of the recorder before and after each use. The accuracy can be verified against another device.*
4.3.5	Transmission: Low Distribution: Low	No temperature recorder, or not measuring ambient temperature of test medium or pipe. (*CSA Z662-19* [8.7.7.4])

4.4 Safety

Manual #	Risk Rank	Description
4.4.1	Distribution: Medium Transmission: Medium	Suitable measures were not taken to keep unauthorized persons out of the area, or to eliminate ignition sources, during testing with a gaseous medium (*CSA Z662-19* [8.2.2])
4.4.2	Transmission: Medium	Licensee did not close the road or railway crossing during pressure testing where test pressures will exceed 80% or greater SMYS using gaseous medium testing. (*CSA Z662-19* [8.7.1.4])
4.4.3	Distribution: Medium Transmission: Medium	The pressure of the test head assembly during testing produced hoop stresses in excess of 75% of the SMYS of any pipe or fitting or was higher than the cold working pressure of any flange or valve in the test head assembly. *(CSA Z662-19* [8.5.1]*)*

5 External Corrosion (Cathodic Protection and Coatings)

Manual #	Risk Rank	Description
5.1	Distribution: Medium Transmission: Low	Protective coatings or corrosion-resistant alloys are not used to protect atmospherically exposed piping, or the company cannot demonstrate that anticipated corrosion is not detrimental to its serviceability. (*CSA Z662-19* [9.1.4])
5.2	Distribution: Medium Transmission: Low	Atmospherically exposed piping is not inspected for corrosion as specified in the company operating and maintenance manuals. (*CSA Z662-19* [9.1.5])
5.3	Distribution: Medium Transmission: Low	Buried or submerged piping is not externally coated as required. * (*CSA Z662-19* [9.1.8]) *Note: See exceptions as allowed under CSA Z662-19 clause 9.1.3.*
5.5	Distribution: Medium Transmission: Low	Coatings were not applied, or coating defects were not repaired in accordance with *CSA Z662*. (*CSA Z662-19* [9.3.2], [9.3.6])
5.6	Distribution: Medium Transmission: Low	Operator does not determine areas where coating is damaged by welding operations and does not address impacts caused by those operations. (*CSA Z662-19* [9.3.7]) *Note: Coating performance may be negatively affected by heating associated with preheat for welding, welding, and post-weld heat treatment.*
5.7	Distribution: Medium Transmission: Low	Piping was not coated after the completion of welding operations. (*CSA Z662-19* [9.3.8])
5.8	Distribution: Medium Transmission: Low	CP was not installed on steel pipeline within one1 year of installation or is not maintained until pipeline is abandoned. (*CSA Z662-19* [9.1.6], [9.5.1]) *Note: See exception by an EA in CSA Z662-19, clause 9.1.3.*
5.9	Distribution: Medium Transmission: Low	The system does not provide enough current to satisfy the selected criteria for CP. (*CSA Z662-19* [9.5.2]) *Note: Criteria are given in annex B of CGA OCC-1.*
5.10	Medium	Insulating devices are not properly installed, not properly rated, or installed in enclosed areas where no safeguards exist. (*CSA Z662-19* [9.6.1])
5.11	Distribution: Medium Transmission: Low	Electrical contact between pipe and other structures has not been considered in the design and maintenance of the cathodic protection system. (*CSA Z662-19* [9.6.2])
5.12	Distribution: Medium Transmission Low	No provisions were made to prevent galvanic corrosion between dissimilar metals. (*CSA Z662-19* [9.6.3])
5.13	Distribution: Medium Transmission: Low	Bonding conductors are not installed and maintained across separated pipeline points that are close to high-voltage DC lines. (*CSA Z662-19* [4.13.1], [4.13.2])
5.14	Distribution: Medium Transmission: Low	Direct-current tests are not completed, or measures were not taken to prevent detrimental effects of stray direct current. (*CSA Z662-19* [9.7.1])

Manual #	Risk Rank	Description
5.15	Distribution: Medium Transmission: Low	No test stations* for electrical measurement are along the pipeline. (*CSA Z662-19* [9.8.1]) **Test stations for potential or current measurements should be provided at enough locations to ensure effective testing or monitoring of cathodic protection. Locations may include, for example, pipe casing installations, foreign metallic structure crossings and tie-ins, isolation joints, waterway crossings, bridge crossings, valve, regulating, and meter stations, galvanic anode installations, road and railroad crossings, and transitions between steel piping and nonmetallic piping, at regular intervals (such as 2 km) or as required.* *All test-station materials, connections, and locations must be suitable for the site conditions where they are installed. Piping system locations subject to induced AC voltage levels that have been identified by test results and that are defined in CSA Standard C22.3 No.6 must have test stations with dead front construction. (CGA OCC-1, 2.3.3.4.1)*
5.16	Distribution: Medium Transmission: Low	Conductor wire is not properly sized to carry current or has more than one conductor wire attached by thermal weld. The use of multi-strand conductors with strand groups larger than No. 6 AWG. (*CSA Z662-19* [9.8.8])
5.17	Distribution: Medium Transmission: Low	Test lead wires for CP of steel pipe are not in accordance with *CSA Z662*. (*CSA Z662-19* [9.8.2], [9.8.9])

6 Emergency Valves

Manual #	Risk Rank	Description
6.1	Transmission: Low Distribution: Low	Valves are not at locations accessible for the purpose of isolating the pipeline for maintenance and for responding to operating emergencies (*CSA Z662-19* [4.4.1]) *Note: Valve locations should be readily accessible by authorized personnel. Valve locations should be protected from damage by people and wildlife (fenced, locked access on major installations) and have proper support to prevent differential settlement and movement of the attached piping.* (CSA Z662-19 *[4.4.2])*
6.2	Transmission: Medium	Valves not installed on both sides of major water crossings on HVP and LVP pipelines. (*CSA Z662-19* [4.4.9])
6.3	Distribution: Medium	Vaults housing pressure-control or -relieving devices are not regularly inspected, adequately vented, or maintained in a safe condition. (*CSA Z662-19* [10.9.7])

7 Pressure Control (Limiting/Relieving)

Manual #	Risk Rank	Description
7.1	Distribution: Serious Transmission: Medium	Pressure-control systems are not installed or properly set to prevent a pipeline from exceeding MOP. (*CSA Z662-19* [4.18.1.1])
7.2	Distribution: Serious Transmission: Medium	Overpressure protection that prevents MOP from being exceeded by more than 10% or 35 kPa is not installed. (*CSA Z662-19* [4.18.1.2])
7.3	Distribution: Serious Transmission: Medium	Pressure control and overpressure protection system not designed in accordance with *CSA Z662.* (*CSA Z662-19* [4.18.2]) *Note: Reference CSA Z662 for specific design requirements.*
7.4	Distribution: Serious Transmission: Medium	Pressure control/limiting systems (or devices) or pressure relieving systems (or devices) not inspected, assessed, tested or replaced as required. (*CSA Z662-19* [10.9.5.2], [10.9.5.3], [10.9.5.4]
7.6	Distribution: Serious Transmission: Medium	Discharge stacks at pressure-relieving installations are not protected by rain caps to prevent the entry of water, where applicable, or are not located where fluid could be safely discharged and dispersed into the atmosphere or containment. (CSA Z662-19 [4.18.3.1])

8 Signage

Manual #	Risk Rank	Description
8.1	Distribution: Medium Transmission: Medium	Pipeline warning/identification signs are not installed in strategic areas as specified in *CSA Z662-19*, clauses 10.5.3.1 and 10.5.3.2.) *Note: Strategic areas may include utility corridors, construction activity, drainage systems, and other anticipated third-party activity.*

9 Pipeline Installations (Compressors, Pumps)

Manual #	Risk Rank	Description
9.1	Transmission: Medium	Shutdown devices and systems are not inspected and tested periodically to ensure proper functionality. (*CSA Z662-19* [10.9.1.2])
9.6	Transmission: Medium	Flare and drain systems of pump stations over 375 KW are not in accordance with CSA Z662. (CSA Z662-19 [4.14.3.2])

10 Right-of-Way Surveillance

Manual #	Risk Rank	Description
10.4	Transmission: Low	Vegetation on pipeline right of way (ROW) is not controlled (where the terms of the easement permit) to maintain clear visibility from the air or to provide ready access for maintenance crews. (*CSA Z662-19* [10.6.2])
10.5	Distribution: Serious Transmission: Medium	Company did not maintain access or prevent unauthorized operation of valves or other exposed facilities. (*CSA Z662-19* [10.6.3])

11 Control Centre

11.1 Liquid hydrocarbon

Manual #	Risk Rank	Description
11.1.1	Transmission: Medium	Does the leak detection system provide clear alarms to alert the pipeline controller of a possible release; result in initiation of a procedure to evaluate the leak condition and to determine the cause of the alarm; be integrated into pipeline control procedures; lead to control action to mitigate the leak (such as pipeline shutdown) unless such deviations can be readily and clearly explained? *(CSA Z662-19 [E.4.1.1])*
11.1.2	Transmission: Medium	Are leak alarms clear, concise, and easily recognizable in a timely fashion by the pipeline controller? *(CSA Z662-19 [E.4.1.2])*
11.1.3	Transmission: Medium	Does the operating company identify and monitor critical instruments to ensure that any failure of an instrument or significant change in instrument uncertainty is identified and corrective actions taken? *(CSA Z662-19 [E.5.2.1])*
11.1.5	Transmission: Medium	What is the test frequency of the leak detection system? *(CSA Z662-19 [E.6.1.1])*
11.16	Transmission: Medium	Is the pipeline controller notified immediately of a full or partial failure of any critical process? *(CSA Z662-19 [E.5.2.2])*
11.1.7	Transmission: Medium	Interview with pipeline controller: Training; Knowledge of the pipeline system. *(CSA Z662-19 [E.10])*