

## Executive Summary

The class location of two areas near the end of the 168.3mm outside diameter PTC Pipeline transporting liquefied petroleum gases has transitioned from CSA Z662-15 Class 1 to Class 2. Except for depth of cover, all other requirements of Clause 10.7.1 of CSA Z662-15 pertaining to the higher class location are satisfied. The lowest measured depth of cover at these two impacted areas does not pose a pipeline integrity concern. Plains plans to mitigate the reduced depth of cover by line lowering in 2018.

## Background

Plains Midstream Canada (Plains) acquired the PTC Pipeline from Spectra Energy on August 4, 2016. The 168.3mm outside diameter (OD) pipeline was manufactured using the high-frequency electric resistance welding process, constructed in 1963, and commissioned in 1964 to transport liquefied petroleum gases. Approximately 933 km in length from Empress to Fort Whyte, the pipeline has a predominantly nominal wall thickness of 4.78 mm and a material grade of 290 MPa (API 5L X42). All nine piggable mainline sections have an approved maximum operating pressure (MOP) of 9,928 kPa (1,440 psig) or 60% of the specified minimum yield strength (SMYS).

During the due diligence process, Plains was made aware of two areas in Section 9 (Portage to Fort Whyte terminal) where the class location might have transitioned from Class 1 to Class 2 – one is due to criterion (c)<sup>1</sup> and the other is due to criterion (d)<sup>2</sup> as per Table 4.1 of CSA Z662-15. These two areas are contained within 5 km upstream of the Fort Whyte terminal and were confirmed to be Class 2 based on the work initiated by Blueline Damage Prevention Solutions in December 2016 and completed in April 2017 (**Attachment 1**).

## Assessment

Clause 10.7.1 of CSA Z662-15 states the following:

“Where class locations change, the pipeline system in such locations shall be subject to the following requirements for the new [higher] class location:

- a) Design factor or location factor, as applicable;
- b) Valve spacing;
- c) Depth of cover and clearance;
- d) Pressure testing; and
- e) Evaluation and repair of imperfections as specified in Clause 10.10 and Clause 10.11.”

---

<sup>1</sup> Class 2 criterion (c) listed in Table 4.1 of CSA Z662-15 is defined as “a small, well-defined outside area occupied by 20 or more persons during normal use (e.g., a playground, recreation area, outdoor theatre, or other place of public assembly).”

<sup>2</sup> Class 2 criterion (d) listed in Table 4.1 of CSA Z662-15 is defined as “an industrial installation (e.g., a chemical plant or a hazardous substance storage area) where release of the service fluid from the pipeline can cause the industrial installation to produce a dangerous or environmentally hazardous condition.”

### **Location Factor**

As per Table 4.2 of *CSA Z662-15*, the location factor for pipe in the “general” location category is derated to 0.8 for HVP service in Class 2. Based on this location factor, the design pressure is determined to be 10,543 kPa as per Clause 4.3.5.1 of *CSA Z662-15*, which is greater than the approved MOP of 9,928 kPa. The more stringent requirement for the higher class location is satisfied.

### **Valve Spacing**

As per Table 4.7 of *CSA Z662-15*, the maximum valve spacing for an HVP pipeline in Class 2 is 15 km. As shown in the aboveground marker (AGM) summary from the 2016 in-line inspection (ILI) (**Attachment 2**), the distance between the upstream valve at KMP 921.1 and the Fort Whyte Terminal receiver trap valve at KMP 932.8 is 11.7 km, which is within the maximum valve spacing requirement.

### **Depth of Cover and Clearance**

As per Table 4.9 of *CSA Z662-15*, clearance between a pipeline and underground structures and utilities is independent of service fluid and class location.

For an HVP pipeline in the “general” location category, the minimum design depth of cover is increased from 0.9 m for Class 1 to 1.2 m for Class 2. In May 2017, Plains contracted Midstream Pipeline Services to gather the depth of cover in the vicinity of the identified Class 2 areas (**Attachment 3**). For the area at KMP 928, the measured depth of cover ranged from 0.82 m to 1.20 m. For the area at KMP 932, the measured depth of cover ranged from 0.76 m to 1.08 m.

### **Surface Loading at Existing Depth of Cover**

With the collected depth of cover measurements, surface load by existing agricultural-related equipment crossing the pipeline was determined using “the CEPA calculator” as per Clause 10.8.3 of *CSA Z662-15*. At each location, a depth of cover of 0.75m (less than the lowest measured value) was used. The combined hoop and longitudinal stresses induced onto the pipeline were determined to be less than the permissible value of 90% of SMYS (**Attachment 4**).

### **Pressure Testing**

As documented under **Attachment 5**, this portion of the pipeline was originally pressure tested in January 1964 and achieved a minimum strength test pressure of 1,800 psig or 1.25 times the approved MOP of 1,440 psig. To satisfy Table 8.1 of *CSA Z662-15*, any future pressure test on this section would be subjected to a minimum test pressure of 1.5 times the MOP for HVP Class 2.

### **Evaluation and Repair of Imperfections**

**Attachment 6** contains an excerpt of the 2016 ILI pipeline listing covering approximately the last 5km of the line impacted by the class location change. The deepest measured corrosion feature in this portion of the line is 25%. The feature with the lowest predicted failure pressure (based on nominal wall

thickness and using the 0.85dL method referenced in Clause 10.10.2.6 of CSA Z662-15) is a 22% external feature. As shown in the "Pipeline Listing (page 206 of 209)", this 22% corrosion feature has a predicted failure pressure of 17,709 kPa. Assessing this corrosion imperfection under Clause 10.10.2.5 of CSA Z662-15 yields a calculated value of 11,333 kPa ( $17,709 \times 0.8 \times 0.8 \times 1 \times 1$ ) which is greater than the MOP of the line.

Plains accounts for the inaccuracy of an ILI tool by adding the depth accuracy tolerance (typically 10%) in the corrosion assessment. The predicted failure pressure of this assumed 32% feature is 16,477 kPa. An assessment under Clause 10.10.2.5 yields a value of 10,545 kPa which is greater than the MOP of the line. Furthermore, by applying a conservative corrosion rate of 5%/year, the assumed 37% would have a predicted failure pressure of 15,789 kPa in 2017 (one year after the 2016 ILI). The same assessment under Clause 10.10.2.5 yields a value of 10,105 kPa which is still greater than the MOP of the line. As such, this feature would not be classified as an ILI defect triggering an excavation. When this feature is eventually excavated before or following the next ILI, it would not be repaired by grinding under Clause 10.11.2.3 of CSA Z662-15; rather it would likely be permanently repaired with a steel compression reinforcement sleeve as permitted under Table 10.1 of CSA Z662-15.

#### Summary

Of the more stringent requirements under Clause 10.7.1 for piping in a higher class location, only the depth of cover is not satisfied for the affected areas. The lowest measured depth of cover has been demonstrated not to pose a pipeline integrity concern from surface loads. This reduced depth of cover will be mitigated via pipe lowering in 2018.

Minh Ho, P.Eng.

Manager, Pipeline Integrity Program



#### Attachments:

- Attachment 1 – Class Location Assessment
- Attachment 2 – 2016 Valve Spacing Information
- Attachment 3 – Depth of Cover Survey
- Attachment 4 – Surface Loading Assessment
- Attachment 5 – Pre-commissioning Pressure Test Results
- Attachment 6 – Excerpt of 2016 ILI Pipeline Listing