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To: All companies under National Energy Board jurisdiction,  
Canadian Energy Pipeline Association  
Canadian Association of Petroleum Producers, and  
Provincial and Territorial Regulators

**National Energy Board Safety Advisory**  
**NEB SA 2016-02**  
**Thermal Expansion - Pipeline Design and Operating Considerations**

Please find attached Safety Advisory SA 2016-02.

The National Energy Board (NEB or the Board) expects regulated companies to demonstrate a proactive commitment to continual improvement in safety, security and environmental protection, and to promote a positive safety culture as part of their management systems.

Safety Advisories are issued periodically in order to improve the oil and gas industry's awareness of an identified safety or environmental concern with the goal of preventing incidents from occurring in the first place. A Safety Advisory also serves to further highlight NEB requirements, and conveys the Board's expectation that regulated companies take appropriate action to mitigate any potential impacts to people or the environment.

If you have any questions regarding this advisory please contact Integrity Management personnel at the Board through our toll free number at 1-800-899-1265.

Yours truly,

*Original signed by*

Sheri Young  
Secretary of the Board

Attachment



## Thermal Expansion Pipeline Design and Operating Considerations

### Background

In 2013, a pipeline rupture occurred on a sweet natural gas pipeline in Alberta that caused the release of an estimated 16.5 million cubic meters of natural gas. The rupture did not result in a fire, and no injuries occurred.

Investigation into the incident (see Transportation Safety Board Pipeline Investigation Report P13H0107) indicated that the rupture occurred due to the lack of clear operating criteria and thermal expansion of the pipeline. Other contributing causes of the failure are as follows:

**Discrepancy between the specified design limits, and the potential operating envelope used for stress analysis:** The Design Basis Memorandum (DBM) for the project specified a maximum discharge temperature of 58°C at the upstream compressor station. However, the stress analysis conducted for this project had used 45°C as the maximum discharge temperature, as well as a non-conservative maximum temperature decay profile decreasing linearly from 45°C to a ground temperature of 10°C, over a distance of 10 km.

**Operating conditions outside the design limits of the pipeline:** Over the 50-day period leading up to the failure, the pipeline was operated at a temperature of 42°C to 48°C, despite the fact the stress analysis was performed for a maximum of 45°C temperature. Just prior to the rupture, the discharge temperature at the upstream compressor station was 51.5°C. The rupture initiated at an overbend elbow due to the excessive stress impressed upon it by the combination of thermal expansion and internal pressure.

**Lack of communication between teams:** The operator's project team (design team members and consultants) did not effectively communicate the maximum discharge temperature of the upstream compressor station.

**Lack of Quality Assurance:** The design review process did not identify the discrepancy in the maximum compressor station discharge temperatures between the DBM and the subsequent pipeline stress analysis. In addition, no verification of assumptions was made at the time of design compared to the actual operating envelope during operation (those are, pressure and temperature).



## **Preventive Actions**

Section 40 of the *National Energy Board Onshore Pipeline Regulations* (OPR) requires that a company's integrity management program:

*...anticipates, prevents, manages and mitigates conditions that could adversely affect safety or the environment during the design, construction, operation, maintenance or abandonment of a pipeline.*

Pipeline companies are expected to implement processes and procedures for quality assurance (QA) in the design phase of a pipeline. These QA programs must include a means to:

- Ensure that models and parameters used for stress analysis are appropriate for the anticipated construction and potential operating envelope of the pipeline, as per Canadian Standards Association (CSA) Z662-15, Clauses 4.2.1.1 and 4.2.2.1.
- Ensure that the pipeline's operating envelope is within its design limits prior to operating the pipeline, as per CSA Z662-15, Clause 10.5.1.
- Verify that assumptions made during the design are still appropriate once the pipeline is in operation. If the design assumptions are no longer valid and changes to the operation of the pipeline are required, management of change procedures must be followed, as per paragraph 6.5(1)(i) of the OPR.
- Consider thermal expansion during design, as per CSA Z662-15, Clause 4.2.2.2 – identify locations that may be susceptible to thermal expansion, and implement mitigation measures where required.

Pipeline companies are expected to consider inadequate design as a potential integrity threat for the safe operation of their pipelines. As for any other threat, its associated risk needs to be assessed and mitigated to an acceptable level.

## **Further Information**

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