Project Profile

Project Name:	Decision Making Tool for Pipelines Risk Assessment with Multi-hazards (Corrosion and Geo-Hazard) Consideration
Project Number:	ES-Pipe-2019-01
Proponent:	University of British Columbia—Dr. Solomon Tesfamariam (Okanagan Campus); Dr. Edouard Asselin and Dr. Dharma Wijewickreme (Vancouver Campus)
Funding Partner:	Mitacs
Funding Envelope:	Engineering and Safety Research—Pipelines
Timeframe:	May 1, 2019, to April 30, 2021

Project objectives

The objective of this project is to develop a multi-hazard risk assessment tool for pipelines that accounts for internal and external corrosion and geo-hazard due to earthquakes.

Project description

The project will provide a risk assessment tool to aid the understanding of different pipelines and their performance under potential hazards of corrosion and earthquakes. The risk assessment tool will support decisions about risk mitigation, future development, investments and maintenance policies so that their operation can be made more efficient and reliable.

The study of corrision hazards will involve collecting soil samples from pipeline right of ways to estimate the external corrosion rate of buried pipe steel. The physiochemical properties of soil samples will be assessed—including redox potential, moisture content, ph and composition. Three sets of experiements will be performed on pipe steel to elucidate the effect of soil corrosivity, cathodic protection and coating type on the corrosion behaviour:

- The first two sets of experiements will use bare pipe steel while cathodic protection will be employed on the pipe steel in the second set.
- The third set of experiments will use coated pipe steel (e.g., liquid epoxy coating) with an artifical defect used with the application of cathodic protection.

The study of earthquake hazards will involve assessing the vulnerability of the pipeline network to earthquake-induced ground displacements. The study will consider intensity and direction of displacement, length of pipeline exposed to displacement and the likelihood of displacement occurrence. Physcial characteristics (e.g., diameter, wall thickness, material strength, joint strength and internal pressure) will be considered as will pipe-soil interaction (e.g., soil strenght, soil weight, depth of soil cover).

Bayseian Belief Network (BBN) will be used to integrate internal corrosion, external corrosion and earthquake risk into an analystical framework.

Project approach

The project involves the following two phases:

1. **External corrosion**: review and report on causes of external corrosion and mitigation. Collect and analyze the physiochemical properties of the soil samples. Carry out three sets of experiments described above and develop the BBN network model for the risk assessment of pipelines using the findings.
2. **Permanent ground displacement and liquefaction**: develop a regional probabilistic seismicity model to predict seismic ground motion hazards. Map the seismic hazards such as liquefaction and slope stability using regional and site-specific data. Evaluate ground displacement deformations for a range of seismic levels. Analyze the vulnerability of the pipelines to the identified seismic hazards. Incorporate findings into the BBN model for risk assessment of pipelines.

Project deliverables

The deliverables from this project include the following:

1. Risk assessment tool—based on the Bayesian Belief Network (BBN) model. The tool will be integrated with Excel for general applicability and use by industry and regulators. A GIS tool will be provided for spatially distributed pipelines—integrating the corrosion and earthquake risk assessment tool.
2. Final report describing the research approach, findings and implications.