Utility Pipeline Risk Management

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April 27, 2017

Corrosion

Murphy's First Corollary

Left to themselves, things tend to go from bad to worse

Devastating Potential

Pipeline Characteristics

1. Horizontal and Linear
2. Product under Pressure
3. Minimal Installed Equipment
4. Extensive Environmental Impacts
5. Multiple Jurisdictional Interface
6. Extensive Public Interface

Several Technical Issues

- Metallurgy
- Fracture Mechanics
- Stress-Strain Reactions
- Coatings
- Soil Chemistry
- Hydrology Influences
- Geotechnical Events
- Electro-Chemical Reactions

Over-Arching Goal

Make Pipelines Safer

Through:

- Understanding Issues
- Measurement and Tracking
- Continuous Improvement

Risk Terminology

Hazard – a characteristic or group of characteristics that provides the potential for a loss.

Hazard ≠ Risk

Risk Terminology

Risk – the probability of an event that causes a loss and the potential magnitude of that loss.

Risk = Likelihood × Consequences

Understanding Risk

Three Questions:

1. What can go wrong?
2. How likely is it?
3. What are the consequences?

Understanding Risk

Failure - What can go wrong?

1. Not able to perform its intended function.
2. Loss of integrity.
3. Unintentional release of pipeline contents.

Understanding Risk

Probability – How likely is it?

1. Likelihood
2. Degree of belief

Related Terms:

Frequency – Past observation counts

Statistics – Past observation analysis

Failure Rate – Counts over time

Understanding Risk

Consequences – What are they?

- Property damage
- Human health impacts
- Environmental damage
- Loss of product
- Repair costs
- Cleanup and remediation costs

Understanding Risk

Consequences – Indirect costs

- Litigation
- Customer dissatisfaction
- Political reaction
- Regulatory agency fines and penalties
- Contract violations
- Loss of public trust

Understanding Risk

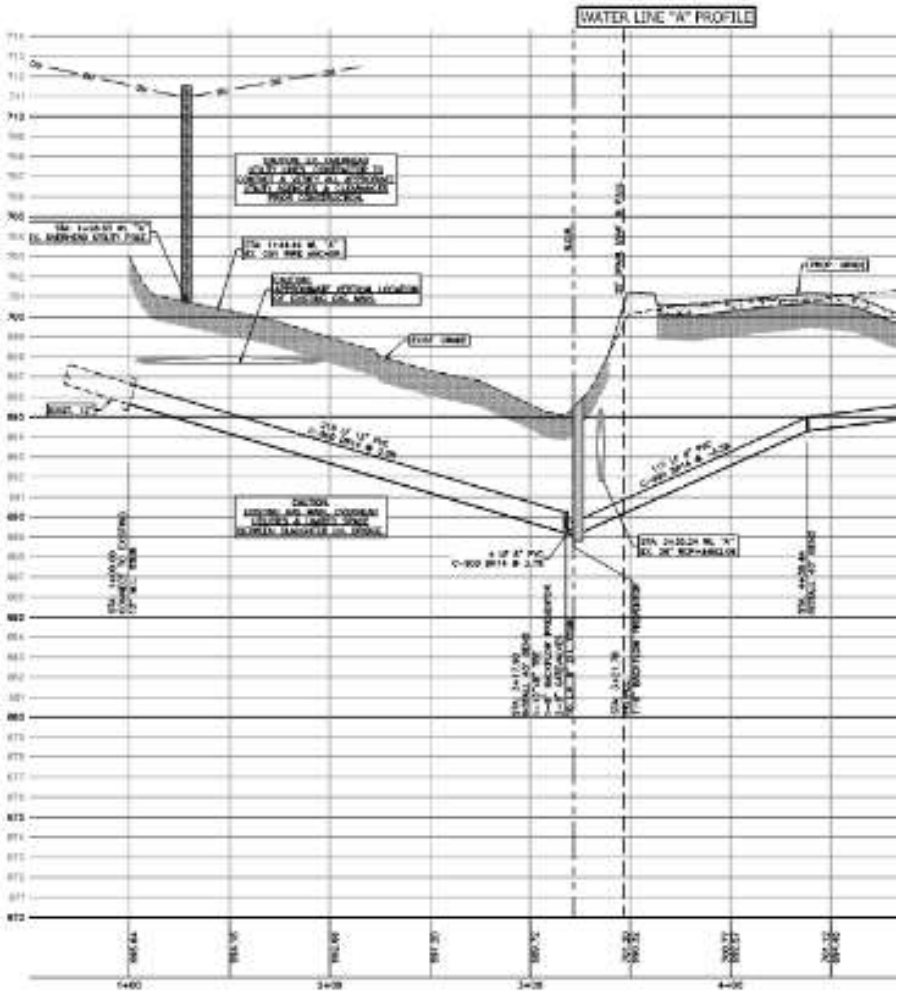
Risk Assessment – A measuring process

- Application of risk modeling tools

Risk Management – A reaction to perceived risk

Design

- Material Selection
- Safety Factor
- Fatigue
- Surge Potential
- Integrity Verification
- Land Movement



Construction

- Inspection
- Materials Handling
- Backfill
- Survey / Maps / Records

Corrosion

- Atmospheric
- Internal
- Subsurface Environment
- Cathodic Protection
- Coatings

Operation

- Training
- Procedures
- SCADA
- Documentation

Third-Party Impacts

Murphy's Second Corollary

It is impossible to make anything foolproof because fools are so ingenious

Third-Party Impacts

- Depth of Cover
- Activity Level
- Above Ground Facilities
- Line Locating
- Right-of-way Conditions
- Patrolling

Risk Score Tabulation

Project: JR-MV Transmission Line - Phase 2

Pipe Section
Station 0+00 to 8+00

Date: February 28, 2018

I. DESIGN INDEX

Section	Index Description	Range	Score	Comments
A.	Material Selection	0-20 pts	18	Wrapped Welded Steel Pipe
B.	Safety Factor	0-25 pts	10	MOP= 180 psi
C.	Fatigue	0-15 pts	10	Normal fluctuations of 10%
D.	Surge Potential	0-10 pts	5	Downstream valves nearby
E.	Integrity Verification	0-15 pts	12	Ability for routine pressure testing.
F.	Land Movement	0-15 pts	12	Flat ground, but recorded earthquack in vicinity.
Total Score		0-100 pts	**67**	

Equations

Safety Factor

$$\text{Ratio} = \frac{\text{Design Pressure}}{\text{MOP}}$$

$$\text{Risk Score} = 25 \times \text{Ratio} - 25$$

(Maximum of 25 points)

Data Tables

Table I-C: Fatigue Risk Score					
Percent Above MOP	Lifetime Cycles				
	$<10^3$	10^3-10^4	10^4-10^5	10^5-10^6	$>10^6$
100	7	5	3	1	0
90	9	6	4	2	1
75	10	7	5	3	2
50	11	8	6	4	3
25	12	9	7	5	4
10	13	10	8	6	5
5	14	11	9	7	6

Data Criterion Categories

Table V-B: Activity Level Risk Score	
Score	Characteristics
0 - 7	• Urban poputation densities (Class 3[1]) • Frequest construction activity • Many buried utilities nearby • Dredging or ditch cleaning
8 - 14	• Suburban poputation densities (Class 2[1]) • Moderate construction activity • Few buried utilities nearby • No dredging
15 - 20	• Rural poputation densities (Class 1[1]) • Low or no construction activity • No buried utilities nearby • No agricutural activities

Sources

1. “Pipeline Risk Management Manual Ideas, Techniques, and Resources”, Third Edition, W. Kurt Muhlbauer (2004)
2. “Identifying and Managing Project Risk”, Tom Kendrick, 2003