Relative Risk Model Applications



Mary Bartholomew, Manager/Engineering Staff



Outline



- Company Information
- Risk Model Overview
- Use of the Outputs
- PMM Analysis
- Continuing Areas of Improvement
- Future Challenges
- Summary

Southwest Gas Corporation

- Arizona, California and Nevada
- 1.9 million customers
- 1,524 miles gas transmission pipelines
- 30,435 miles gas distribution main
- 1.85 million gas distribution services



GAS

Risk Model Overview



- Started with Bass-Trigon (now American Innovations) risk model
- Continuing Improvement and Customization
 - -Additional B31.8S inputs
 - -Southwest Gas specific



	Var #	Variable Reference Source Requirement	Variable Name	Variable Weight	MAX Score	Min Score	Score Contribution	Variable Definitions
	2	AI suggested	Coating Condition - As found	10.0%	1.00	0.00	1.00	The condition of the coating at the time of the inspection.
			No Data	0				
			Excellent	0				No coating damage present
			Good	1				Default. 'Scuffed, scratched, no exposure, no disbondment,
			Fair	3				Well bonded, small holidays, scratches
			Poor	5				Large disbonded areas, poor coating guality,
			Very Poor	7				Problematic coating condition, large disbonded areas, large areas of coating deterioration
			Uncoated	10				Bare pipe
			No Visual Inspection Performed	10				
			Non Applicable	0				
- 1	3	SWG added	Coating Condition - As left	9.0%	0.90	0.00	0.90	The condition of the coating following the inspection.
			No Data	0				
			Excellent	0				Default
			Good	1				
			Fair	3				
			Poor	5				
			Very Poor	7				
			Uncoated	10				
			No Visual Inspection Performed	10				
			Non Applicable	0				
	4	B31.8S implied	Completed Assessment Age	7.0%	0.70	0.00	0.70	Years since last full assessment
			(20 < to <=)	10				
			(15 < to <= 20)	9				
			(10 < to <= 15)	7				
			(5 < to <= 10)	5				
			(0 < to <= 5)	0				
			= NULL	10				
	5	B31.85	Cover Type	E 00/	0.50	-0.40	0.90	The base of encountry the encountry (is an iteration and encode
		referenced	No Data	5.0%				The type of cover over the component (le. rainoad, paved road).
			Coil	10				
			Poad - Paved	-5				
			Road - Hanaved	-5				
			Standing permanent water	-9				
			Building structure	-5				
			Environmentally Sensitive Area	-5				
			Pailroad POW	-5				
			Airport rupway	-8				
			Other	5				
			Unknown	10				
	6	B31 85 implied	Defect Mitigation Type	5 00%	0.50	-0.50	1.00	The type of repair used to mitigate the incident or defect
	•	oortoo implied	Coating repair	0.0%	0.50	0.00	1.00	The type of repair deed to finitigate the incluent of delett.
			Composite Sleeve	-10				
			Grinding Procedure	-10				
			Increase cover denth	0				
			Install warning tape	0				
			Operating Pressure Reduction	-1				
			Operating temperature reduction	-1				
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Example of Southwest Gas Risk Model Inputs





Risk Model Overview



• SME Input

- Review Likelihood of Failure (LOF) threat weightings and Consequence of Failure (COF) annually
- Discussion of findings and concerns

- Full risk model reload

LOF (LIKELIHOOD OF FAILURE)																							
ALGORITHM WEIGHTING:	'03 Original	'05	'06	Change	'07	Change	'08	Change	'09	Change	'10	Change	'11	Change	'12	Change*	'13*	Change*	'14*	Change*	'15*	Change*	'15*
Excavation	45%	50%	45%	-5%	45%	0%	45%	0%	45%	0%	45%	0%	40%	-5%	40%	0%	40%	0%	40%	0%	40%	0%	40%
External Corrosion	13%	8%	13%	5%	13%	0%	15%	2%	15%	0%	15%	0%	15%	0%	15%	0%	15%	0%	15%	0%	15%	0%	15%
Weather & Other Forces	5%	5%	5%	0%	5%	0%	5%	0%	5%	0%	5%	0%	5%	0%	5%	0%	5%	0%	5%	0%	5%	0%	5%
Equipment	3%	3%	3%	0%	3%	0%	5%	2%	5%	0%	5%	0%	4%	-1%	4%	0%	4%	0%	4%	0%	4%	0%	4%
Internal Corrosion	2%	2%	2%	0%	2%	0%	1%	-1%	1%	0%	1%	0%	1%	0%	1%	0%	1%	0%	1%	0%	1%	0%	1%
Construction	13%	13%	13%	0%	13%	0%	15%	2%	15%	0%	15%	0%	15%	0%	15%	0%	15%	0%	15%	0%	15%	0%	15%
Incorrect Operations	5%	5%	5%	0%	5%	0%	5%	0%	5%	0%	5%	0%	4%	-1%	4%	0%	4%	0%	4%	0%	4%	0%	4%
Manufacturing	13%	13%	13%	0%	13%	0%	8%	-5%	8%	0%	8%	0%	15%	7%	15%	0%	15%	0%	15%	0%	15%	0%	15%
Stress Corrosion Cracking	1%	1%	1%	0%	1%	0%	1%	0%	1%	0%	1%	0%	1%	0%	1%	0%	1%	0%	1%	0%	1%	0%	1%
TOTALS	: 100%	100%	100%	0%	100%	0%	100%	0%	100%	0%	100%	0%	100%	0%	100%	0%	100%	0%	100%	0%	100%	0%	100%
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Risk Model Overview



- Continual Data Improvement
 - -Additions to current data sets
 - Field findings
 - Records research
 - -Additions of new data sets
 - Purchased data sets
 - Institutional knowledge additions
 - Industry information

Use of the Outputs



• Prioritization of the HCAs

-Scheduling of Baseline activities

• Top 50% - assessment findings confirmed

-HCA addition assessments - post Baseline

- Additional activities
 - System-Wide Preventive and Mitigative Measure(PMM) Benefit Evaluation



- Internal Process Developed to Provide Structure to Additional PMM Applications
- Decision making & Prioritization Tool
- Utilizes Regulatory Requirements, SME Input and Statistics
- Part of the Risk Analysis Process



- Overall analysis is based upon regulatory drivers
- 49 CFR 192.935(a)
 - "....an operator must take additional measures beyond those already required by part 192 to prevent a pipeline failure...."
 - "...An operator must base the additional measures on the threats the operator has identified to each pipeline segments..."
 - "...An operator must conduct, in accordance with one of the risk assessment approaches in ASME/ANSI B31.8s, section 5, a risk analysis of its pipeline to identify additional measures to protect the high consequence area and enhance public safety..."



- Goal is to obtain adequate spread in values to demarcate benefit rankings of PMMs
- Various indices are calculated and then weighted
 - PMM Index
 - Threat Index
 - P/D(Prevention/Detection) Method Value Index



- PMM index is based upon regulatory drivers
- 49CFR192.935(c)
 - "…. If an operator determines, based on a risk analysis, that an ASV or RCV would be an efficient means of adding protection to an HCA....."
 - "....an operator must, at least, consider the following factors swiftness of leak detection and pipe shutdown capabilities, the type of gas being transported, operating pressure, the rate of potential release, pipeline profile, the potential for ignition and location of nearest response personnel."



- PMM Index
 - Simple Sum Relative Index
 - Variable weighting determined by Southwest Gas
 SMEs
 - Consequence driven and focused on HCAs that are currently least addressed should an incident occur
 - Weighted based upon HCA position Top 5%, 5-10% or below top 10%

- PMM Index
 - LOS_Distance distance from service center to HCA centroid
 - MAOP (psig)
 - Product (type) all natural gas
 - Pipe Diameter (inch)
 - Automatic Shut-Off Valves or Remote Valves (yes/no)
 - Response time to control valves
 - SCADA monitoring devices (yes/no)
 - Distance to SCADA Monitoring
 - Pressure Recording Devices (yes/no)
 - Distance to pressure recording devices





- Threat Index
 - Calculated for each HCA by Threat (EC, IC, etc.)
 - Threat index scores taken directly from risk model
 - Threat indices weighted by threat type by HCA -Top 10%, 10-20% or below top 20%



CN: 1x0.15

IO: 0x0.05 EQ: 0x0.05

WO: 1x0.05

EX: 1x0.45

EC: 1x0.15

IC: 0x0.05 SCC: 0x0.01

MN: 0x0.08

- P/D(Prevention/Detection) Method Value Index
 - Starts with determination of P/D method availability and coverage for each threat
 - Utilizes LOF weighting from risk model
 - Threat coverage is the sum of the LOF threat weightings by
 P/D method value between 0 and 1
 P/D Method: Foot Patrol
 - Example P/D method:

Value of Threat Coverage = 0.75



- P/D(Prevention/Detection) Method Value Index (cont.)
 - Need to account for the "cost of implementation"
 - Principle of IMP utilizing the resources available, address the highest risks/threats



- Value Index
 - Value Index = Threat Coverage / Cost Index
 - Cost Index (orders of magnitude estimate):
 - Cost: \$3k-\$30k $\log_{10}(10^4) = 4$
 - Cost: \$30k-\$300k $\log_{10}(10^5) = 5$
 - Cost: \$300k-\$3,000k+ $\log_{10}(10^6) = 6$
 - Threat Coverage = Sum of P/D threat coverage weights
 - Results in a Benefit-to-Cost ratio



- Goodness Value is a term coined by Southwest Gas to hook the risk of the HCA to the benefit of the chosen P/D and the cost of its implementation
- GV= (Value Index) * ROF
- Used for grouping of possible projects
- Example Calculation:

Foot Patrol Threat Coverage= 0.75Foot Patrol Cost Index= 4Foot Patrol Value Index= 0.75/4 = 0.19ROF of HCAxyz = 23.1(from risk model)

GV = 0.19 * 23,1= 4.3



- Once scores are calculated for each HCA for each P/D method final analysis is conducted
- Top P/D methods are determined both system-wide and HCA specific
- Determination is made if and where additional PMMs should be implemented



 Final Step - Document Final PMMs Utilizing MOC Process



Continuing Areas of Improvement



- More Data
- Interactive Threats NYSEARCH project
- Additional Application of Statistical Methods

Future Challenges



- Continuing to Move in a Quantitative Direction
- Addressing Data Gaps
- As System Improves, Determining True System Risk and Areas of Focus

Summary



- Relative risk model has evolved
- System risk reduction has been achieved
- SME input provides system specificity
- Additional data provides better system view
- Statistical analysis of data can provide repeatable methods for applying P&Ms
- Models can and will continue to evolve and improve



Questions?