Dynamic Risk Assessment Systems, Inc.

Your Integrity Management Partner

From wellhead to burner tip, Dynamic Risk's integrity management solutions provide you the information to make effective decisions for your entire asset base.

Overview of ASME B31.8S

October 20, 2015

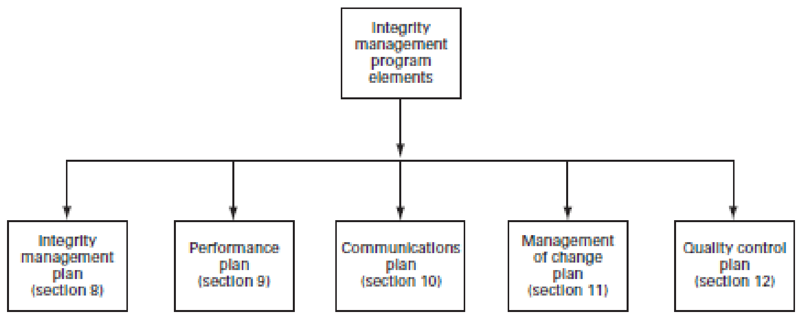
Brief History

- Edison Failure led to Congress Initiating Risk Management
  - Class location added extra wall thickness to protect a denser population
  - Likelihood reductions needed to further consider population density - Risk
- RSPA held Multiple Industry Meetings with AGA, AOPL, API, & INGAA,
  - Agreed on a path forward in the joint meetings
  - API initiated the working groups that developed API 1160
  - GRI initiated an R&D Program for AGA & INGAA Members that developed ASME B31.8S Managing System Integrity of Gas Pipelines
  - High Consequence Areas focus mitigation and prevention activities
    - Recognized that all pipe can't be done at once, highest risk first, lower later
    - HCAs are about 3% to 8% for Transmission, >20% for Distribution

2 Overview - B31.8S Organization

- Program contains Plans -

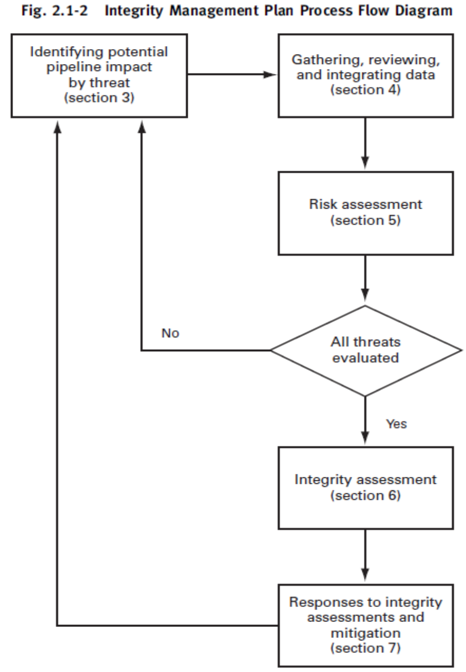
Fig. 2.1-1 Integrity Management Program Elements



Process Flow Diagram

- Two loops
- Both periodic
- Large loop is the integrity assessment interval by regulation a maximum of 5 or 7 years
- Small loop could be considered an annual re-evaluation interval.

Fig. 2.1-2 Integrity Management Plan Process Flow Diagram



3 Consequences

- Affected area is determined by the available fuel = P x Area (Diameter)
- Burn radius $r = 0.69\ D\ P^{0.5}$ for Natural Gas others have different constants
- PIR Screens for structure locations- it is not a dispersion/thermal radiation estimate

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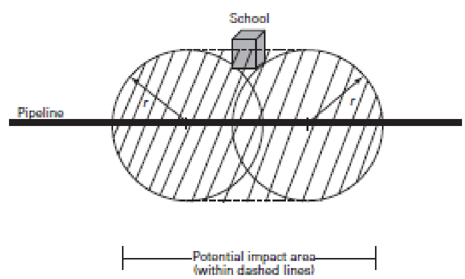
Fig. 3.2.4-1 Potential Impact Area



GENERAL NOTE: This diagram represents the results for a 30-in. (762-mm) pipe with an MAOP of 1,000 psig (6 900 kPa).

4 Gathering Data, Review and Integration

- Purchase and Construction Records are essential – know what you own
- Location – know were it is
- Maintenance inspections – excavations, ILI, DA, patrols, neighbors, records, audits – know the current integrity
- A Basic listing is given but more is expected to support estimations of likelihoods of each threat and possible consequences
  - More data requirements are listed in Appendix A by Threat

5 Risk Assessment (likelihood x consequences)

- Organizes Data to prioritize mitigation and maintenance activities
  - Determine which inspection, prevention, and mitigation activities will be performed and when
- Prescriptive first (then Performance if criteria are exceeded)
- Objectives
  - Prioritization for assessment and mitigating action
  - Assessment of the benefits from mitigating action
  - Determination of the most effective mitigation measures for the threats
  - Assessment of the integrity impacts from modified inspection intervals
  - Assessment of the need for alternative inspections
  - More effective resource allocation

5 Risk Assessment - model descriptions

- Identify threats, estimate likelihood, estimate consequences, calculate risk, identify priorities, provide feed back, allow for continuous evaluation and improvements
- Risk Models always prioritize for ruptures (leaks are small in consequence)
  - **Subject Matter Experts** – used in all categories
    - Provides a relative comparison by threat category
  - **Relative Assessment** – added complexity
    - Use algorithms for threats and weighs the treats and consequences
  - **Scenario Based** – description of the event series
    - Uses fault trees or other descriptions of the progress of a threat to predict event outcomes
  - **Probabilistic models**
    - Most complex and requires detailed knowledge
  - **Combinations** of all of the above

Effective Risk Assessment Approach Requires

- Attributes – defined logic to provide a complete, accurate, and objective analysis
- Resources – adequate people and time
- Operating/Mitigation History – considers operator's past events plus industry experiences and be capable of updates
- Predictive Capability – trending and data integration to predict threats not considered
- Risk Confidence – as missing data are collected uncertainty drops
- Feedback – to accommodate new threats and consequences
- Documentation – of the process, changes, and verifies the methodologies
- "What if" Determinations – allows evaluation to estimate proposed change over time
- Weighing Factors – help compare across multiple threats
- Structure – documented to support decision making over time
- Segmentation – be able to compare lengths with similar attributes
- Validation – consistent with operator's and industry's experience and inspections

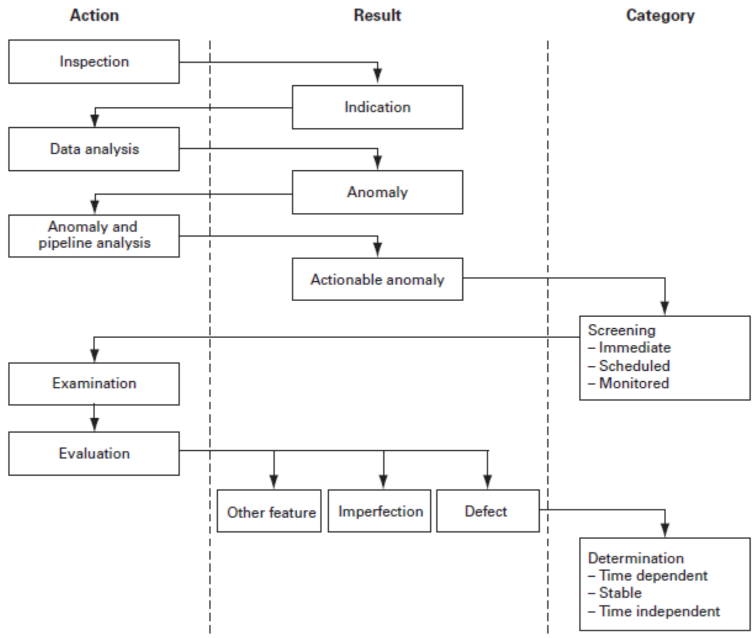
6 Integrity Assessment and Requirements

- In-Line Inspection – detection, identification and sizing of anomalies, for multiple threats
  - Metal Loss Tools – Axial and Transverse MFL and normal beam UT,
    - standard and high resolution tools
  - Cracks – shear wave UT and EMAT
  - Dents – MFL and UT
  - Dents with Indications – hard
  - Strain – Caliper and Inertial tools
  - Validation of records – Grade not possible but differentials recognized
- Pressure Testing – Pressure exceeds MAOP, addresses most threats
  - Qualification and Re-Qualification 8 Hour Leak Test
  - Spike Testing and High pressure followed by 8 Hour Leak Test
- Direct Assessment - only addresses corrosion
  - Appendix A covers ECDA, ICDA, SCCDA, (not CDA)
- New Technology – none accepted

Definitions

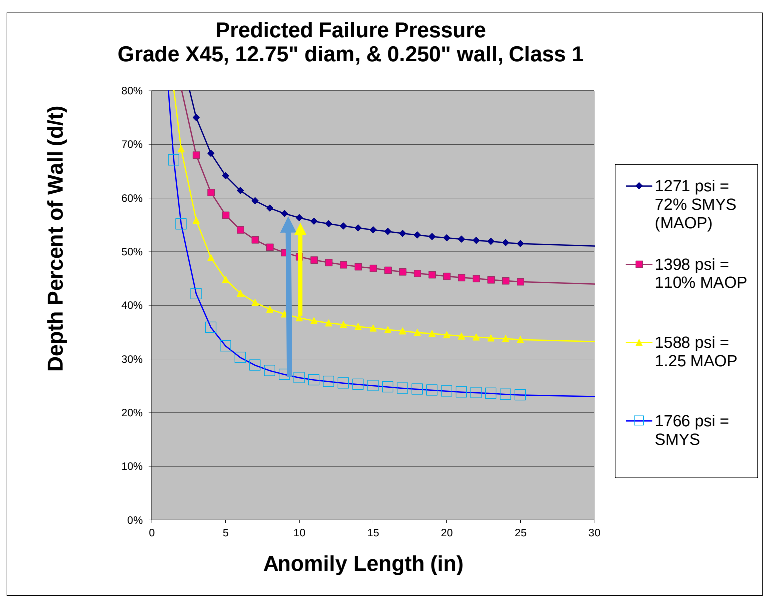
- When is a defect not a defect!

Fig. 13-1 Hierarchy of Terminology for Integrity Assessment



Why Increase Test Pressures?

- 12" Pipe Example
  - Corrosion Depth by d/t
  - Corrosion Length
- Line locii represents different pressures
- Arrows indicate corrosion growing through the wall thickness



7 Responses to Integrity Assessments

- Expectations for ILI Discovered Threats
- Limitations to Response Times in fig 7.2.2-1
  - 10 , 15, and 20 years depending on design
- Congress has an override
  - 5 years between integrity assessments for liquids
  - 7 years for natural gas

7 Responses to Integrity assessments

- To the left = immediate
- In the figure = scheduled
- To the right = monitored
- 110% MAOP is the old construction test
  - Immediate if you can't pass
- SMYS at end of lines
- Same as Table 5.6.1-1

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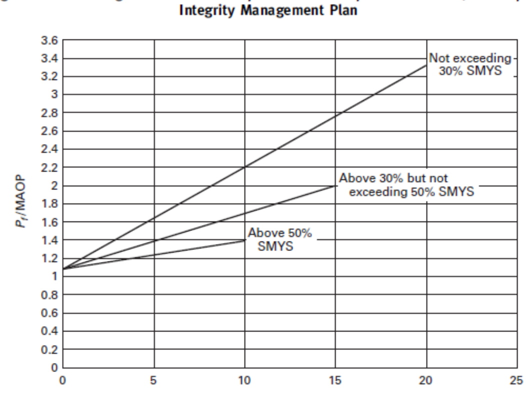
Fig. 7.2.1-1 Timing for Scheduled Responses: Time-Dependent Threats, Prescriptive Integrity Management Plan



GENERAL NOTE: Predicted failure pressure, P_f, is calculated using a proven engineering method for evaluating the remaining strength of corroded pipe. The failure pressure ratio is used to categorize a defect as immediate, scheduled, or monitored.

Table 7.1-1 Acceptable Threat Prevention and Repair Methods (Cont'd)

Prevention, Detection, and Repair Methods	Third-Party Damage			Corrosion Related		Equipment				Incorrect Operation	Weather Related			Manufacture		Construction				O-Force	Environ-ment
	TPD(IF)	PDP	Vand	Ext	Int	Gask/ Oring	Strip/ BP	Cont/ Rel	Seal/ Pack	IO	CW	L	HR/F	Pipe Seam	Pipe	Gweld	Fab Weld	Coup	WB/B	EM	SCC
Repairs (Cont'd)																					
Type B, pressurized sleeve	...	X	X	X	X	...	...	...	...	...	...	...	...	X	X	X	X	X	...	...	X
Type A, reinforcing sleeve	...	X	X	X	...	...	...	...	...	...	...	...	...	X	X	X	A/D	...	...	...	X
Composite sleeve	...	D	D	X	...	...	...	...	...	...	...	...	...	X	X	X	A	...	...	...	...
Epoxy filled sleeve	...	X	X	X	...	...	...	...	...	...	...	...	...	X	X	X	A	X	X	C	...
Annular filled saddle	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	B	...	...	...	...
Mechanical leak clamp	...	...	...	X	...	...	...	...	...	...	...	...	...	...	...	...	A	...	...	...	...

Key
X = acceptable
. . . = unacceptable
A = these may be used to repair straight pipe but may not be used to repair branch and T joints.
B = these may be used to repair branch and T joints but may not be used to repair straight pipe.
C = the materials, weld procedures, and pass sequences need to be properly designed and correctly applied to ensure cracking is avoided. Particular care must be exercised to ensure the safety of workers when welding on pressurized lines. Guidance can be found in publications by W. A. Bruce, et al., IPC2002-27131, IPC2006-10299, and IPC2008-64353.
D = this repair is not intended to restore axial pipe strength. It can only be used for damaged pipe where all the stress risers have been ground out and the missing wall is filled with uncompressible filler. Transitions at girth welds and fittings and to heavy wall pipe require additional care to ensure the hoop carrying capacity is effectively restored.

GENERAL NOTE: The abbreviations found in Table 7.1-1 relate to the 21 threats discussed in section 5. Explanations of the abbreviations are as follows:

Cont/Rel = control/relief equipment malfunction
Coup = coupling failure
CW = cold weather
Direct deposition weld = a very specialized repair technique that requires detailed materials information and procedure validation to avoid possible cracking on live lines
ECA = engineering critical assessment
EM = earth movement
Ext = external corrosion
Fab Weld = defective fabrication weld, including branch and T joints
Gask/Oring = gasket or O-ring
Gweld = defective pipe girth weld (circumferential)
HR/F = heavy rains or floods
Int = internal corrosion
IO = incorrect operations
L = lightning
PDP = previously damaged pipe (delayed failure mode such as dents and/or gouges); see ASME B31.8, para. 851.4.2 and Nonmandatory Appendix R, para. R-2
Pipe = defective pipe
Pipe Seam = defective pipe seam
SCC = stress corrosion cracking
Seal/Pack = seal/pump packing failure
Strip/BP = stripped thread/broken pipe
TPD(IF) = damage inflicted by first, second, or third parties (instantaneous/immediate failure)
Vand = vandalism
WB/B = wrinkle bend or buckle

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8 Integrity Management Plan

- Risk Assessment – prioritize activities at locations
- Repair – recoat, support, or replace, the pipe
- Prevent future deterioration
  - Not all can be addressed by inspections
  - Prevention of third party damage
  - Prevention of outside force damage
  - Review for like similar segments
  - Update the plan

9 Performance Plan

- Show improved integrity - Lagging easiest (reactive), Leading (proactive) are harder
  - Simple, measureable, attainable, relevant, timely; industry based
- Show effectiveness, and improvements

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Table 9.2.3-1 Performance Measures

Measurement Category	Lagging Measures	Leading Measures
Process/activity measures	Pipe damage found per location excavated	Number of excavation notification requests, number of patrol detects
Operational measures	Number of significant ILI corrosion anomalies	New rectifiers and ground beds installed, CP current demand change, reduced CIS fault detects
Direct integrity measures	Leaks per mile (km) in an integrity management program	Change in leaks per mile (km)

10 Communications Plan

- Consider API 1162 public Awareness Programs for Pipeline Operations as a beginning
- External Communications
  - Landowners and tenants, the neighbors especially identified sites, and interacting consequences
  - Public Officials and Emergency Responders, locating identified sites, emergency response leaders
  - Public to help protect people, property assets, and the environment
- Internal Communications
  - Up and to the field who need the inputs to help do their jobs

11 Management of Change

- Formal Procedure
- Not the exceptions which are a one off signed off deviation - different
- Address technical physical, procedural, and organizational changes to the system
  - Reason, implications, sign off, communication, time limitation, qualifications, documentation

12 Quality Control Plan

- Documented Proof that the requirements and activities were met
  - Monitor, analyze, and control to meet planned results
    - Materials, construction, operations activities
    - Employees and contractors, and their responsibilities
    - Periodic internal or third party audits
    - Corrective actions documented and effectiveness monitored

Appendix A: outlines the requirements for each of the Nine Prescriptive Threats

1. External Corrosion (suggests API 1110 Hydrotesting, API 11163 ILI, and NACE SP 0502 ECDA
2. Internal Corrosion (also NACE SP 0206 ICDA
3. Stress Corrosion Cracking (also NACE SP 0204
4. Manufacturing (pipe and seam)
5. Construction (Girth Weld, Wrinkles, Buckles, Threads, Couplings)
6. Equipment (Gaskets, seals, packing, controls, relief)
7. Third party Damage (Immediate, vandalism, previously damaged)
8. Incorrect Operations (not just control room but expanded)
9. Weather Related and Outside Force (Earth movement, Hydrogeological, Lightning, Excessive Heat or cold)

Example of the Minimum ECDA Data Expected

(a) year of installation
(b) coating type
(c) coating condition
(d) years with adequate cathodic protection
(e) years with questionable cathodic protection
(f) years without cathodic protection
(g) soil characteristics
(h) pipe inspection reports (bell hole)
(i) MIC detected (yes, no, or unknown)
(j) leak history
(k) wall thickness
(l) diameter
(m) operating stress level (% SMYS)
(n) past hydrostatic test information

API, NACE and other Standards
contain examples of data collection requirements

Questions

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