Transmission Pipeline Repair Methods

Appalachian Underground Corrosion Short Course

PRESENTED BY ROB SHOAF, P.E.
NACE CP SPECIALIST
MAY 17, 2011
COURSE OUTLINE

I. Introduction – Why & What
II. Code
III. Evaluation of pipe
   A. Types of Anomalies
   B. Methods of Analysis
IV. Repair Methods
   A. Split sleeve
   B. Composite sleeve
   C. Clamp
V. Safety
VI. Economics
VII. Products
VII. Questions & Closing Remarks

WHY DO WE NEED THE ABILITY TO REPAIR A PIPELINE?

- Public safety
- Operational restriction or loss of service
- Economics
Interstate (between or among states) natural gas and hazardous liquid pipelines are governed by the 49th Code of Federal Regulations (CFR) Parts 190-199.

Intrastate (within states) natural gas and hazardous liquid pipelines are governed by the states in which they reside, most of the time each state adopts the federal code.

For Natural Gas Pipelines the applicable parts of the 49th CFR Part 192 – Subpart M (Maintenance) are as follows:

§ 192.703(a,b,c) – The Options
§ 192.709(a) – Record Keeping
§ 192.711(a,b) – Public Safety
§ 192.713(a,b) – Repair of Damage or Imperfections
§ 192.715(a,b,c) – Repair of Welds
§ 192.717(a,b,c) – Repair of Leaks
§ 192.703(a) – “No person may operate a segment of pipeline, unless it is maintained in accordance with this subpart.”

§ 192.703(b) – “Each segment of pipeline that becomes unsafe must be replaced, repaired, or removed from service.”

§ 192.703(c) – “Hazardous leaks must be repaired promptly.”
FEDERAL CODE – RECORD KEEPING

§ 192.709 – Each operator shall maintain the following records for transmission lines for the periods specified:

(a) The date, location, and description of each repair made to pipe must be retained for as long as the pipe remains in service.

FEDERAL CODE – PUBLIC SAFETY

§ 192.711(a, b)

(a) Each operator shall take immediate temporary measures to protect the public whenever:

   (1) A leak, imperfection, or damage that impairs its serviceability is found in a segment of steel transmission line operating => 40% of SMYS.
   (2) It is not feasible to make a permanent repair at the time of discovery. As soon as feasible, the operator shall make permanent repairs.

(b) Except as provided in § 192.717(b)(3), no operator may use a welded patch as a means of repair.
FEDERAL CODE – REPAIR OF DAMAGE OR IMPERFECTIONS

§ 192.713(a, b)

(a) Each imperfection or damage that impairs the serviceability of pipe in a steel transmission line operating at or above 40% SMYS must be –

(1) Removed by cutting out and replacing a cylindrical piece of pipe; or
(2) Repaired by a method that reliable engineering tests and analyses show can permanently restore the serviceability of the pipe.

(b) Operating pressure must be at a safe level during repair operations.

FEDERAL CODE – REPAIR OF WELDS

• § 192.715(a, b, c) – Each weld that is unacceptable under § 192.241(c) must be repaired as follows:

– (a) If it is feasible to take the segment of transmission line out of service, the weld must be repaired in accordance with the applicable requirements of § 192.245.

– (b) A weld may be repaired in accordance with § 192.245 while the segment of transmission line is in service if:

• (1) The weld is not leaking;
• (2) The pressure in the segment is reduced so that it does not produce a stress that is more than 20% of the SMYS of the pipe; and
• (3) Grinding of the defective area can be limited so that at least 1/8-inch (3.2 millimeters) thickness in the pipe weld remains.

– (c) A defective weld which cannot be repaired in accordance with paragraph (a) or (b) of this section must be repaired by installing a full encirclement welded split sleeve of appropriate design.
• § 192.717(a,b,c) – Each permanent field repair of a leak on a transmission line must be made by –
  – (a) Removing the leak by cutting out and replacing a cylindrical piece of pipe; or

(b) Repairing the leak by one of the following methods:
   (1) Install a full encirclement welded split sleeve of appropriate design, unless the transmission line is joined by mechanical couplings and operates at less than 40 percent of SMYS.
   (2) If the leak is due to a corrosion pit, install a properly designed bolt-on-leak clamp.
   (3) If the leak is due to a corrosion pit and on pipe of not more than 40,000 psi (267 MPa) SMYS, fillet weld over the pitted area a steel plate patch with rounded corners, of the same or greater thickness than the pipe, and not more than one-half of the diameter of the pipe in size.
FEDERAL CODE – REPAIR OF LEAKS (CONTINUED)

(4) If the leak is on a submerged offshore pipeline or submerged pipeline in inland navigable waters, mechanically apply a full encirclement split sleeve of appropriate design.

(5) Apply a method that reliable engineering tests and analyses show can permanently restore the serviceability of the pipe.

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EVALUATION OF PIPE

§ 192.485(a,b,c)

(a) General Corrosion. Each segment of transmission line with general corrosion and with a remaining wall thickness less than that required for the MAOP of the pipeline must be replaced or the operating pressure reduced commensurate with the strength of the pipe based on actual remaining wall thickness. However, corroded pipe may be repaired by a method that reliable engineering tests and analyses show can permanently restore the serviceability of the pipe. Corrosion pitting so closely grouped as to affect the overall strength of the pipe is considered general corrosion for the purpose of this paragraph.
§ 192.485 (a,b,c)
(b) *Localized corrosion pitting.* Each segment of transmission line pipe with localized corrosion pitting to a degree where leakage might result must be replaced or repaired, or the operating pressure must be reduced commensurate with the strength of the pipe, based on the actual remaining wall thickness in the pits.

(c) Under paragraphs (a) and (b) of this section, the strength of pipe based on actual remaining wall thickness may be determined by the procedure in ASME/ANSI B31G or the procedure in AGA Pipeline Research Committee Project PR 3-805 (with RSTRENG disk). Both procedures apply to corroded regions that do not penetrate the pipe wall, subject to the limitations prescribed in the procedures.
REPAIR METHODS

A. Split sleeve
B. Composite sleeve
C. Clamps

Do a pro/con list of each (split sleeve that is a Class A and isn’t welded up can have water migrate in and out).

CAUTION: Not all repair methods are compatible with all anomalies (i.e. composites with cracks).

ACCEPTABLE THREAT PREVENTION AND REPAIR METHODS

Table 4 - Acceptable Threat Prevention and Repair Methods (Cont’d)

<table>
<thead>
<tr>
<th>Prevention, Detection, and Repair Methods</th>
<th>Fluidity Storage</th>
<th>Corrosion</th>
<th>Radiation</th>
<th>Equipment</th>
<th>Biological</th>
<th>Inorganic</th>
<th>Nonmetallic</th>
<th>Mechanical</th>
<th>Operation</th>
<th>Damage</th>
<th>Material</th>
<th>Construction</th>
<th>Inspection</th>
<th>Criteria</th>
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<tbody>
<tr>
<td>Repair</td>
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<td>Composite sleeve</td>
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</table>

GENERAL NOTE: The abbreviations found in Table 4 relate to the 21 threats discussed in sars. Explanations of the abbreviations are as follows:

Crt/Col = Control/Colliion Equipment Malfunction
CpR = Coupling Failure
FWS = Field Weld Joint
G = Gas Monitor
ID = Internal Inspection
InP = In-Plant Operations
M = Mutiny
P = Pressure
Pipe = Pipeline
Sec/Val = Security/Valve
Sic = Sudden Cessation
Slt = Sudden Loss
St = Stabilized String
Sw = Swelled String/Stranded Pipe
Th = Throttled/Throttled String
W = Weather
Wd = Weakening
Wtr = Water
EVALUATE THE SITUATION

• Is the line in service?
• Can the line be taken out of service?
• Does the line need to be taken out of service?
• Does the pressure need to be reduced?
• What temperatures exist on the pipeline?
• Are ambient temperatures hot or cold?
• Is it wet or dry?
• How quickly does the repair need to be made?
• What are the resources available?
• Are there cracks?
• Is there a leak?
• Does your O&M manual cover pipeline repairs?
• Long term can you certify people on a product?

METHODS OF ANALYSIS

ASME B31G

RSTRENG
Transmission Pipeline Repair Methods
(AUCSC - 5/18/2010) pointIntegrity.com

This program calculates the maximum allowable pit length and safe operating pressure.

THE INFORMATION BELOW IS REQUIRED TO PERFORM THE CALCULATIONS:

STATION NUMBER:
CORROSION PIT DEPTH, INCHES:
CORROSION PIT LENGTH, INCHES:
NOMINAL WALL THICKNESS, INCHES:
NOMINAL DIAMETER OF PIPE, INCHES:
YIELD STRESS, PSI (< 10000):
CLASS LOCATION (0, 1, 2, 3, 4):
<TOAD CROSSINGS - 0>:
DO YOU WANT A PRINTOUT? (Y/N):

according to the information provided by you
and the ASME GUIDE MATERIAL APPENDIX G-8 (1983)

LOCATION OF PIT:
STATION NUMBER:
NOMINAL PIPE DIAMETER:
YIELD STRESS (ksi):
CLASS LOCATION:
NOMINAL WALL THICKNESS:
DEPTH OF PIT:
LENGTH OF PIT:
CALCULATED MAXIMUM ALLOWABLE PIT LENGTH:
DESIGN MAX:

*************** CONCLUSION ***************

* THE ACTUAL PIT LENGTH EXCEEDS THE CALCULATED MAXIMUM *
* ALLOWABLE PIT LENGTH. THE ASME GUIDE SAYS THE MAXIMUM *
* SAFE PRESSURE FOR THE CORRODED AREA IS 54 PSI. *
* ANY REDUCED MAX SHOULD BE VERIFIED AND APPROVED BY *
* DIVISION MANAGER AND VICE PRESIDENT OF TRANSMISSION. *

CALCULATIONS PERFORMED BY:
DATE 05/18/04 TIME 02:06:05

Press any key to continue...
Transmission Pipeline Repair Methods

(AUCSC - 5/18/2010)

pointIntegrity.com

<table>
<thead>
<tr>
<th>Case</th>
<th>Effective Area</th>
<th>Pressure, psi (×)</th>
<th>Predicted Burst Pressure, psi</th>
<th>Safety Factor</th>
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<td>604</td>
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</tbody>
</table>

**Notes:**
- Diameter, inches = 30.000
- SMLS, psi = 52,000
- Total Length, inch = 20.00
- Eff. Length, inch = 13.00
- Start, inch = 8.00
- Stop, inch = 21.00

(*) If the calculated safe maximum pressure for the criteria that the user follows (CASE 1, CASE 2, or CASE 3) is less than the established pressure, remedial action must be taken.
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SAFETY

• Excavation safety – trenching and shoring - follow 29th CFR Part 1926 Subpart P
• Personnel safety – dig under pressure or not?
• Air permits, environmental permits, city land permits, Corps of Engineers permits, County permits, State permits
• Notifications to DOT, FERC, EPA, Local Emergency Response Committees, NTSB, NRC, State and Local Officials, etc.

ECONOMICS

• Each case must be individually evaluated to choose the best choice. Of course, if throughput is adversely affected the quickest and safest option is the best.
• Due to the amount of DOT approved choices today there are many different possibilities that weren’t there just 5-10 years ago.
WEBSITES…(DO SOME RESEARCH!)

Search on Pipeline Repair:
- Aquawrap http://www.corrodefense.com/
- Clockspring m-tec http://www.pipelineintervention.com/repair.htm#
- Mid-States http://www.mid-states-pipe-repair.com/
- PermaWrap by WrapMaster http://www.wrapmaster.us/
- Steel Works http://www.steelworks.ca/pipelinerep.html
- Tecnomarine http://www.pr67.dial.pipex.com/clamp.htm
- Tekmar http://www.tekmar.co.uk/equipment_prc.shtml

QUESTIONS AND ANSWERS

• What was left out that you would like to see contained in this presentation?
• What questions do you have that were not answered?
• Suggestions for improvement?

Recommend a course by Keiffner or Rosenfeld on ASME B31.8.
Thank You