Pipeline Construction Challenges

NAPCA Workshop
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PHMSA Mission

- To ensure the operation of the Nation’s pipeline transportation system is:
  - Safe
  - Reliable
  - Environmentally sound
Incidents (2002-2009)
Incidents (2002-2009)
Incidents

- 2007
- Natural Gas
- Excavation
- 1 fatality
Incidents

- 2007
- Natural Gas
- 30-inch
- Corrosion
- 1 fatality
Incidents

- 2007
- Natural Gas
- 30-inch
- Selective Seam Corrosion
- High Resistivity Soils
- No injuries
Incidents

- 2007
- 12 inch HVL
- LF-ERW Seam
- 2 fatalities
Incidents

- 2008
- Natural Gas
- 30-inch
- Excavation
- 5 injuries
New Construction Issues Observed by PHMSA Inspectors

- Coating: Occurrences
- Welding: Occurrences
- Excavation: Occurrences
- NDT: Occurrences
- Pipe: Occurrences
- Steel: Occurrences
- Bending: Occurrences
- Lowering: Occurrences
Observed Coating Issues
Backfill before Coating has Cured
Patch Stick: Inadequate Adhesion
Coating Over Tape
Coating Disbondment
Backfill Damage
Coating Over Dirt/Debris
Welding Band Damage
Pipe Quality Issues

- Low strength X70 & X80
- Inconsistent chemical and mechanical properties
- Poor mill rolling practices
- Advisory Bulletin (PHMSA 2009-1048)
Girth Weld Failures

Radiographic Weld Inspection

Hydrostatic Testing
Hydrogen Cracking

- Hydrogen
- Microstructure
- Tensile Stress
Hydrogen Cracking Risk by Electrode Type

Increasing Risk

E9010
E8010
E7010
E6010
FCAW (flux-cored)
E9018
E8018
E7018
GMAW (MIG)

- Cellulosic
- Low Hydrogen
Susceptible Microstructure (Hardness)

- Historically, values > 350 HV should be evaluated for the risk of hydrogen assisted cracking
- Cracking observed at 200 to 260 HV
Hydrogen Cracking

- Thru-thickness Repair
- Partial-thickness Repair
- Transitions
- Tie-ins

Full thickness repair of mechanized weld
Partial Thickness Repair:
Only 1 Cellulosic Weld Pass

Low Hydrogen Weld Metal

Mechanized GMAW

9018-M

9018-M

9010

Repair

6:00
Partial Thickness Repair: Cellulosic & Low Hydrogen
Self-shielded Flux-Cored Transition

81T8 (FCAW-S) Fill & Cap
9018-M Hot
6010 Root
6010 Backweld
Weld Preheat

- Heat entire circumference, especially 12:00 & 6:00 locations

- Measure temperature immediately before start of every weld pass using:
  - Temperature Indicating Crayons
  - Contact Pyrometer
  - Infrared Thermometer (reading depends on surface condition and distance)
Girth Weld Issues

- Transitions
- Misalignment
- Cut Induction Bends
Improper Weld Transitions

ASME B31.8 Fig. I-5
Misalignment
Alignment – Does this meet API 1104?

7.2 ALIGNMENT

The alignment of abutting ends shall minimize the offset between surfaces. For pipe ends of the same nominal thickness, the offset should not exceed 1/8 in. (3 mm). Larger variations are permissible provided the variation is caused by variations of the pipe end dimensions within the pipe purchase specification tolerances, and such variations have been distributed essentially uniformly around the circumference of the pipe. Hammering of the pipe to obtain proper lineup should be kept to a minimum.
Bends & Fittings

Bend fittings
Hot induction bends

• If cutting bends, use **segmentable** bends with tighter body tolerance

• Ends should meet:
  - API 5L dimensional limits
  - API 1104 fit-up requirements

Hot induction bend cross-section
Weld Misalignment at Cut Bend
Best Practice: Shop fabricated bend assembly
Lowering In Stress

• Maximum weld stress occurs during lowering in
• Most weld failures at top & bottom of pipe
Industry Actions

- Workshops
- Pipe Quality Work Groups (8 work groups)
- Construction Work Groups (5 work groups)
- Standards updates

PHMSA is appreciative of industry efforts
API 5L

- Proposed changes to reduce potential for non-conforming pipe
- Quality management system (QMS) for steel mill & rolling mill
- Tensile test & bracket retest locations in coil/plate
- Traceability of pipe to coil/plate
- Enhanced Manufacturing Procedure Specification (MPS)
  - Applies to steel mill, rolling mill, & pipe mill
- Enhanced Manufacturing Procedure Qualification Test (MPQT)
  - Test of initial production to qualify MPS. Includes assessment of coil/plate tensile property variability and coil/plate to pipe strength changes
- New - Inspection and Test Plan (ITP)
API 1104 Appendix A

- Guidance for ECA & lowering-in stresses
- Retests for Charpys & crossweld tensiles
- Consideration for weld misalignment
- Weld Procedure Essential Variable. A change in the:
  - Steel mill (slab, ingot, etc.)
  - Rolling mill (plate, coil)
  - Pipe mill (manufacturing facility)
  - Pipe manufacturing process (UOE, spiral, ERW, etc.)
  - Chemical composition limits (Pcm, CE, C)
API 1104 Repair Task Group

- Backweld, multiple, & double repairs
- Repair length (minimum & maximum)
- Hardness testing
- NDT delay
- Preheat & Postheat
- Procedure qualification
- Welder qualification
API 5L/1104 Joint Task Group

- Misalignment & dimensional tolerances
- Tensile test orientation
- Residual magnetism
- Identification of steel/rolling mill
- Multiple grades & strength limits
Recent PHMSA Actions

April 2009: PHMSA New Construction Workshop
May 2009: ADB: Potential Low & Variable Yield & Tensile Strength & Chemical Composition Properties in High Strength Line Pipe
June 2009: PHMSA Letter to Industry Trade Associations
Summer 2009: Letters to Alt MAOP SP holders on Low Strength Pipe
Spring/Fall 2009: Worked with operators to identify and remove low strength pipe
August 2009: Construction web site established
March 2010: ADB: Girth Weld Quality Issues Due to Improper Transitioning, Misalignment, and Welding Practices of Large Diameter Line Pipe
April 2010: Distribution Construction Workshop
Looking Ahead

- Continued focus on construction inspections
- Expect increased enforcement actions on construction issues – for 72% SMYS and 80% SMYS pipelines
Since 2007, the pipeline industry has been experiencing unparalleled growth driven by the need to satisfy the Nation's energy demand and bring new sources of supply to the market. As a result, PHMSA has stepped up the number of new pipeline construction inspections performed each year and our inspections of these new pipeline projects have discovered a number of issues that if left unresolved could have an impact on the long and short term integrity of the pipeline.

Many of these new pipeline construction projects have applied for special permits to deviate from PHMSA regulations. When PHMSA has approved requested special permits we have required the operator to go above and beyond our current regulatory requirements to prove and maintain both short and long term pipeline integrity. Many issues have been discovered that could have impacted pipeline integrity as a result of these special permit conditions of approval required by PHMSA. Through new construction inspections, performed during the 2008 pipeline construction season, PHMSA inspectors discovered issues requiring immediate operator remediation prior to the pipeline being placed in service or requiring pressure reduction to assure pipeline integrity. Issues discovered during PHMSA inspections have included poor quality control and procedures for welding, coating, and materials; as well as inadequate operator inspection and general construction practices.

PHMSA has met with operators constructing new pipelines on several occasions to discuss issues found during inspection. In an effort to reach out to all member of the pipeline industry, PHMSA hosted a workshop in collaboration with our State partners, the Federal Energy Regulatory Commission (FERC) and Canada’s National Energy Board (NEB) in April 2009. The objective of the workshop was to inform the public, alert the industry, review lessons learned from inspections, and to improve new pipeline construction practices prior to the 2009 construction season. This website makes available information discussed at the workshop and provides a forum in which to share additional information about pipeline construction concerns. This workshop focused on transmission pipeline construction, a workshop to address distribution pipeline construction will be held in the first quarter of 2010.

In 2009, PHMSA challenged industry leaders to come up with a plan or practice to resolve these issues. A letter was sent by PHMSA to industry trade groups to
PHMSA – Links

• Pipeline Safety Guidance – Advisory Bulletins, Low Strength Pipe Guidelines, MAOP Rule FAQs

• Construction Issues

• MAOP Rule – FAQs

• Special Permits – FAQs
Thank you

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QUESTIONS