Working Group 5
Design/Materials/Welding-Joining & Valves

WG Leader: Jim Fekete and Yong-Yi Wang
Facilitators: Ken Lee and Steve Nanney

Attendance Breakdown

Approximate total attendance	# 24
Federal Regulators	# 2
State Regulators	# 2
International Regulators	# 0
Pipeline Industry/Service Providers	# 8
Standard Developing Organizations	# 2
Researchers	# 9
Academics	# 1
Other	# 0

Top 6 Identified R&D Gaps

Gap #1 – **Strain-based design and assessment (SBDA) of segments of pipelines with and without fittings**
Technology, General Knowledge, guidelines/standards

Gap #2 – **Interaction of high longitudinal strain and anomalies from corrosion and mechanical damage**
Technology, General Knowledge, guidelines/standards

Gap #3 – **Effects of hydrocarbon permeation on plastic pipe strength and fusion performance**
Technology and general knowledge

Top 6 Identified R&D Gaps

Gap #4 – **Advanced pipeline sensing (line break detection) systems**
Technology, General Knowledge, guidelines

Gap #5 – **Characterization of linepipe toughness for fracture arrest assessment of modern high toughness steels**
Technology, standards

Gap #6 – **Fatigue study of steels and welds in hydrogen environment**
Technology and standards

Associated Details
(Gap #1)

Strain-based design and assessment (SBDA) of segments of pipelines with and without fittings

New or Revised Consensus Standards (standards, guidelines or recommend practices)

a. Does the need address safety or specification related consensus standards? (Yes)
b. Which standard developing organization and which consensus standard name and number is affected? (ASME B31 and API)
c. What pipeline type(s) does the consensus standard target? (gas and liquids)
d. What operating environment(s) does the consensus standard target? (gas and liquids, onshore and offshore))
e. What technical details are necessary and recommended? (N/A)
f. Can any targets or timeframes be identified to complete this research? (2-3 years)

Creation and Dissemination of General Knowledge

a. What pipeline type(s) does the new knowledge target? (oil and gas)
b. What operating environment(s) does the new knowledge target? (oil and gas, onshore and offshore)
c. What technical details are necessary and recommended? (N/A)
d. Can any targets or timeframes be identified to complete this research? (2-3 years)

Associated Details
(Gap #2)

Interaction of high longitudinal strain and anomalies from corrosion and mechanical damage

New or Revised Consensus Standards (standards, guidelines or recommend practices)

a. Does the need address safety or specification related consensus standards? (Yes)
b. Which standard developing organization and which consensus standard name and number is affected? (ASME B31 and API)
c. What pipeline type(s) does the consensus standard target? (gas and liquids)
d. What operating environment(s) does the consensus standard target? (gas and liquids, onshore and offshore))
e. What technical details are necessary and recommended? (N/A)
f. Can any targets or timeframes be identified to complete this research? (2-3 years)

Creation and Dissemination of General Knowledge

a. What pipeline type(s) does the new knowledge target? (oil and gas)
b. What operating environment(s) does the new knowledge target? (oil and gas, onshore and offshore)
c. What technical details are necessary and recommended? (N/A)
d. Can any targets or timeframes be identified to complete this research? (2-3 years)

Associated Details
(Gap #3)

Effects of hydrocarbon permeation on plastic pipe strength and fusion performance

Creation and Dissemination of General Knowledge

a. What pipeline type(s) does the new knowledge target? (plastic, natural gas)
b. What operating environment(s) does the new knowledge target? (natural gas, distribution)
c. What technical details are necessary and recommended? (N/A)
d. Can any targets or timeframes be identified to complete this research? (2-3 years)

Associated Details
(Gap #4)

Advanced pipeline sensing (line break detection) systems

1. New or Improved Technology

a. What pipeline type(s) does the technology target? (steel, oil and gas)
b. What operating environment(s) would the technology operate? (oil and gas, transmission and distribution)
c. What are any functionality and or performance requirements? (very quick, no false positive)
d. What road blocks or barriers prevent the technology deployment? (None)
e. What are anticipated targets or timeframes to complete this research? (2-3 years)

3. Creation and Dissemination of General Knowledge

a. What pipeline type(s) does the new knowledge target? (oil and gas)
b. What operating environment(s) does the new knowledge target? (oil and gas, transmission and distributior
c. What technical details are necessary and recommended? (N/A)
d. Can any targets or timeframes be identified to complete this research? (2-3 years)

Associated Details
(Gap #5)

Characterization of linepipe toughness for fracture arrest assessment of modern high toughness steels

1. New or Improved Technology

a. What pipeline type(s) does the technology target? (steel, natural gas)

b. What operating environment(s) would the technology operate? (gas, transmission and distribution)

c. What are any functionality and or performance requirements? (ductility and toughness, suitable for mill production environment)

d. What road blocks or barriers prevent the technology deployment? (expensive to conduct full-scale tests and burst models)

e. What are anticipated targets or timeframes to complete this research? (5-10 years)

2. New or Revised Consensus Standards (standards, guidelines or recommend practices)

a. Does the need address safety or specification related consensus standards? (Yes)

b. Which standard developing organization and which consensus standard name and number is affected? (API 5L and 5L3)

c. What pipeline type(s) does the consensus standard target? (gas)

d. What operating environment(s) does the consensus standard target? (gas, onshore and offshore)

e. What technical details are necessary and recommended? (ductility and toughness, test suitable for mill production environment)

f. Can any targets or timeframes be identified to complete this research? (5-10 years)

Associated Details
(Gap #6)

Fatigue study of steels and welds in hydrogen environment

<u>New or Revised Consensus Standards (standards, guidelines or recommend practices)</u>
a. Does the need address safety or specification related consensus standards? (Yes)
b. Which standard developing organization and which consensus standard name and number is affected? (ASME B31.12 and B31.8)
c. What pipeline type(s) does the consensus standard target? (natural gas and hydrogen)
d. What operating environment(s) does the consensus standard target? (hydrogen, onshore and offshore (natural gas))
e. What technical details are necessary and recommended? (material fatigue data as required in B31.12 and B31.8)
f. Can any targets or timeframes be identified to complete this research? (2-3 years)

Additional Identified Gaps

Measurement of fitup of field girth weld
Develop a plastic pipe database (1) determine the types of materials in service (2) determine the material property through mechanical tests
Effect of shale gas quality on pipeline integrity
Determine impurity limits and interaction between impurities (CO2 pipelines+B9)
Advanced welding processes and filler metals for improving weld resistance to SCC and hydrogen embrittlement. Fundamental understanding of deformation and crack propagation mechanisms in gaseous environments. Fracture testing of welds to compare standard methods to torsion method (which is a rapid way to quantify the weakest location in an inhomogeneous weld)
New valve designs and flow control to address various types of systems and reduce cost of installation

Additional Identified Gaps

Enhanced computer modeling to assess pipeline rupture response and placement of valves and associated sensors
Develop proper corrosion test methods and understanding of the effect of biodiesel on corrosion of steel in the water layer that could be present underneath it. Effects on materials other than steels (seals, non-metalic materials).
Effect of dilbit on pipeline integrity
Reliability-based design
Determine effects of CO2 and its impurities on gaskets and seals (non-ferious alloy and pipeline steels)