Advanced Welding and Joining Technical Workshop

Boulder, Colorado, January 25-26, 2006

Working Group 4
Weld Maintenance and Repair

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Attendance Breakdown

Approximate total attendance	10 persons
Federal Regulators	1 persons
State Regulators	0 persons
International Regulators	0 persons
Pipeline Industry (operators)	4 persons
Pipeline Industry (vendors/suppliers)	2 persons
Standard Organizations	0 persons
Researchers	1 persons
Academics	2 persons

Working Group Meeting Plan

Day 1
1. Roundtable Introduction
2. Discuss Weld Maintenance and Repair Topics
3. Brainstorming Session

Day 2
1. Prioritization Session

WG 4 - Discussion Topics

1. Pre-Weld Planning
2. Industry Standards Considerations
3. In-the-Ditch Application
4. Quality Control
5. Other Mentionable Aspects

Topic: Pre-Weld Planning

1. Cooling rate model improvements
   - Funding necessary upgrade to PRCI's commercial product with previously developed improvements, or
   - Advances in computing technology make the creation of a brand new thermal model attractive (current models are based on old/very old thermal modeling technology)
2. Microstructure/Hardness Limits as a function of hydrogen, chemistry, and wall thickness.

Topic: Industry Standards Consideration

1. In-service welding – API 1104 Appendix B is developed, ASME guidance being developed (Post-Construction Sub Committee), CSA Z662 developed.
2. Welding procedure and welder performance qualification for weld deposition repair
   - ASME weld build-up qualified by a butt weld procedure qualification within the set of essential variables.
   - API 1104 Appendix B – under development
   - CSA Z662 requirements recently incorporated
3. Application of fillet weld in-service welding procedure to partial-penetration weld used to attach a branch pipe (weld considered fillet weld in API 1104) – issue recently resolved
4. Branch and sleeve weld design considerations
   - Weld metal strength issues for high strength pipelines

Topic: In-the-ditch Application

1. Weld Deposition Repair
   - In-service versus out-of-service maintenance
2. Heat Input control – run out ratio method and validation
3. In-service Welding Processes
4. Type A versus Type B (pressure containment)
   - Sealing of Type A – steel sleeve ends (thick layer of epoxy paint)
   - Cathodic Protection Issues?
5. Chemical analysis difficulties, lack of chemical composition data
   - Justification for use of company or industry database(s)
   - New in-situ tools for analysis – what can we do?
6. Weld Deposition Repair Discussion
   - Acceptability of WDR on or adjacent to weld seams, Long. and/or girth. Standardizing the training.

Topic: Quality Control

1. Low-hydrogen welding electrode QC. Completed PRCI work, issue is technology transfer. PRCI's Pipeline Repair Manual
2. Welding procedure/guidance implementation in-the-ditch, knowledge transfer, training.
3. Heat Input level control. (Is there a need for recommended practice for welder training manual for in-service welding)

Topic: other mentionable aspects

1. Technology transfer of expert system rollout to broad spectrum of operators/regulators
2. Welded repair of sub-sea pipelines
3. Application of wet welding for pipeline maintenance
4. Better distribution of PRCI knowledge.

Top 3 Identified Goals

Goal #1 – Improve Methods of Technology Transfer

- Better ways of informing operators of results of completed research and industry practices (e.g., manuals, notes for guidance documents, websites, training courses, videos, interactive CD-ROMs)

Goal #2 – Further Develop Understanding of Metallurgical Factors that Affect Hydrogen Cracking

- Microstructure/hardness limits as a function of hydrogen, chemistry, and wall thickness
- Methods for determining chemical composition of in-service pipelines (e.g., database development, development of new analytical methods, etc.)

Goal #3 – Develop Better Predictive Models for Pre-Weld Planning

- Cooling rate/microstructure/hydrogen model for predicting hydrogen cracking
- Thermo/mechanical model for predicting burnthrough

Associated Actions
(Goal #1)

Improve Methods of Technology Transfer

Regulatory

1. None required

Technology

1. None required for completed research
2. Continue to disseminate new technology as developed (ongoing)

Consensus Standards

1. Continue to incorporate research results into consensus standards (ongoing)
2. Provide support for technology developers for incorporation of research results (?)

General Knowledge

1. Yes! – Develop technology transfer mechanisms (near term - the sooner the better and ongoing)

Associated Actions
(Goal #2)

Further Develop Understanding of Metallurgical Factors that Affect Hydrogen Cracking

Regulatory
1. None required

Technology
1. Yes! - Develop Understanding of Metallurgical Factors (1-3 years)

Consensus Standards
1. Incorporate results into consensus standards (upon completion)

General Knowledge
1. As required

Associated Actions
(Goal #3)

Develop Better Predictive Models for Pre-Weld Planning

Regulatory
1. None required

Technology
1. Yes! - Develop better predictive models (1-3 years)

Consensus Standards
1. Refer to better predictive models in consensus standards (following development)

General Knowledge
1. As required

Additional Identified Goals - 1

- Weld deposition repair on or adjacent to girth and seam welds
- Training and certification of welding inspectors for in-service welding
- Availability of high CE pipe material for procedure qualification
- In-service welding on pipelines that are and have been in hydrogen service, recognized as a long term issue.

Additional Identified Goals - 2

•For others, see:

Grace, Paul, “In-Service Welding of Pipelines – Industry Action Plan,” IIW Asian Pacific International Congress, Welding Technology Institute of Australia, Melbourne, Australia, November, 2000.

•Paper describes the development and current status of an industry action plan for in-service welding of pipelines (many still relevant in 2006)
•Issues were identified during the First International Conference on Welding onto In-Service Petroleum Gas And Liquid Pipelines, Wollongong, Australia, March 2000.
•Action plan pertains to issues that need further research, other issues that do not require research, and expert technology tools.