Welding and Repair Workshop

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January 24, 2006

Repair Considerations

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Mechanical Repair Fitting (MeRF)

- Program Objectives
  - "The program will develop a simple, mechanical device that can be installed on a 4" PE pipe under system operating pressures of up to 60 psig."**
  - Through an iterative design and development exercise, the overall program objectives have been successfully satisfied

**Mechanical Repair Sleeve for Polyethylene Pipe Proposal - May 2002

MeRF - Benefits

- The fitting provides a permanent repair to damaged and/or gouged PE pipe
- Damage can be mitigated simply, quickly and cost effectively
- Pressure is maintained during repair, minimizing customer interruptions*
- Potential for use on suspect butt heat fusion joints

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MeRF - Product Definition (1/2)

- Size: 4 IPS (primary focus based on industry feedback)
- Initial MAOP of 60 psig @ 73ºF. Pressures up to 125 psig ultimate target desired
- Shell to be a thermoplastic material meeting the requirements of ASTM D2513.
- Nominal fitting length to between 12” and 20”.
- Venting capability, built into the MeRF so the fitting can be safely applied to a perforation, and vented while it is being secured over the damage
- Hardware to be a proven corrosion resistant material.

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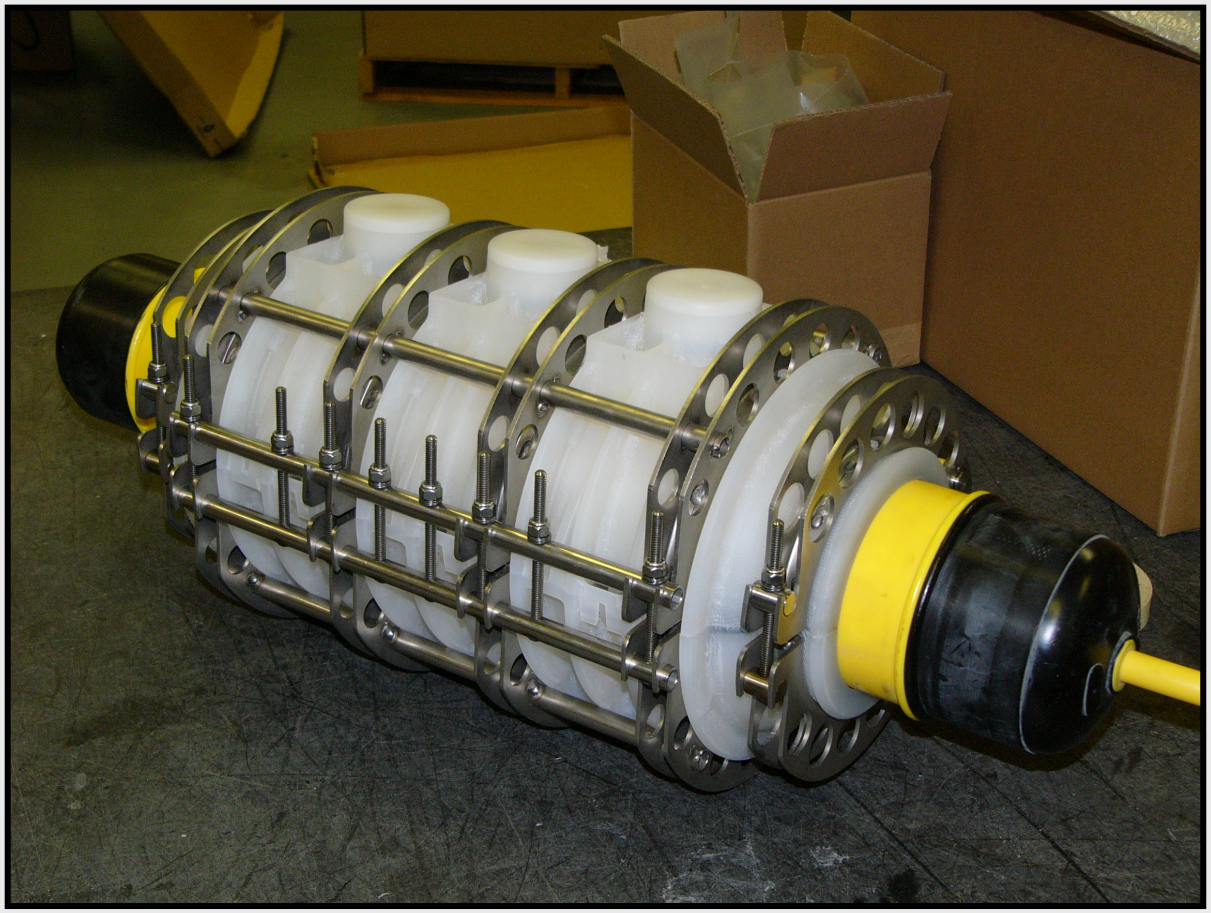
MeRF - Product Definition (2/2)

- Able to manually install on pipe with blowing gas at 60 psig.
- Able to cover a protrusion from the pipe outside surface of up to ¾ inch.
- Damage not to exceed 1/3 the circumference.
- Maximum damage created by a backhoe tooth (2” X 2”) on 4” IPS pipe
- Ensure the mitigation of slow crack growth within the fitting*

MeRF - Prototype Generation III



Mechanical Repair Fitting

- Summary
  - Through iterative design, development and testing, “a proven Mechanical Repair Fitting prototype that can be installed on a 4” PE pipe under system operating pressures of up to 60 psig” **<u>has been developed!!!</u>**
  - Comprehensive testing to ensure conformity to existing Industry/ASTM standards for gas distribution applications are on-going

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Joining Considerations and Increase in Design Factor

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Increase in Design Factor (3/36)

- Background
  - Unprecedented increase in use of Polyethylene (PE) materials
  - PE piping systems have served the gas distribution industry well for over 40 years and continue to do so
  - Continued improvements with respect to overall performance properties of modern PE materials
  - Tremendous interest to utilize plastic piping infrastructure to its maximum potential
    - Larger diameters, Increased pressures, Capacity
    - Previous AGA sponsored petition to increase operating pressure to 125 psig has been approved
- Promote code changes without sacrificing safety

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Increase in Design Factor (5/36)

- Program Objective
  - Comprehensive approach and data development to establish technical justification and support for the petition to increase the design factor for PE piping systems
    - Phase I: Develop minimum material performance based requirements and investigate additional design considerations to justify an increase in design factor (2004)
    - Phase II: Testing and evaluation to validate impact on pertinent construction and operating practices (2005-2006)
    - Phase III: Targeted field installations under waivers and proposed rulemaking initiative Ensure that the overall safety and system integrity are not adversely compromised (2005-2006)

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Increase in Design Factor (7/36)

> Implications for an Increased Design Factor

(A) Use of PE piping at higher pressures

(B) Use of thinner wall PE piping for same operating pressures

(A)

DF = 0.32

$$p = \frac{2*1600}{11-1} \times 0.32$$

$$p = \frac{3200}{10} \times 0.32$$

$$p = 102.4\,psig$$

DF = 0.40

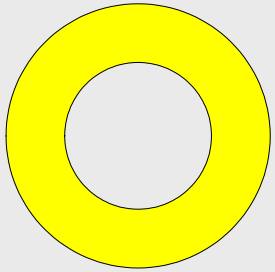
$$p = \frac{2*1600}{11-1} \times 0.40$$

$$p = \frac{3200}{10} \times 0.40$$

$$p = 128\,psig$$

(B)

SDR 11

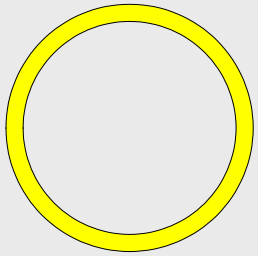


$$p = \frac{2*1600}{11-1} \times 0.32$$

$$p = \frac{3200}{10} \times 0.32$$

$$p = 102.4\,psig$$

SDR 13.5



$$p = \frac{2*1600}{13.5-1} \times 0.40$$

$$p = \frac{3200}{12.5} \times 0.40$$

$$p = 102.4\,psig$$

Increase in Design Factor (33/36)

- Phase II: Construction, Maintenance, and Operating Practices (2005)
  - Objective:
    - Perform comprehensive testing to develop best practices for plastic piping systems at higher hoop stress and/or with thinner wall thickness for pipe sizes ranging from ½” to 12”
      - Evaluation of joint integrity
      - Flow Control
      - Effects of external loads

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IDF – Phase II

> Evaluation of Saddle Heat Fusion

– Characterize propensity for “blow-out” – PPI TN-20-00b

Polyethylene service/branch saddles and self-tapping tees are fused to live (pressurized) PE mains in order to establish a branch connection. Under a 0.40 DF, the allowable hoop stress in the pipe wall is 25% greater compared to the hoop stress permitted with a 0.32 DF. While long-term pressure rating is not a concern, PPI and its member companies are concerned that higher hoop stress in the pipe wall will increase the potential for gas main blowout during the process of fusing these branch connection type fittings to the pipe.

– Prepare saddle fusion joints in accordance to PPI TR-41

Heater Adapter Surface Temperature	500°±10°F
Initial Interfacial Pressure	60±6 psi
Heat Soak Interfacial Pressure	0 psi
Fusion Interfacial Pressure	30±3 psi
Total Heating Time on Main—1 _” IPS Pressure Main	15 seconds max.
Total Heating Time on Main-- 2” IPS Pressure Main	25-35 seconds max.
Total Heating Time on non-pressure 1 _” IPS, 2” IPS mains, and on pressure or non-pressure 3” IPS and larger mains.	Look for a 1/16” bead around the fitting base

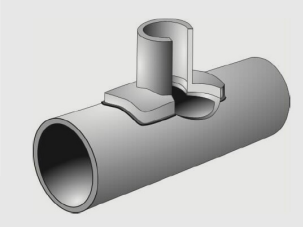

Figure 3 Standard Sidewall Fusion Joint

IDF – Phase II

- Evaluation of Electrofusion Joints (Couplings/Saddles)
  - Characterize propensity for “blow-out” similar to saddle fusion
  - Prepare pipe/fitting assemblies per prescribed procedures using a universal box
  - Proposed Testing per ASTM F1055
    - Quick Burst
    - Sustained pressure testing
    - Tensile Strength (Couplings only)
    - Impact Resistance (Saddles only)
    - Joint Integrity

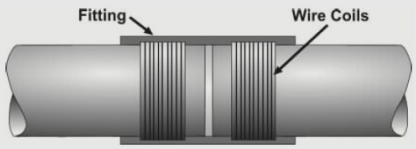

Figure 5 Typical Electrofusion Joint

IDF – Phase II

- Cooperative program with leading gas utility companies, regulatory staff, manufacturers, and research organization to ..
  - Phase I: Develop minimum material performance based requirements to justify an increase in the design factor within Title 49 CFR Part 192 requirements **(2004)**
  - Phase II: Comprehensive testing to characterize impact on pertinent construction and operating practices **(2005)**
  - Phase III: Targeted field demonstrations to evaluate effects of various geographic and climatic influences **(2006)**
- Provide technical justification for DOT to facilitate a change to Part 192 requirements

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