the Energy to Lead

Technologies to Repair Gouges, Cracks and Anomalies in High Pressure Plastic Pipelines

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## **Gouges and Cracks in Plastic Pipe**

- > Successful technologies for repairing damage to high pressure plastic pipelines will entail working through several methodical steps:
  - A methodology to properly quantify the wall stress induced by different configurations of damage to the wall of non-metallic pressure pipe (PE, PA, Composites)
  - Formal process to quantify the total risk to public safety due to pipe wall damage together with interacting environmental, service and material conditions - <u>Threat Interactions</u>
  - Identifying new technologies that can be used to repair plastic pipe damage
  - Conducting initial feasibility studies for the most promising new plastic pipe damage repair technologies

## **Pipe Stresses Induced by Damage**

#### > Need

 There is a need to publish an authoritative index of the stress fields associated with different defect geometries in plastic and other non-metallic pipe that properly accounts for viscoelastic behavior.

#### > Status

- There are published works based on fracture mechanics and sharp cracks that challenge the suitability of a 10% pipe wall gouge depth for larger diameter pipe
- There are published methodologies for conducting precise viscoelastic stress analyses that are not commonly used



$$K = Y \sigma^{\infty} \sqrt{\pi a}$$



## **Pipe Stresses Induced by Damage**

#### > Additional Research Needs

 Use state-of-the-art methods to compile the appropriate tables and equations to allow the fitness for service of damaged plastic and non-metallic pipe to be assessed





Jorgen Bergstrom, Ph.D., Advanced FEA Modeling of Polymers, Veryst Engineering, LLC., 2012

# **Survey Typical Plastic Pipe Damage**

#### > Additional Research Needs

- Collect an extensive sample of damaged plastic pipe from operators, manufacturers and other sources
- Conduct 3-D scans of the damage
- Prepare statistical distributions of damage geometry
- Prepare probabilistic distributions of likelihood of failure due to typical in-field damage to plastic pressure pipe

A. Frank, Fracture Mechanics Based Lifetime Assessment and Long-term Failure Behavior of Polyethylene Pipes, Ph. D dissertation, University of Leoben, 2010



### **Emerging Technologies for Plastic Pipe Damage Repair**

#### >Additional Research Needs

- Recent advances in Nano-composite technology may be suitable for targeted and precise repair of scratched, gouged or cracked pipe
- A well formulated research program that properly identifies repair methodologies for the types of damage that introduce the greatest risk for failure
- Conduct carefully planned feasibility studies for each promising technology to properly define the type and extent of damage that can be repaired
- Prepare lifetime prediction methodologies for the repaired systems

### **Comprehensive Industry Guidelines** for Plastic Pipe Damage Mitigation

#### >Additional Research Needs

- Prepare a comprehensive fitness for service standard for plastic and other non-metallic pipe
- Prepare comprehensive industry guidelines outlining:
  - > How to determine what pipe damage needs to be mitigated, and
  - > What repair technologies are best suited for plastic and other non-metallic pipes

