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## BHR Group

EXPERTS IN FLUID ENGINEERING

## Oversized HDPE Liners to Combat Internal Corrosion & Erosion in Mining Industry Pipelines



[www.bhrgroup.co.uk](http://www.bhrgroup.co.uk)

18th International Conference on  
HYDROTRANSPORT  
Rio de Janeiro, Brazil; 22 – 24 September 2010

## Agenda

- History of Oversized HDPE (PEAD) Lining
- Benefits of Oversized HDPE Lining
- Design Considerations
- Oversized HDPE Lining Installation Process
- Typical HDPE Lining Concerns and Management
- HDPE Lining Improvements
- Conclusions and Action

## History of Oversized HDPE Lining

- Initially used in Oil & Gas applications
- Expanded into smaller slurry pipeline projects
  - Newmont Gold, Kennecott in US
- Escondida in 1994/1995
  - First Long Distance Slurry Pipeline w/ liner
- Additional large projects since then and ahead
  - Antamina, Century Zinc, Collahuasi, Ambatovy, etc.

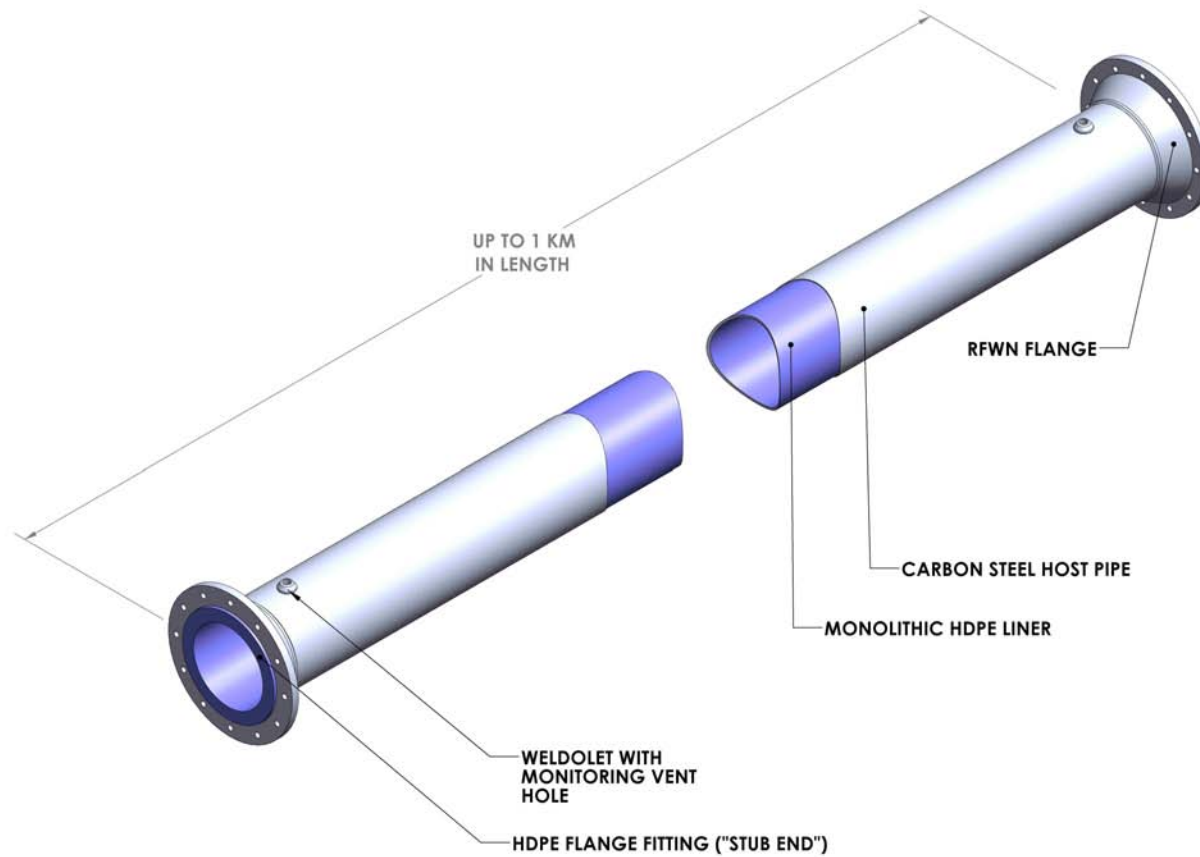
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## Oversized HDPE Lining



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## Oversized HDPE Lining



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## Benefits of Oversized HDPE Lining

- Escondida makes an excellent case study
- Problems encountered
  - Heavy internal scaling
  - Acid cleaning of pipeline
  - Galvanic corrosion during extended downtime
  - Microbiologically Influenced Corrosion (MIC)
  - Excessive wear (6 O’Clock groove and slack flow)



## Benefits of Oversized HDPE Lining

- Oversized HDPE Lining Solutions Provide
  - Chemical Resistance
    - ♦ High MW, non-polar, paraffin HC
    - ♦ Excellent resistance esp. vs. acids, alkalis, salts
    - ♦ Plastics Pipe Institute, Perry's
  - Biological Resistance
    - ♦ HDPE not a nutrient medium
    - ♦ New pipeline protection and existing rehabilitation

## Benefits of Oversized HDPE Lining

- Oversized HDPE Lining Solutions Provide
  - Abrasion Resistance
    - ♦ “3 – 5 times (vs.)...steel pipe” (1984)
    - ♦ x10 at 7fps,x4 at 15fps, coarse sand (SRC, 1975)
    - ♦ x 4 at 23 fps through bends (Schreiber, 1968)
  - Surface Roughness (“Smoothness”)
    - ♦ Extruded HDPE vs. new steel
    - ♦ Operating costs
  - Earthquake consequences



## Benefits of Oversized HDPE Lining

- Oversized HDPE Lining Solutions Provide
  - International acceptance
  - Fit-and-Forget solution
- HDPE Lining “Never Stops Working For You”

# Oversized HDPE Lining Design Considerations

- Outside Diameter
- Wall Thickness
- Installed HDPE Liner Pipeline Length

## Oversized HDPE Lining Design Considerations

- Bends and Roto-Lining Solution



- Wear Free Bends (e.g., Vortex-Ell Bend)

## Oversized HDPE Lining Installation Process

- Field Installation for Long Distance Slurry Pipeline
- Steel Pipeline Construction
  - Traditional methods
  - Required section lengths
  - HDPE Liner installation in concert with steel

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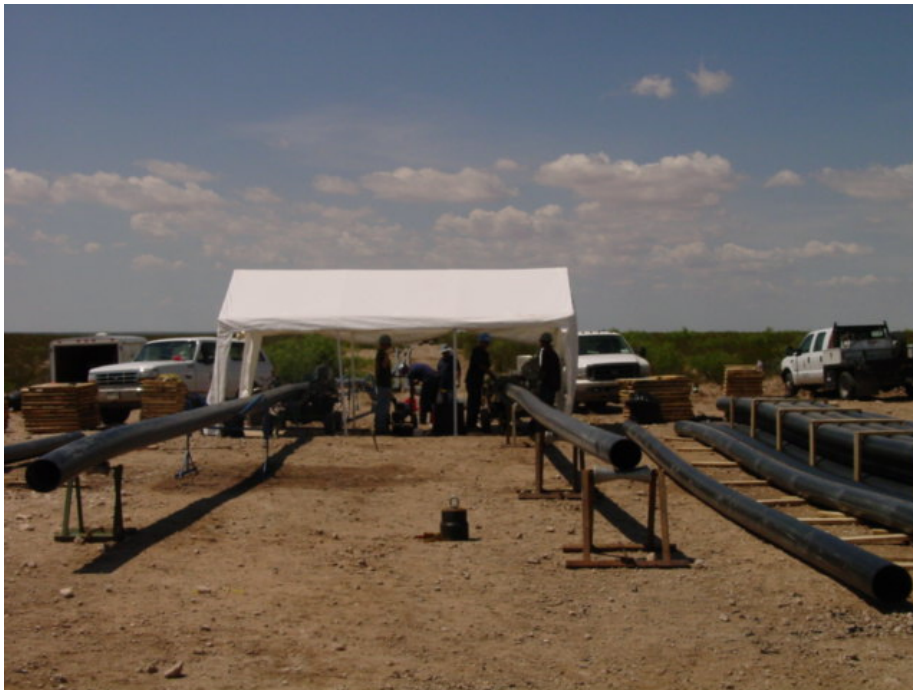
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## Oversized HDPE Lining Installation Process

- On site HDPE fusion to customized lengths of steel pipe



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## Oversized HDPE Lining Installation Process

- Wireline cable, blowdown pig, sizing plate



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## Oversized HDPE Lining Installation Process

- Customized material and Specialized equipment



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## Oversized HDPE Lining Installation Process

- During this brief time of reduced diameter, the HDPE liner is quickly installed to line the host pipe



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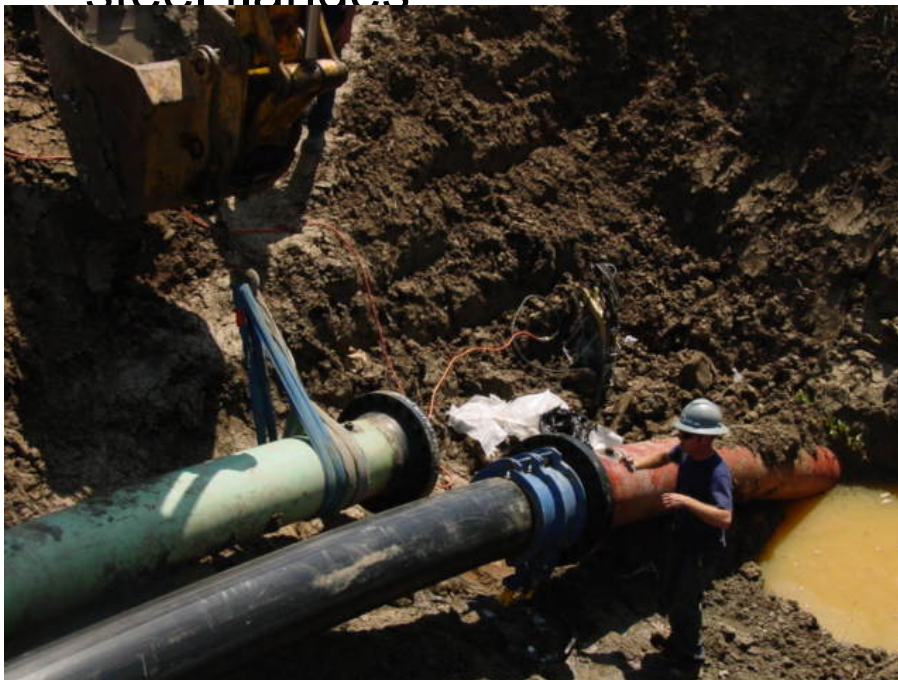
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## Oversized HDPE Lining Installation Process

- Internal and external clamps are then used to facilitate the installation of the HDPE end connections or “stub-ends” that are custom machined to tightly match the specially machined RFWN steel flanges



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## Oversized HDPE Lining Installation Process

- Fusion of stub-end, removal of internal/external weld bead, release of internal clamp



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## Oversized HDPE Lining Installation Process

- Relaxation/tightening of oversized HDPE liner, air-test, and bolt-up.





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## Oversized HDPE Lining Installation Process

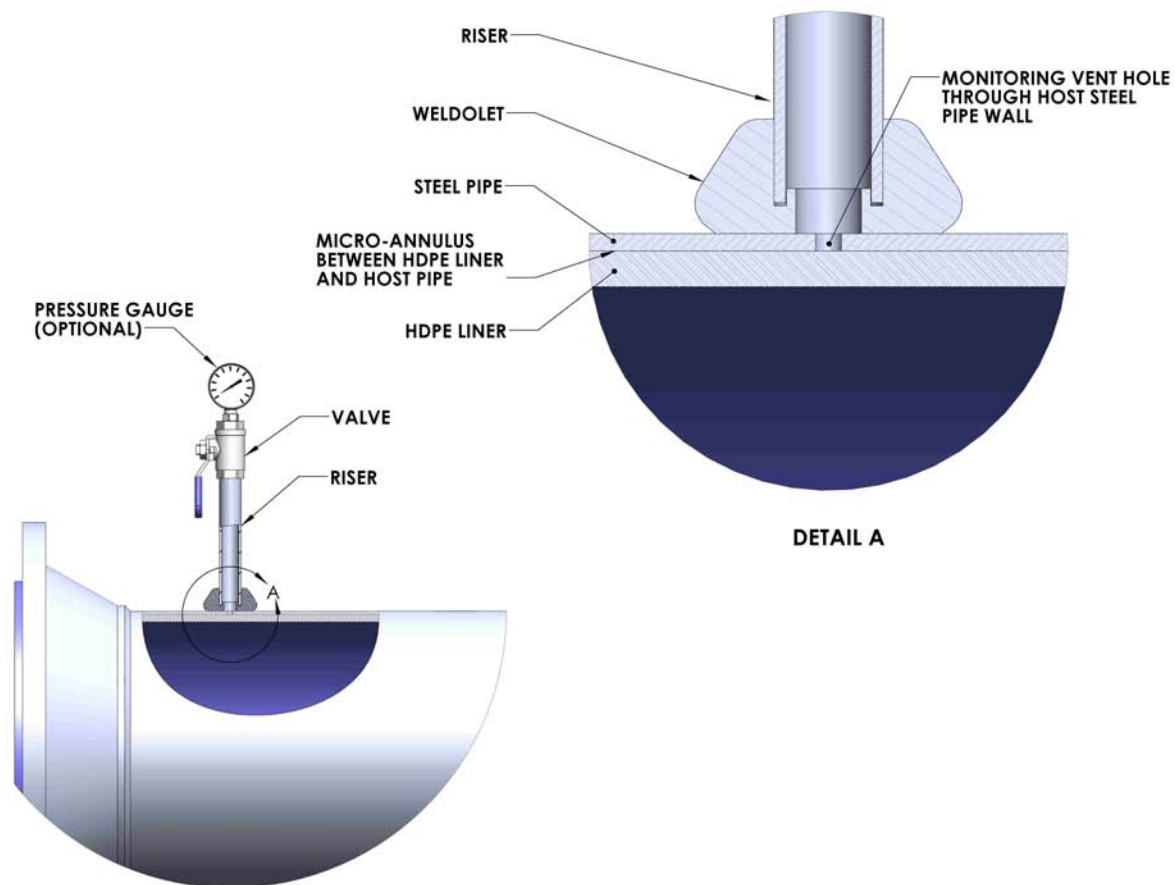
- Completed connection and installation



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## External monitoring vent



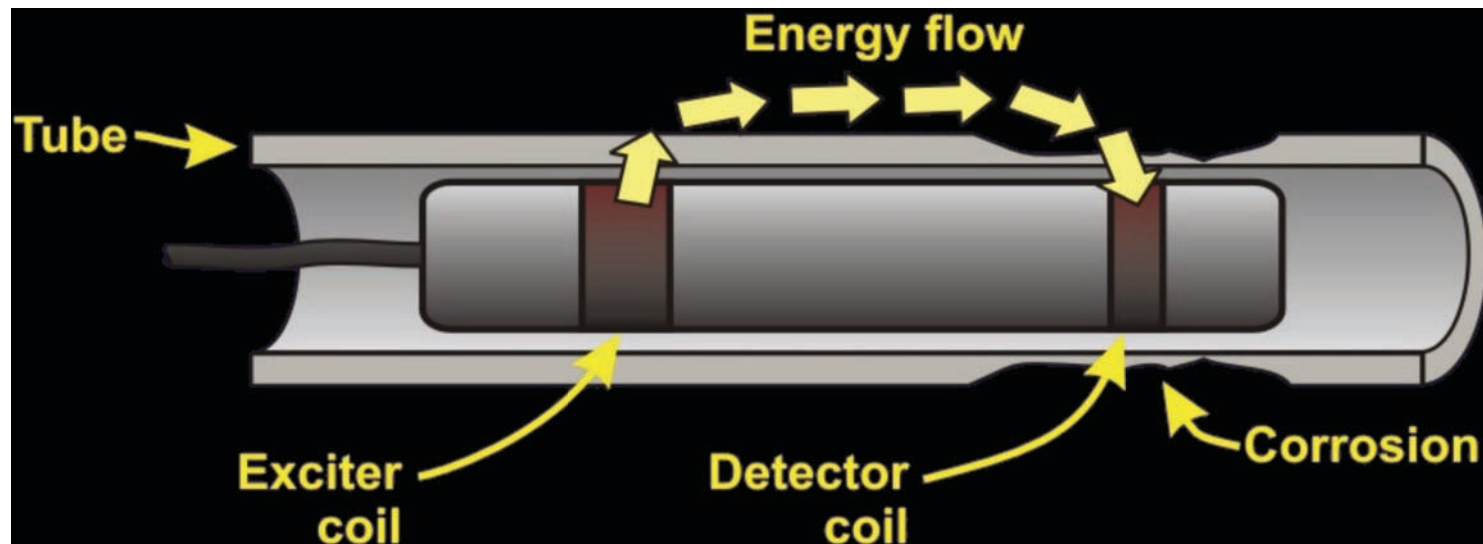
## Typical HDPE Lining Concerns

- Wear
- Permeation/Vacuum and Possible Collapse
- Leaks and Leak Detection
- Flanged Connections

# HDPE Lining Improvements

- Wear
  - ◆ Modeling
  - ◆ Laboratory Analysis
  - ◆ Scheduled Inspection
  - ◆ Inspection Ports
  - ◆ Caliper Pigs
  - ◆ RFT

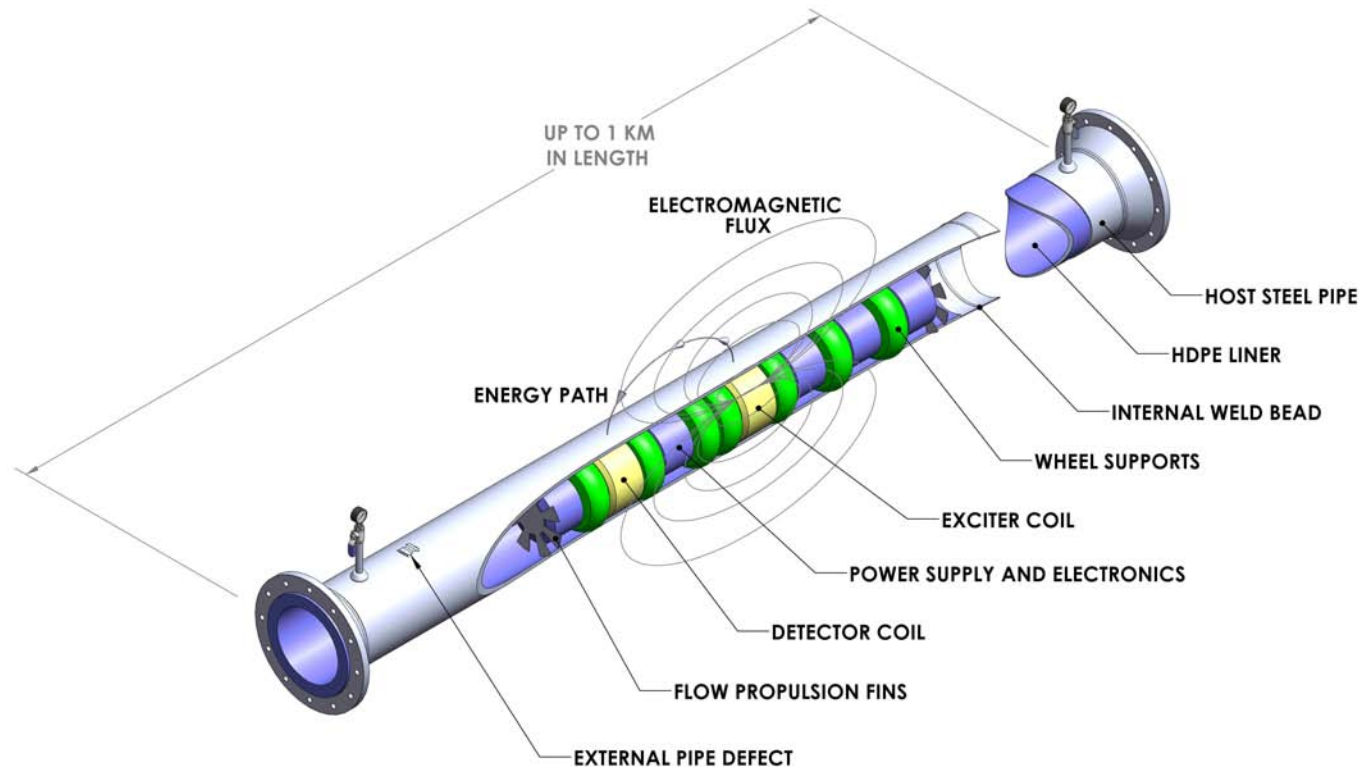
# HDPE Lining Improvements: Wear - RFT



RFT information by Russell NDE Systems

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## HDPE Lining Improvements: Wear - RFT





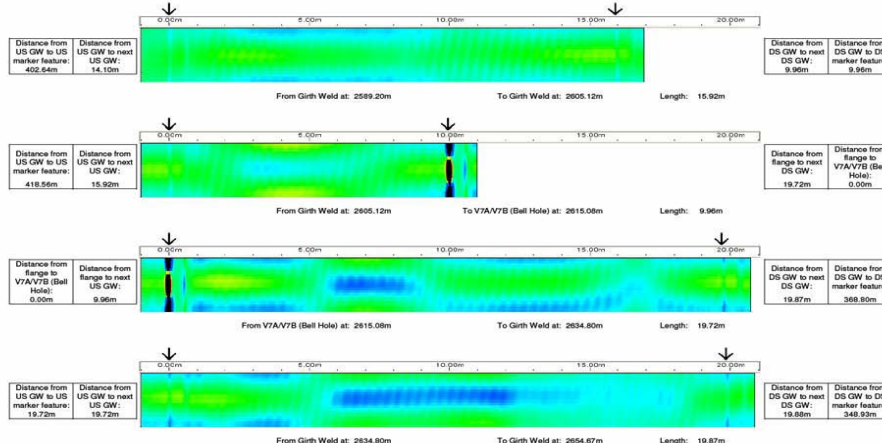
## HDPE Lining Improvements: Wear - RFT

- 8-inch Steel Pipe
- Sour gas transportation
- Age = approx. 5 yrs old
- External concrete jacket
- HDPE lined
- 16.5km x four segments



## HDPE Lining Improvements: Wear - RFT

- No major wall loss detected
- Lines are in good condition
- No immediate threat to surroundings
- Findings backed by selective digs

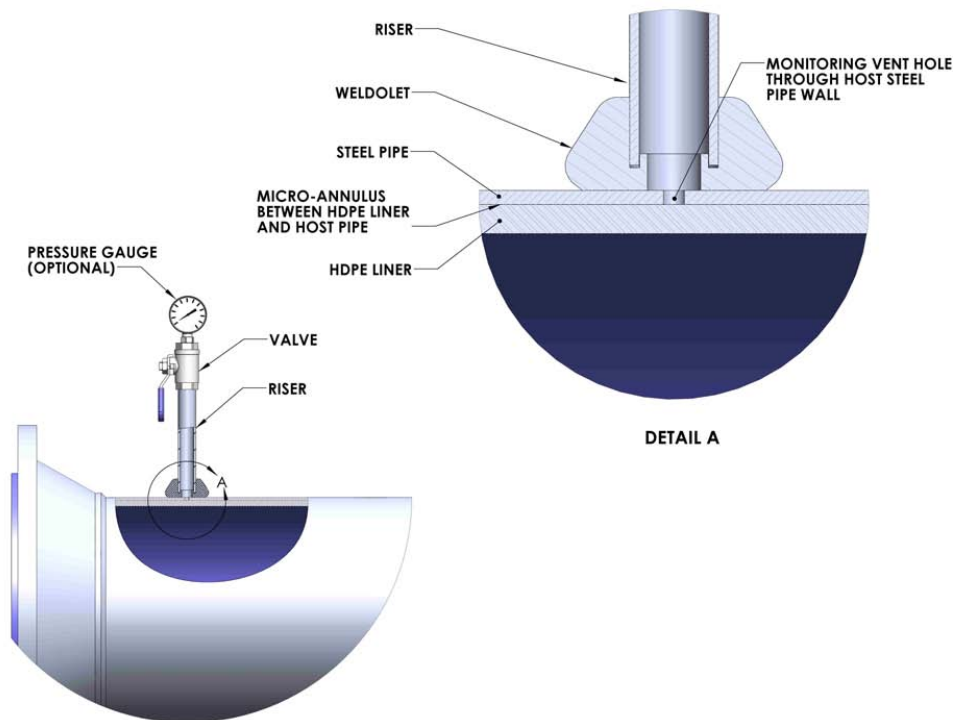


## HDPE Lining Improvements

- Permeation/Vacuum and Possible Collapse – Oversize Liner, Design, and Monitoring
- “Hoop-compressive” state
- $P_c \propto E(t/R)^2$

## HDPE Lining Improvements

- Leaks and Leak Detection – Monitoring Vents



## HDPE Lining Improvements

- Flanged Connections – Welded Connections
  - ◆ First subsea installation in 1994
  - ◆ Flanges worked. Flanges work.
  - ◆ Improvements and insurance desired
  - ◆ CRAs used – internal corrosion, not erosion
  - ◆ Onshore use possible

## Conclusions – Oversized HDPE Liners

- History
- Benefits
- Installation Process
- Typical Concerns
- Addressing, Managing, Resolving Concerns



## Action – Oversized HDPE Liners

- Communication
- Identification
- Cooperation
- Corroboration
- Satisfaction

The logo for NBS (National Bureau of Standards) features the letters 'NBS' in a stylized, blue, sans-serif font. The letters are bold and have a slight shadow effect.

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The logo for BHR Group features the text 'BHR' in a bold, blue, sans-serif font, followed by 'Group' in a green, italicized, sans-serif font. A thin green horizontal line is positioned below the text.

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# Questions?

# Next Steps?

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The logo for NBS (National Business Systems) features the letters 'NBS' in a stylized, blue, sans-serif font. The 'N' and 'B' are connected, and the 'S' is slightly larger and more rounded.

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# Oversized HDPE Liners to Combat Internal Corrosion and Erosion in Mining Industry Pipelines

Paper by **Jim Thorne and Associates**

Presentation by **Jim Schmitz**

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