

Pipeline Research Council International, Inc.

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Young Pipeline Professional Session

Non Destructive Examination



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Why Is Accurate & Reliable Non-Destructive Examination (NDE) Important?

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- **Nov. 4 Explosion at the Silver Eagle Refinery in Woods Cross, Utah - November 17, 2009 .**
- **Prior to May 2009, mechanical integrity inspections -- including thickness monitoring of pipes and vessels at the refinery -- were completed by a contract company hired by Silver Eagle. The refinery later replaced this company with a second outside inspection company, which remains active at the site.**
- **Witness evidence indicates that various thickness readings taken by the prior contractor are of questionable validity. The refinery is now in the process of revalidating those readings.**
- **Specifically, witnesses report that in 2007 the prior contractor documented the thickness of the pipe that failed on November 4th to be nearly one-half-inch. But measurements following the accident show that the pipe thickness was only one-eighth of an inch. A likely explanation is that the 2007 thickness measurement was inaccurate. This and other recent measurements call into serious question the pipe thickness readings obtained by the prior contractor.**



Why Is NDE Important

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- **We make multi million dollar decisions every day based on the results on NDE.**
- **The key element of the terminology is the ability to ‘see’ things without destroying or taking apart the component.**
- **NDE exists in all the cycles of cradle to grave across a pipelines existence.**
 - Quality Assurance in manufacturing stages, pipe mills, forging shops, machine shops.
 - Construction Quality Control, welding and joint quality evaluation even the hydrotest can be considered NDE (if it holds!!).
 - In service integrity evaluation over the pipe, in the pipe and in the ditch.
 - Decommissioning lifting lugs, where to cut NDE etc.

The Key Foundational Elements of NDE

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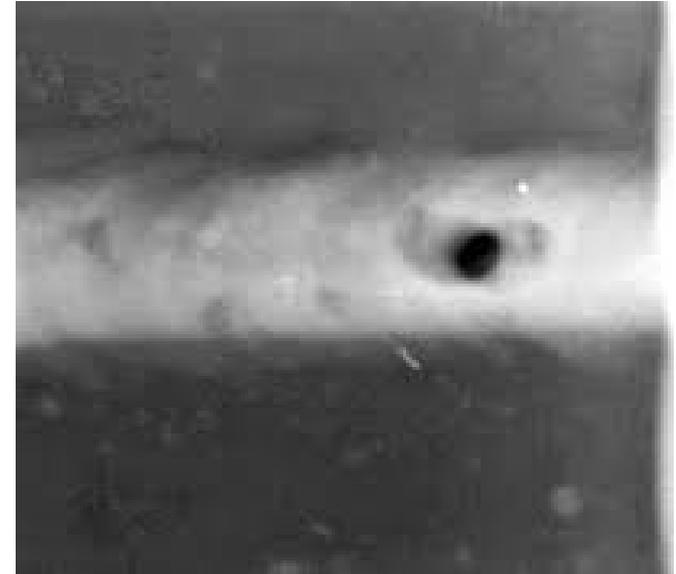
- **Visual**
- **Magnetic Particle Examination**
- **Liquid Penetrant Examination**
- **Radiographic Examination**
- **Ultrasonic Examination**
 - 0 Degree Thickness Measurement
 - Shear Wave Weld Examination
 - Time of Flight Diffraction
 - Phased Array
- **Electromagnetic Examination**
 - Eddy Current
 - *Saturated Low Frequency*
 - *Remote Field*
 - Magnetic Flux Leakage



Radiographic Examination

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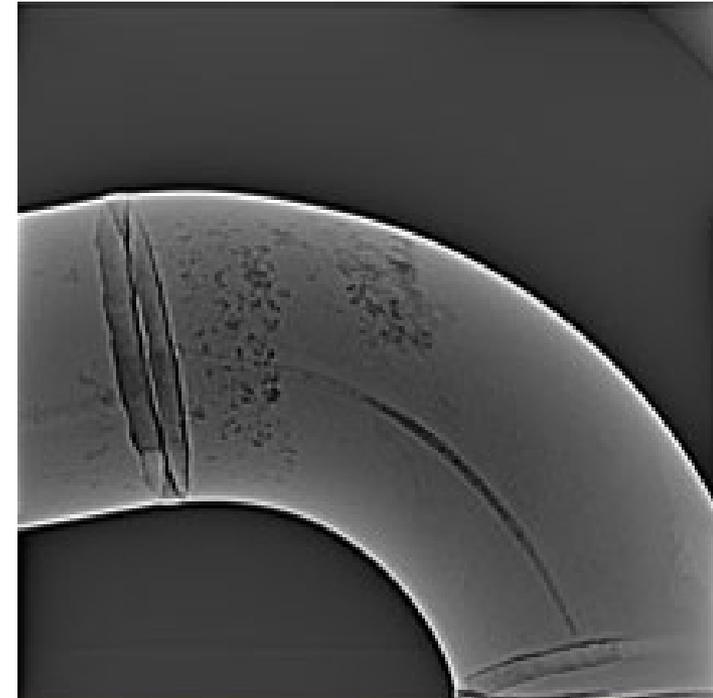
- Has for many years been the mainstay of NDE examination to determine pipeline weld quality.
- Radiation from X-Ray or Gamma source penetrant pipe wall and flaws are identified on the resultant film image more recently forms of digital recording media.



In-Service Wall Loss Damage.

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- Radiography can also be utilized in service to identify wall loss – generally restricted to smaller diameter piping.
- Advances in digital imaging media is providing a renaissance in the application of radiographic techniques.



Ultrasonic Techniques

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- Around since the 1950' has come to greater prominence in the last 10-15 years as computer imaging and recording has provided imagery akin to radiographs.



In Line Inspection Tools (ILI)

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- Well known by a number of names but often commonly referred to as “Intelligent Pigs”.
- Operate through insertion into a live pipeline.
- Propelled often by process fluid (oil, water or gas)
- Can be variants that are tractor driven or other propulsion methods.



A Wide Variety of Tools

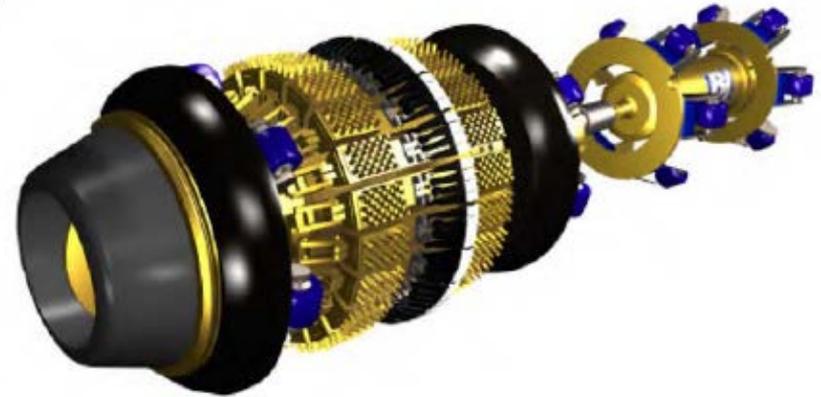
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NDE Techniques on ILI Tools

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- Can employ a wide variation of the basic NDE techniques:
 - Cameras (visual)
 - Electromagnetic
 - *Magnetic Flux leakage*
 - *Eddy Currents*
 - Ultrasonic
 - *0 Degree*
 - *Shear Wave*
 - *Electromagnetic Acoustic Transducers.*



Wall Loss Is Not the Only Damage Mechanism We Look For

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- A range of tools now are designed to generate complex examination solutions to identify and characterize cracks in various parts of the pipe wall and particularly weld areas.



Advanced Data

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- Modern ILI tools generate vast amounts of data.
- Advanced graphics assist in converting raw NDE signals in to comprehensible imaging of flaws.

