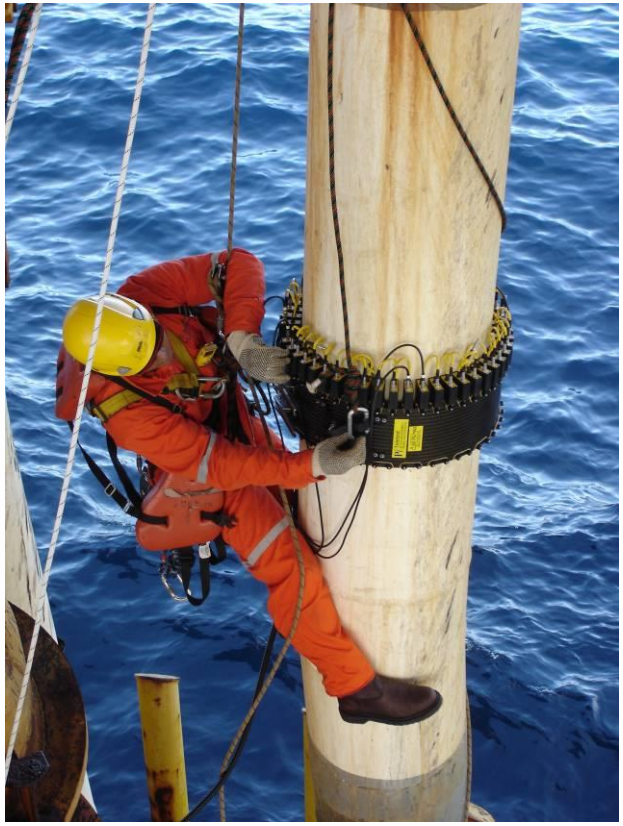
# Guided Wave UT

TechCorr

# Guided Wave Ultrasonic Testing

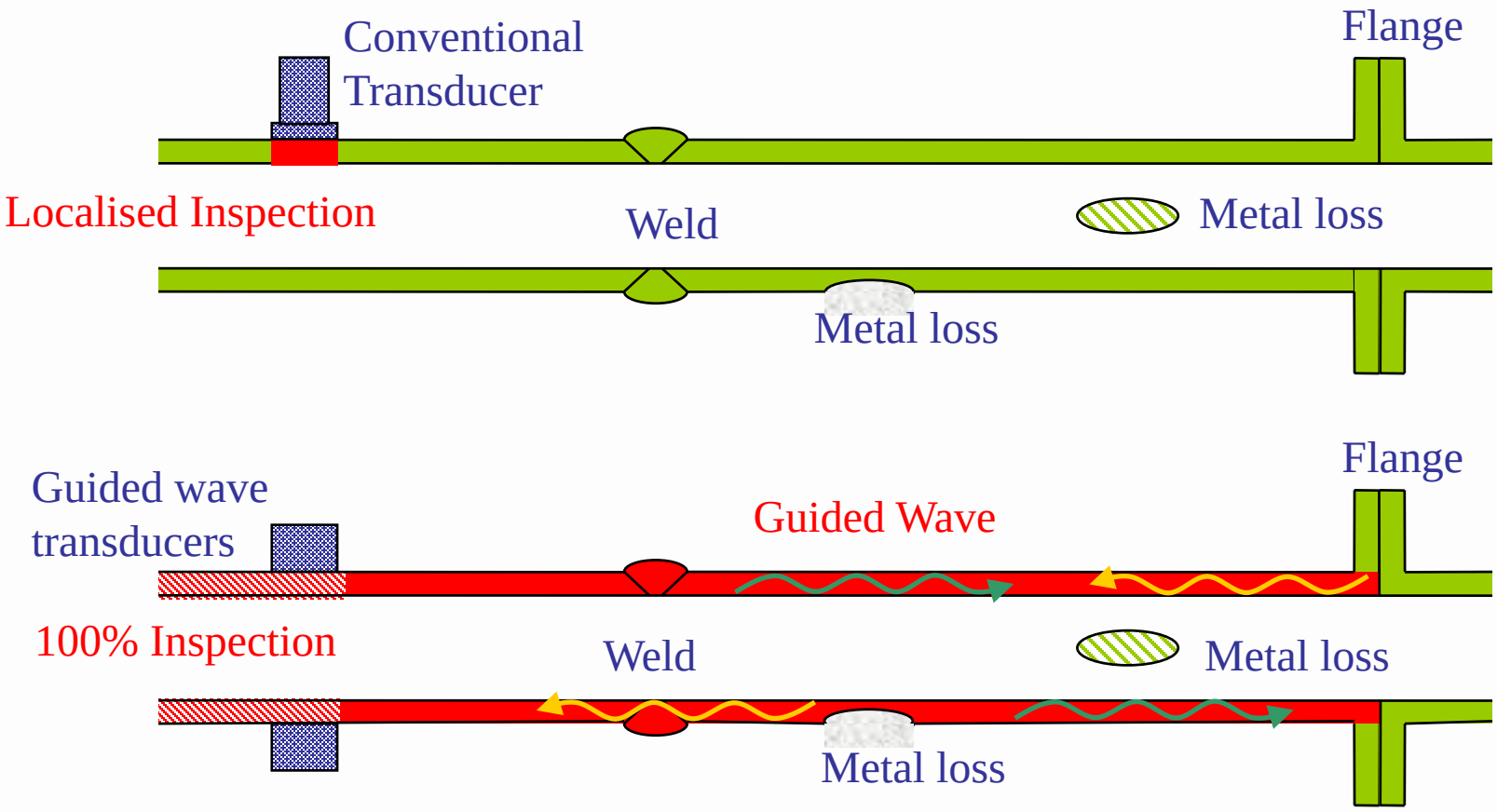

New Tool Developments
TechCorr

# Guided Waves



- Rapid screening for In-service degradation
- Reduction in costs of gaining access
- Avoid removal of insulation or coating
- Ability to inspect inaccessible areas
  - i.e clamps and cased or buried pipes
- 100% coverage

# Conventional UT versus LRUT

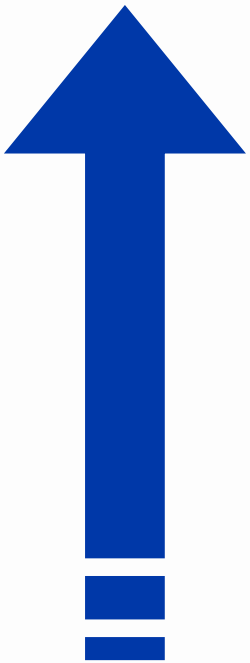


# Features

- Detection of internal or external metal loss
- Sensitivity
  - Metal loss down to 3% of pipe wall cross-section
  - Reliable detection of 9% metal loss flaws
  - Now able to discriminate clock position
- Discrimination between flaws, pipe features, welds, casing supports, etc.
- Longitudinal accuracy better than ±1”
- New Beam Focusing (Helps with Flaw Discrimination)
- New C-SCAN Imaging (Visual Presentation of Circumferential Extent)
- New Software System for Improved Analysis
  - Multiple Distance Decline Curves
  - Select locations for multiple focusing

# Performance Summary

Long range



Short range

| Surface condition | Geometry | Contents |
|---|---|---|
| Bare metal | Straight lengths | Gas |
| Smooth well bonded paint | | |
| Fusion bonded epoxy | Attachments | Liquid |
| Light pitting | | |
| Heavy pitting | | |
| Plastic, e.g. PVC | Branches | |
| Buried (earth or sand) | | |
| Bitumen coated | Multiple bends | High viscosity |
| Concrete coated | Flanges | |

# Some Limitations of LRUT

Geometric features such as Elbows, Flanges, Tees, Welded Supports, socked welds, etc will attenuate or totally absorb the LRUT signal.

Additional LRUT locations are need before and after every elbow to guaranty 100% coverage.

Focus only works in straight sections . It does not work after elbows.

LRUT signal do not travel after flanges.

# Some Limitations of LRUT

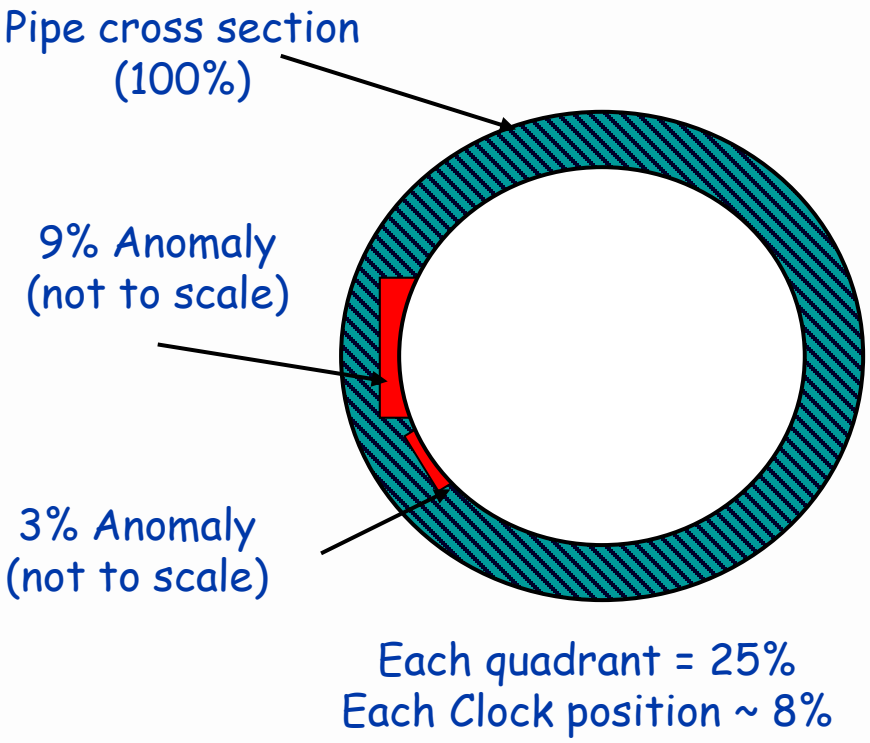
Big Tees or branches absorbs tremendous energy. Therefore additional test locations are required before and after these features.

It is not the right tool to detect isolated pin holes.

Signal to noise ratio decreases when testing buried pipes in presence of heavy coatings or fluids. This reduces the probability of detection of small indications.

LRUT does not provide a reading of the remaining wall / wall thickness at the location of the indication.

# General Description Sensitivity




- An approximation of the cross section area Loss can be given by:

$$CSL = \frac{Length_{defect} \times Depth_{defect}}{2\Pi \times Radius_{pipe} \times Thickness_{pipe}}$$

- The total CSL is then equal to the sum of all the defect present on the same cross section (12% in this case)

# Applications

- Road and river crossings
- Power plant tubing
- Risers
- Offshore topsides pipework
- Jetty lines
- Jetty Supports
- Refinery pipework
- Chemical plant pipework
- Tank farm link lines
- Sphere legs
- Pipe bridges
- Spiral welded pipe
- Austenitic stainless steel
- Sprinkler systems
- Lamp-posts

# Examples of Application

Road Crossings

Buried Pipe

Sphere Support Leg

Gas Pipelines

# Teletest  Focus Unit

- Integrated Battery – 12 Hrs
- Integrated Air Pump
- Auto System Check
- Rugged System
- Easy to Transport

# Features

- Diameters – 1.5" to 48"
- 100% Coverage
- Multi-Mode Modules
  - Torsional & Longitudinal
  - True Beam Focusing
- Test Range
  - Typical ±90 Ft.
  - Ideal conditions ±350 Ft.
- Productivity
  - Typical 1,000 Ft. per day
- Service Temperature up to +260°F

# Advantages


- Easy to use unit and tool design for quick data collection
- Multimode – Longitudinal and torsional wavemodes on one tool
- Focusing – Defect distribution around circumference “one-click” away
- User friendly interface with report manager generator

# Minitest

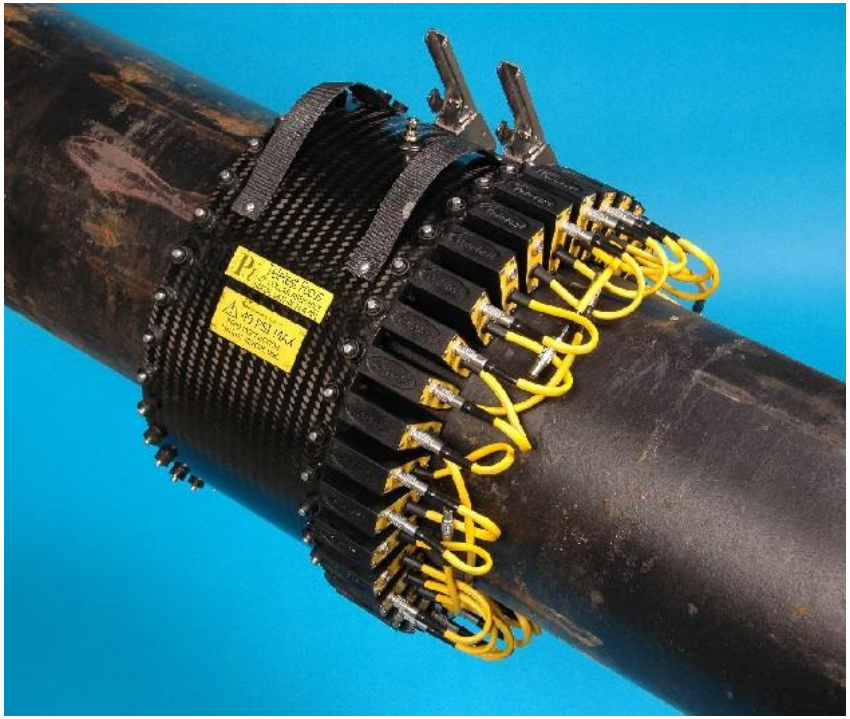

Advantages:

- 1.5-4” Diameter Pipes
- 1.5” Thick Collar
- 3-ring Torsional
- Light Weight Design
- Modularize (1/2” Changes)

Limitation:

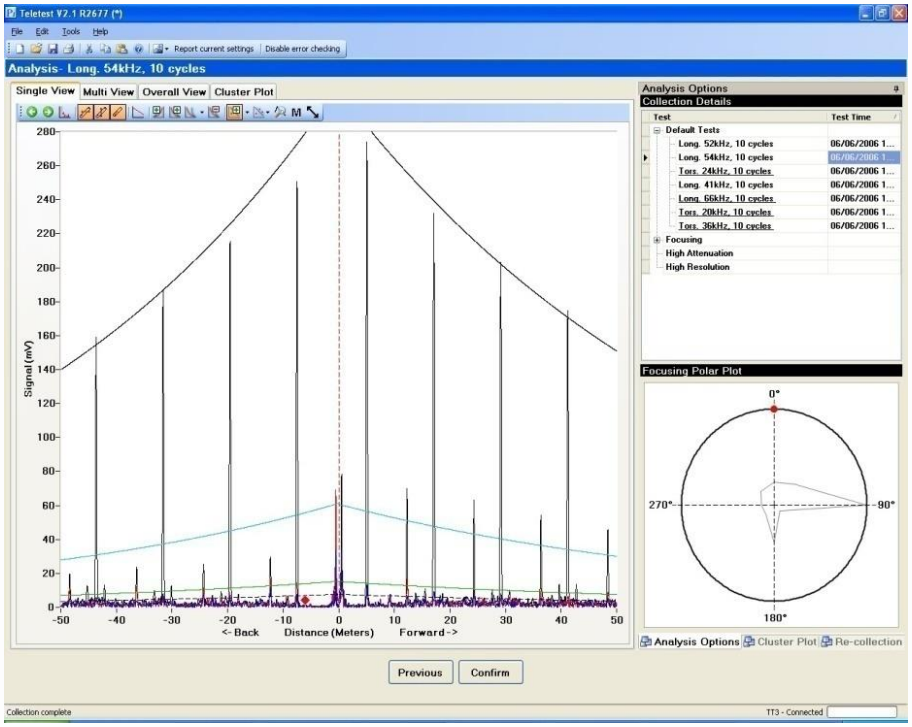
- No Beam Focusing or Multi-Mode Functionality

# Collar design



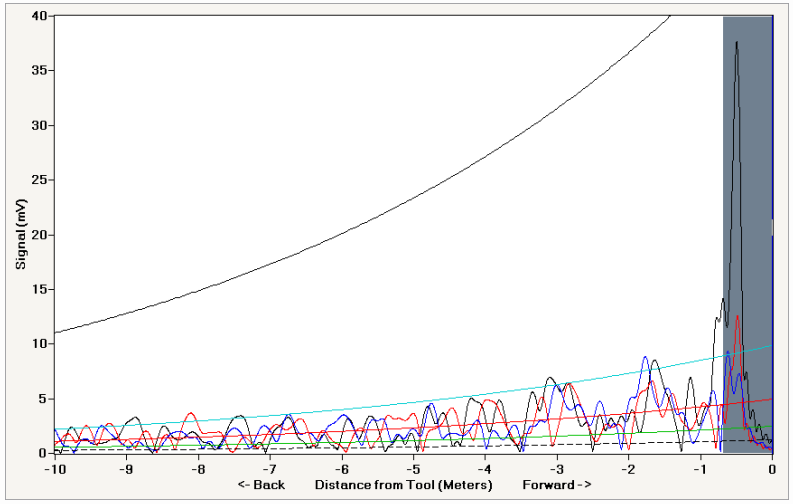
- Robust composite construction
- Integrated clamp and bladder
- Collars link for >24”
- Multimode
- Lightweight
- Cost efficient
- Easily Transported

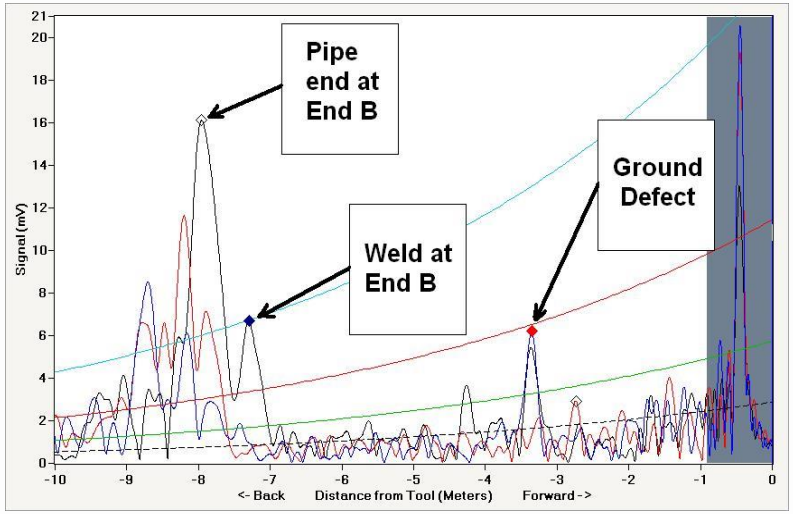
# New Software



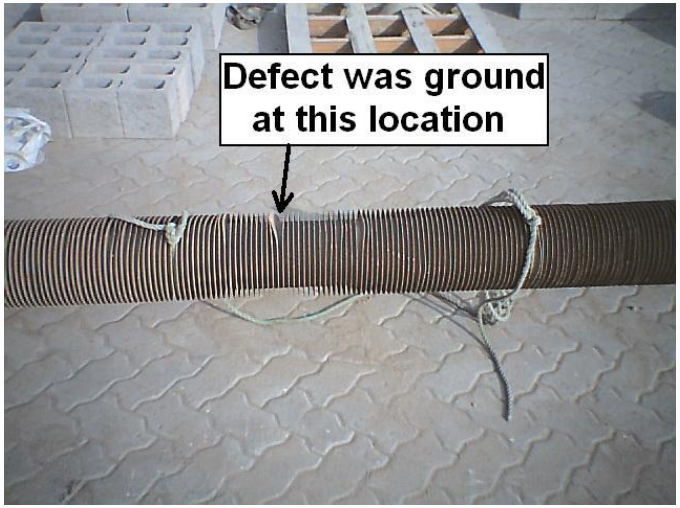

- Automated set-up
- Fast and reliable defect detection
- Simultaneous Multimode  Shots
- Simplified Analysis
- Multiple DAC Curves
- On-site MS Word report generator
- <15 min data collection

# Defect only detected using Longitudinal waves



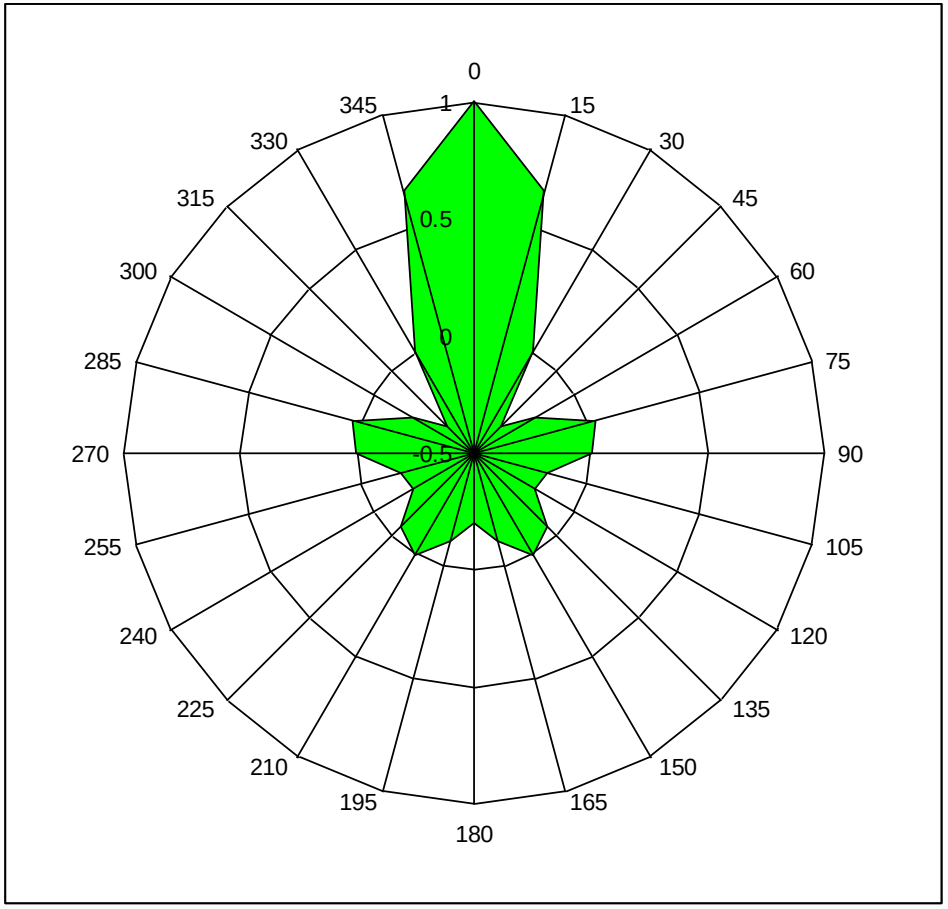

- Torsional: No defects detected using T mode



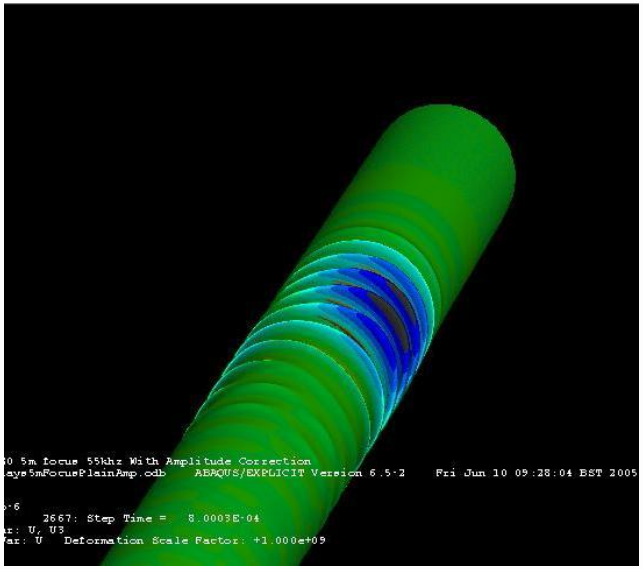

- Longitudinal: both the pipe end and the defect could be identified

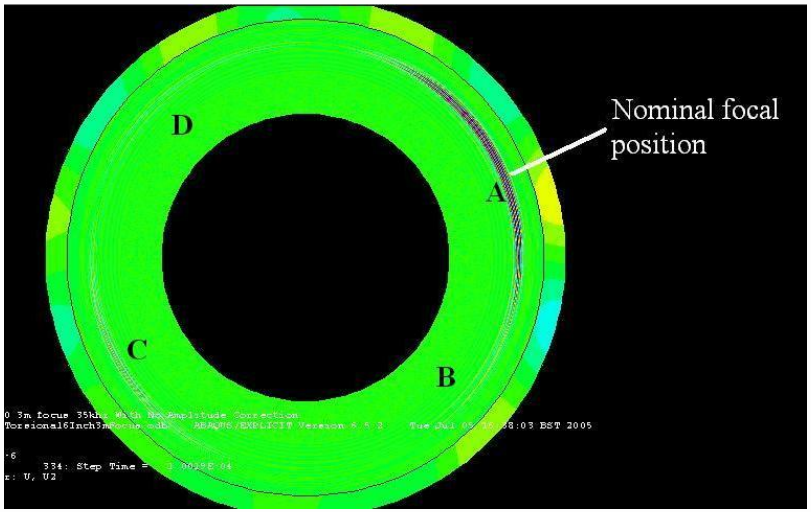
# FOCUS

Applying the appropriate correction factors allows a concentration of energy (focus) at a specific angle for a given distance from the transducer.

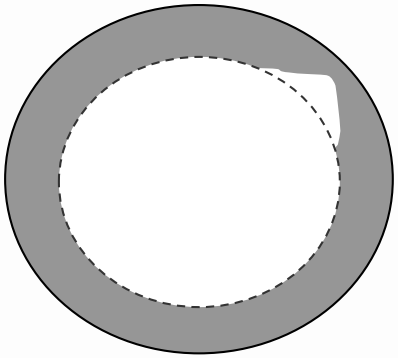


# Benefits of focusing



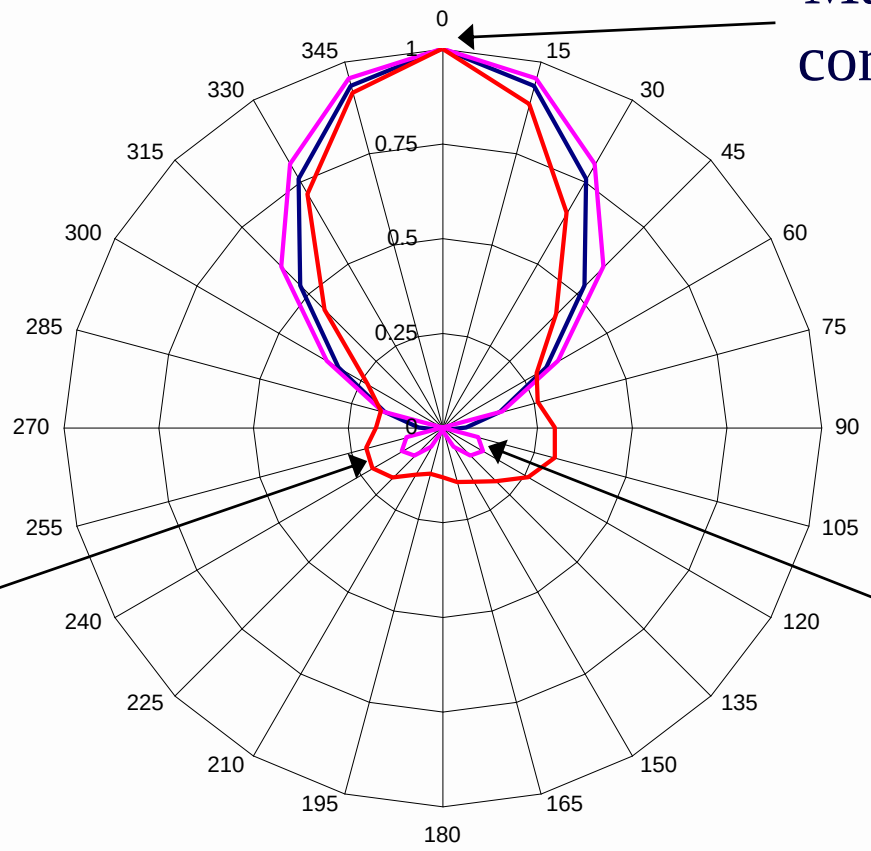



Focusing allows the energy to be concentrated where the defect is, increasing sensitivity and giving position and size information



# Focal Spot – Actual measured shape

Main lobes all at correct angle and shape



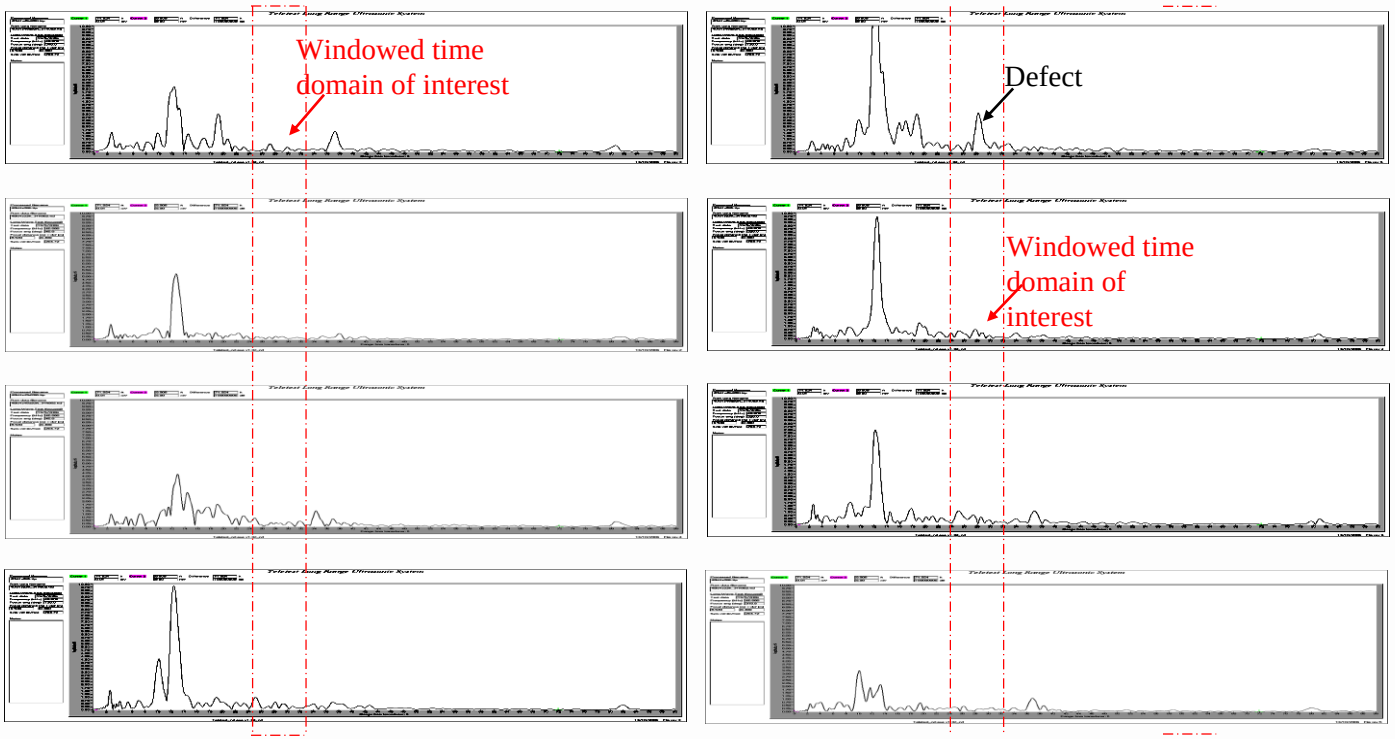

Similar sidelobes

Small sidelobes predicted

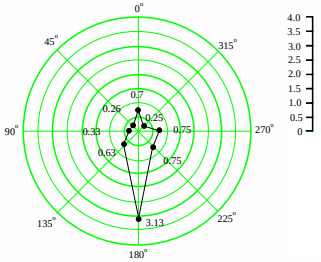
# Focus – Benefits

- Improved Sensitivity to smaller defects
- Better call/no call information
- Improved prioritisation of calls
- Ability to find angular position of defects
- Improved presentation possibilities for results

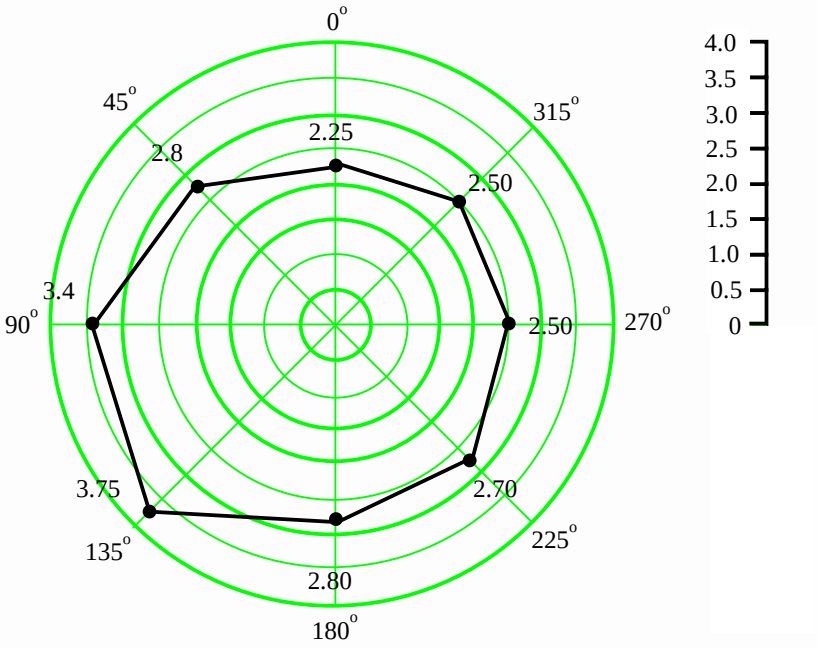
# Directionality data from focusing



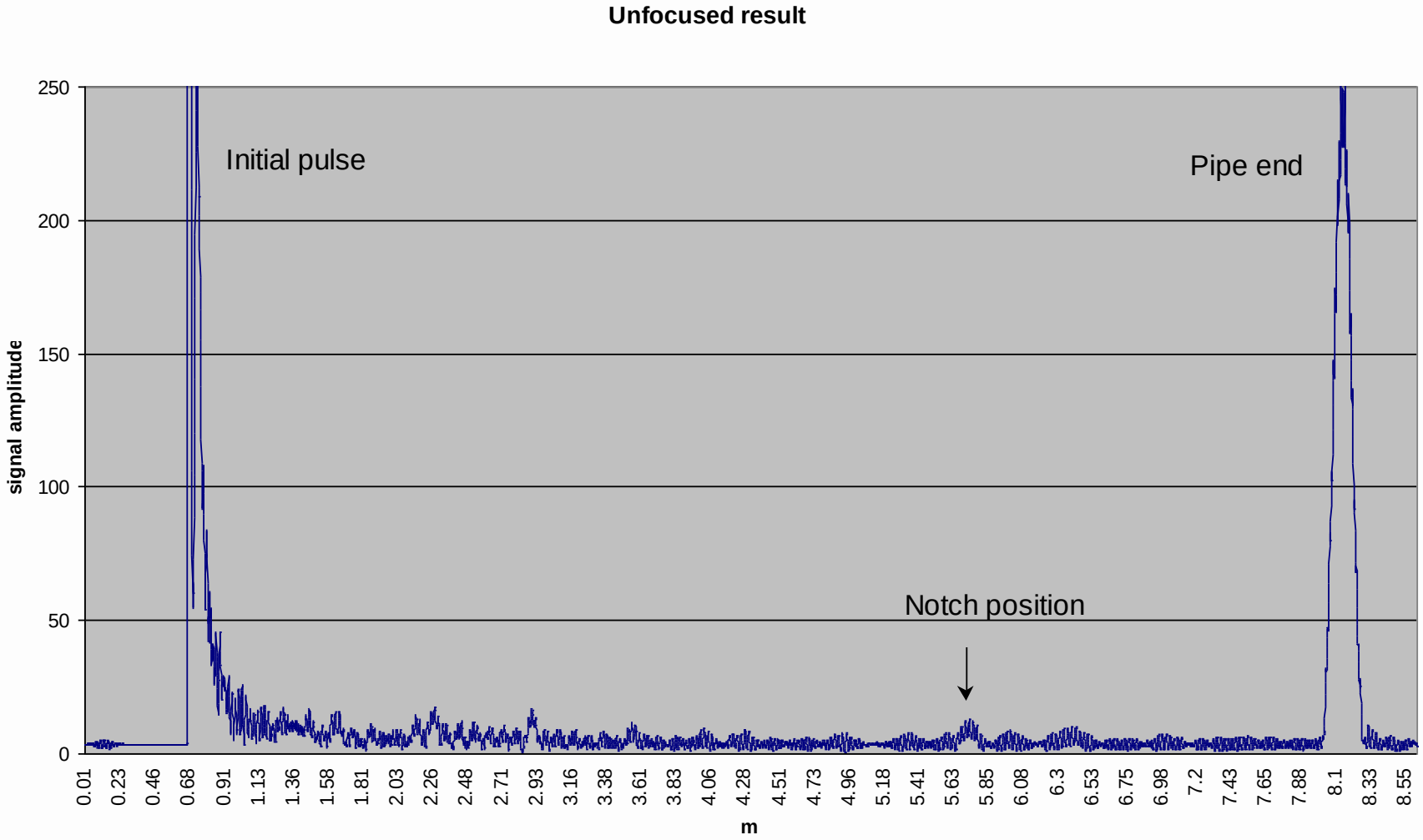

Focused at z= 32.8 ft.



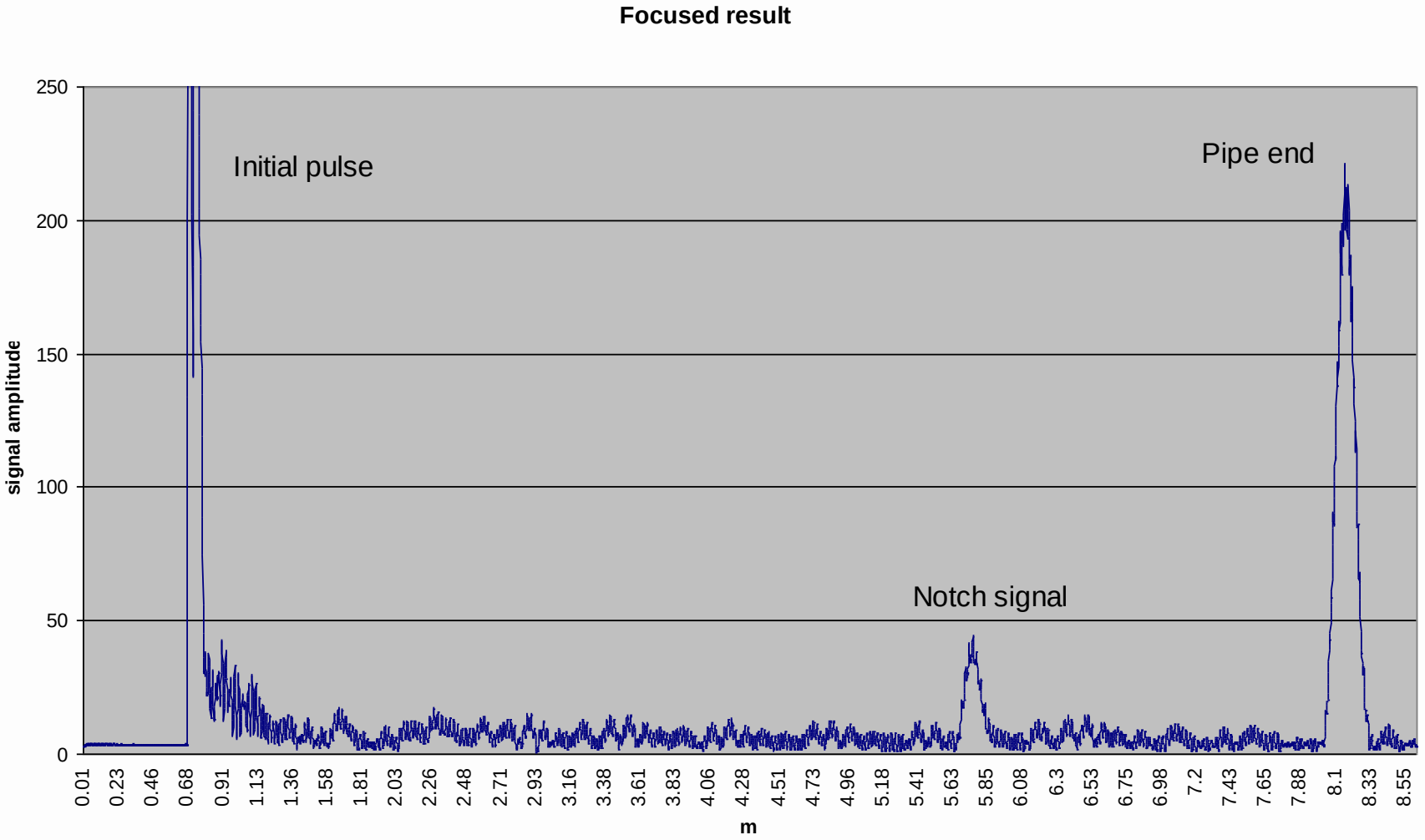
# Non Directional response from a weld



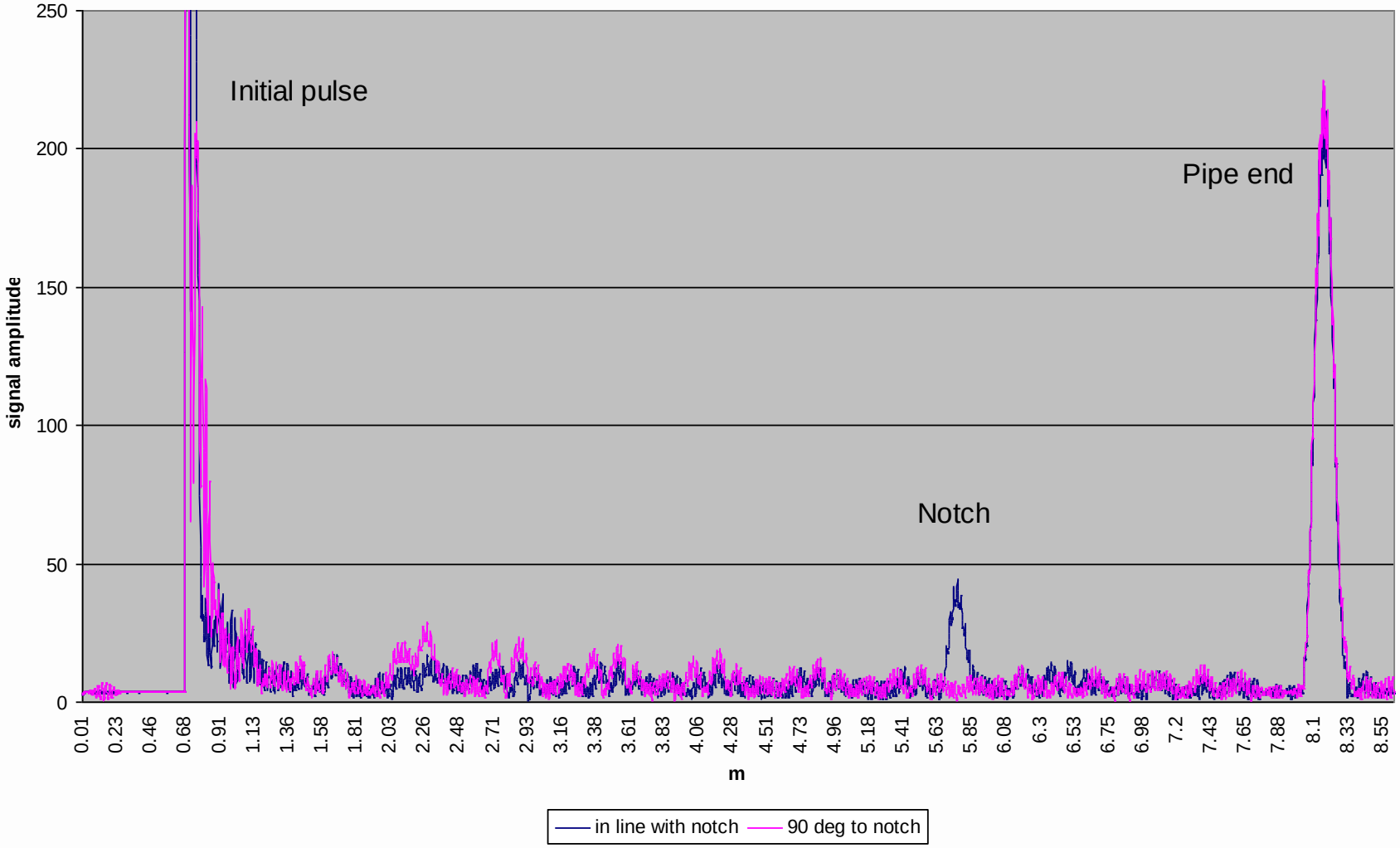
# Unfocused - 3% notch in 16” pipe



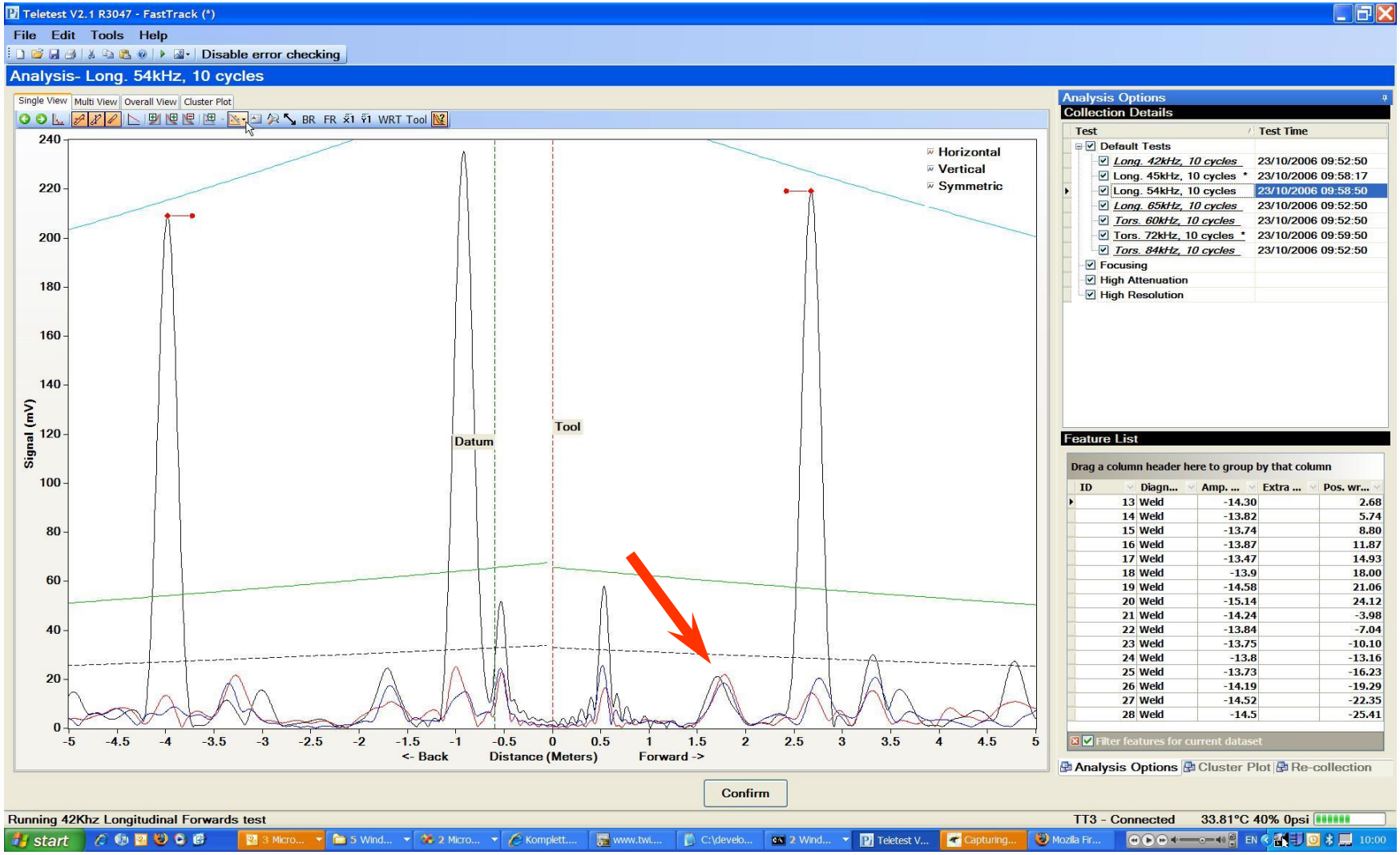
# Focused at Notch



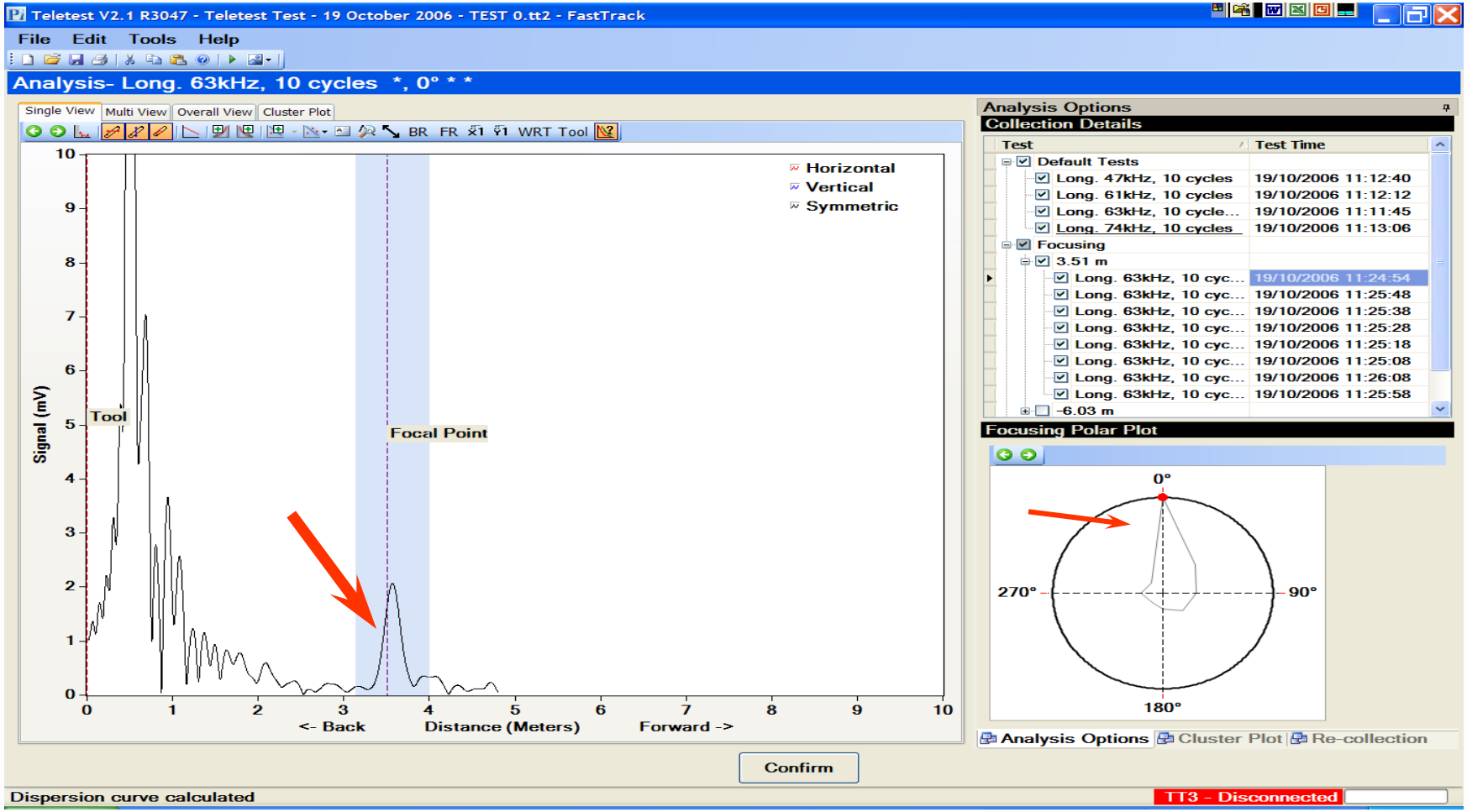
# Focused in Line and at 90° to Notch



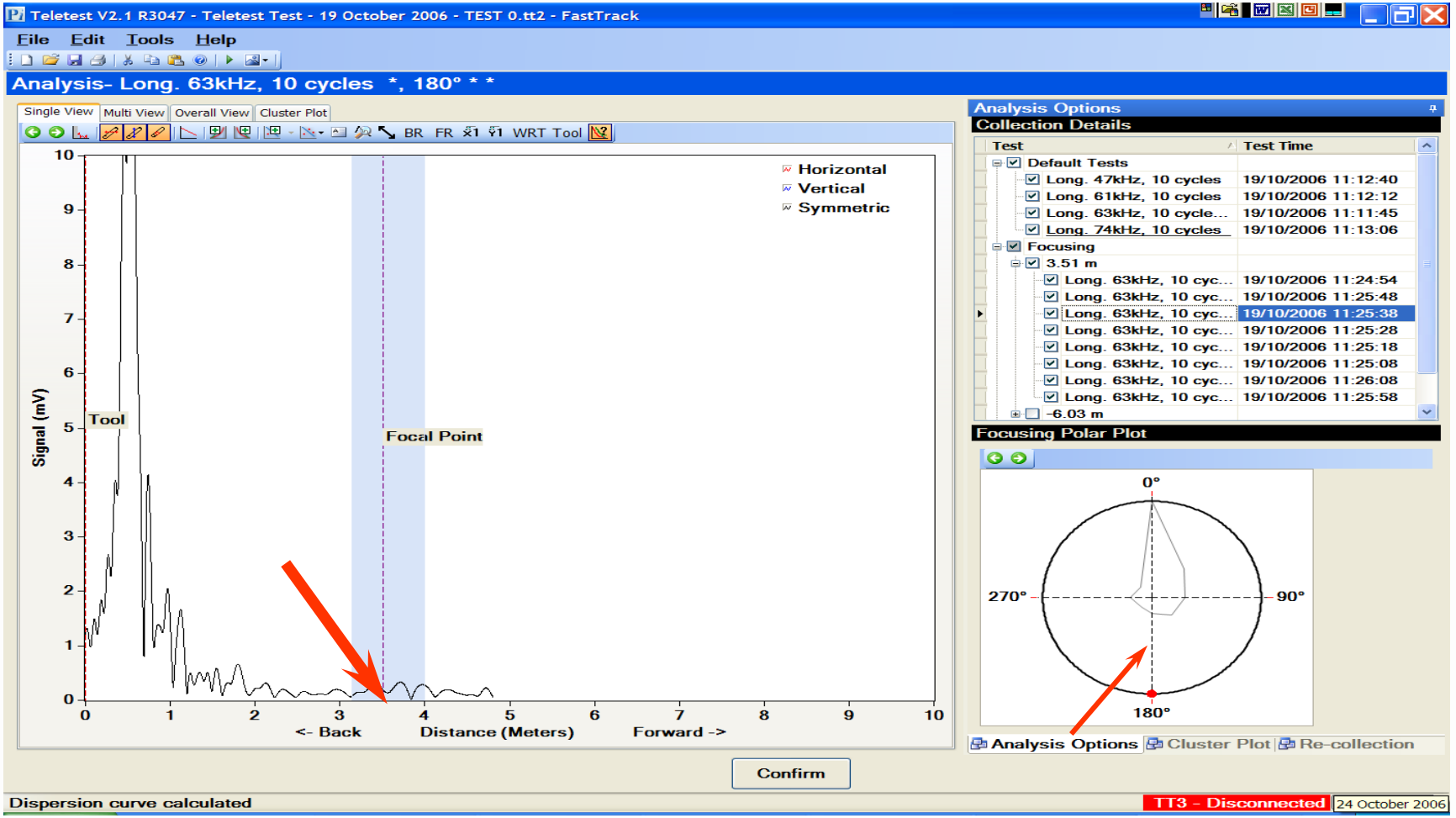
# Practical Implementation



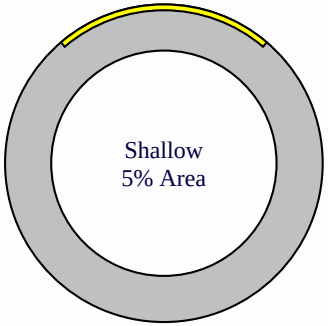
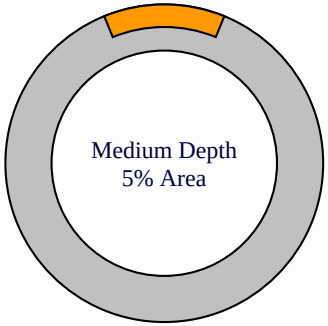
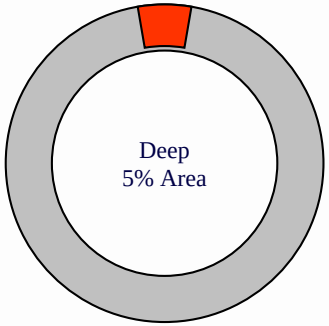
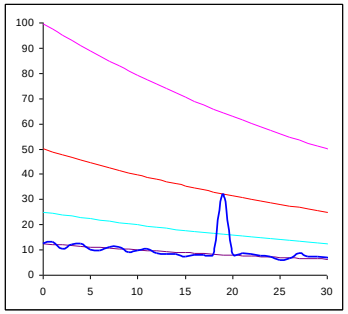
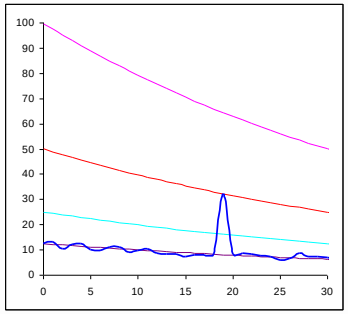
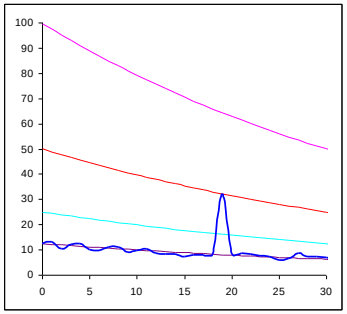
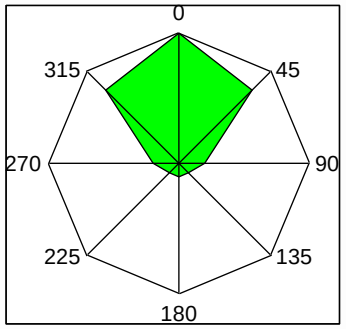
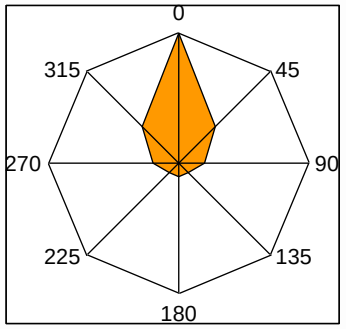
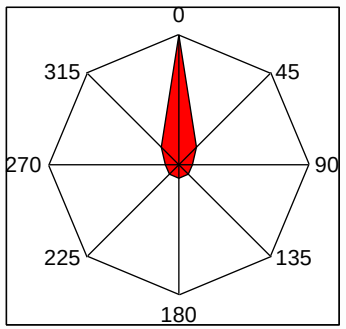
# Energy Focused in-line with Defect



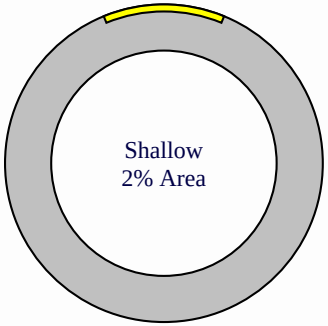
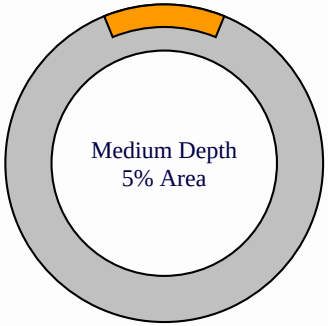
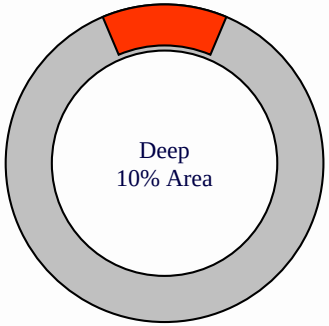
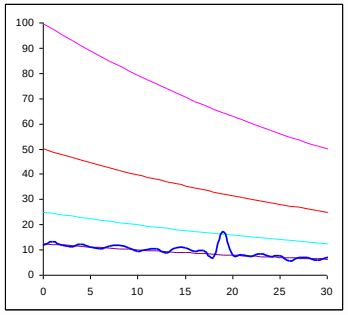
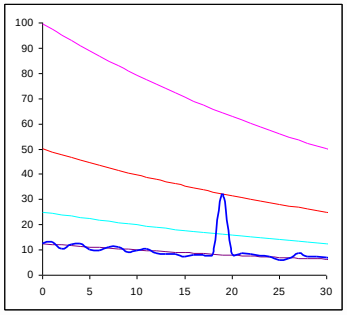
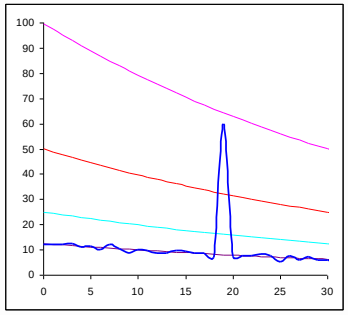
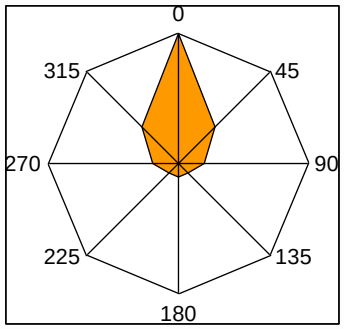
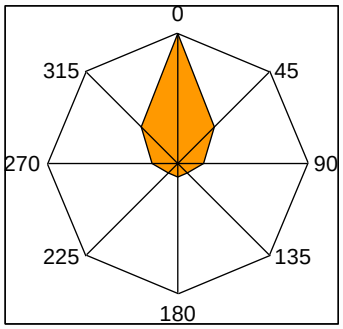
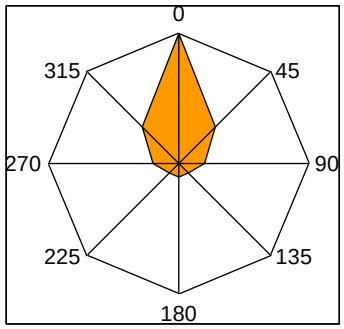
# Energy Focused 180° from Defect



# Focal Response with constant area

| | | | |
|---|---|---|---|
| **Defect Shape with constant area loss** |  |  |  |
| **Axi Symmetric response showing amplitude** |  |  |  |
| **Focus response showing angular distribution** |  |  |  |

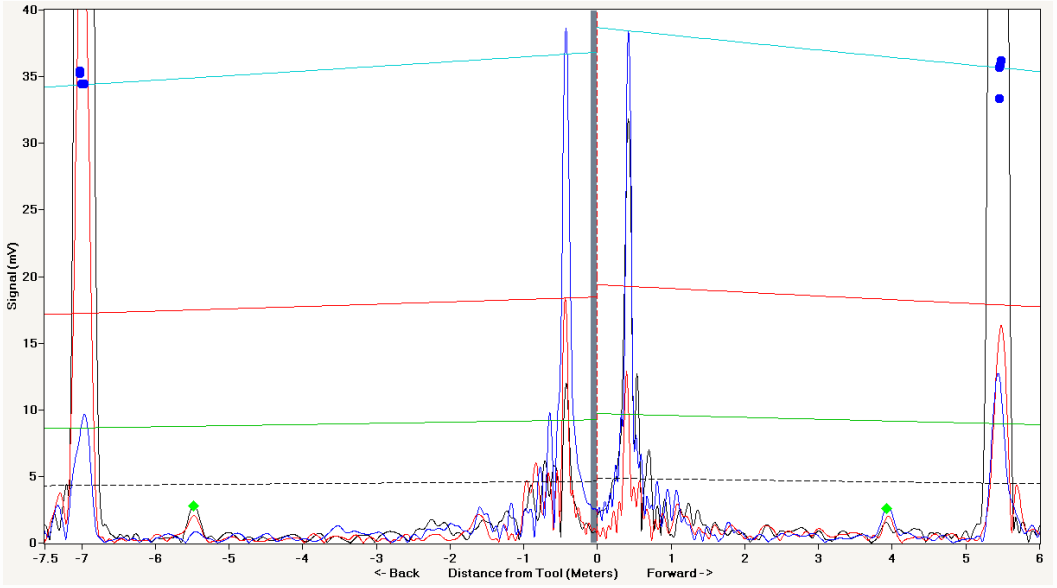
# Focal Response – Constant Angle

| | | | |
|---|---|---|---|
| **Defect Shape with constant area loss** |  |  |  |
| **Axi Symmetric response showing amplitude** |  |  |  |
| **Focus response showing angular distribution** |  |  |  |

# Improved Focusing

- Sound energy concentrated in one region
- Rotation 8 times around pipe
- 4 times greater sensitivity than cross sectional volume
- Multi defect focus capability
- Defect / Feature discrimination
- Circumferential information is obtained.
- Data can be displayed in a more easily interpreted manner.
- The operator needs to distinguish between:
  - Areas of concern that need immediate attention
  - Areas to earmark for inspection in the future
  - Areas of no significant problems
- This method provides semi-quantitative results
- It is an efficient classifier of defects

# Enhanced high resolution plots



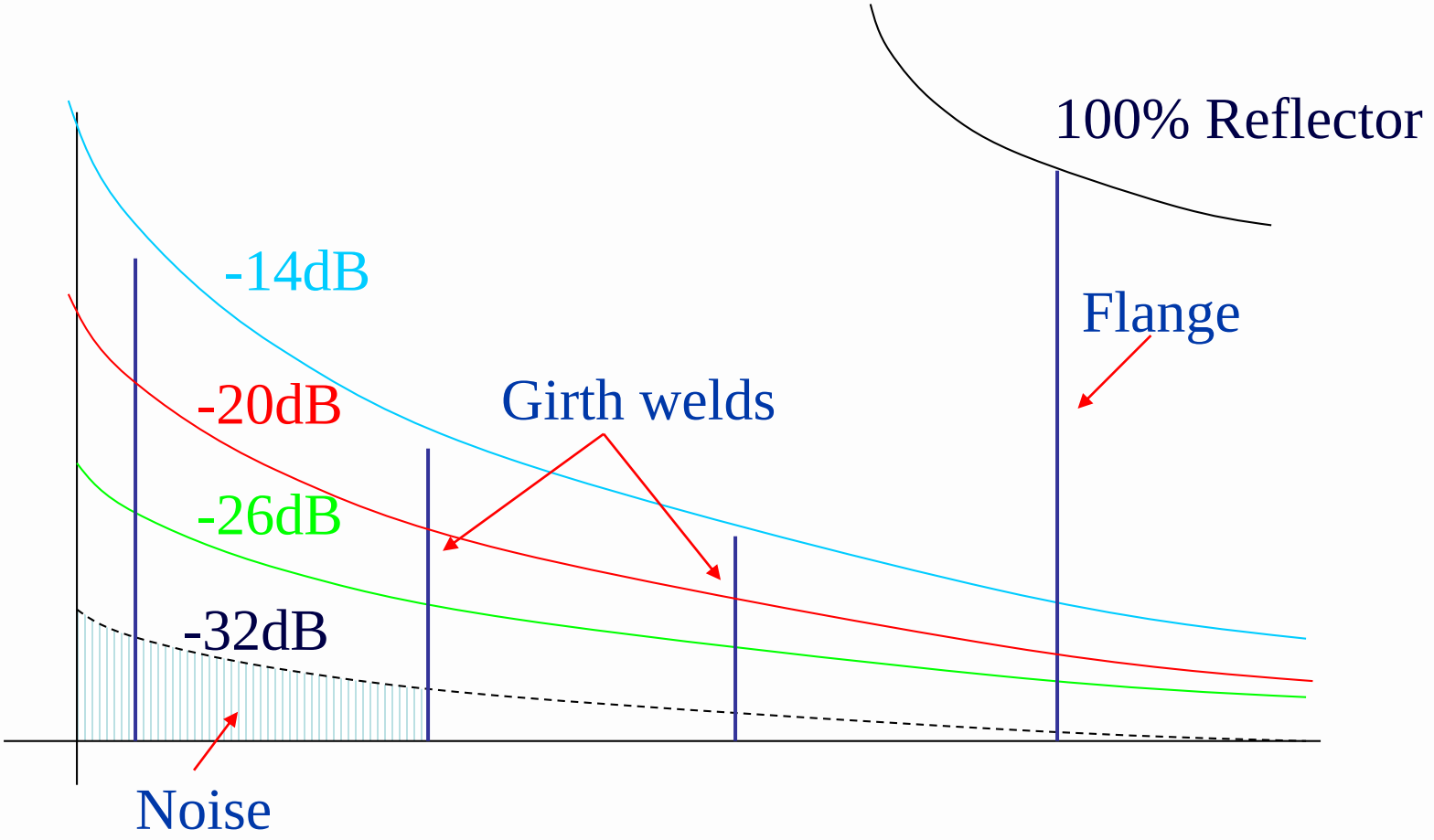
# Classification Scheme

Combine axisymmetric amplitude with distribution of the angular response from focusing, to get a follow-up priority

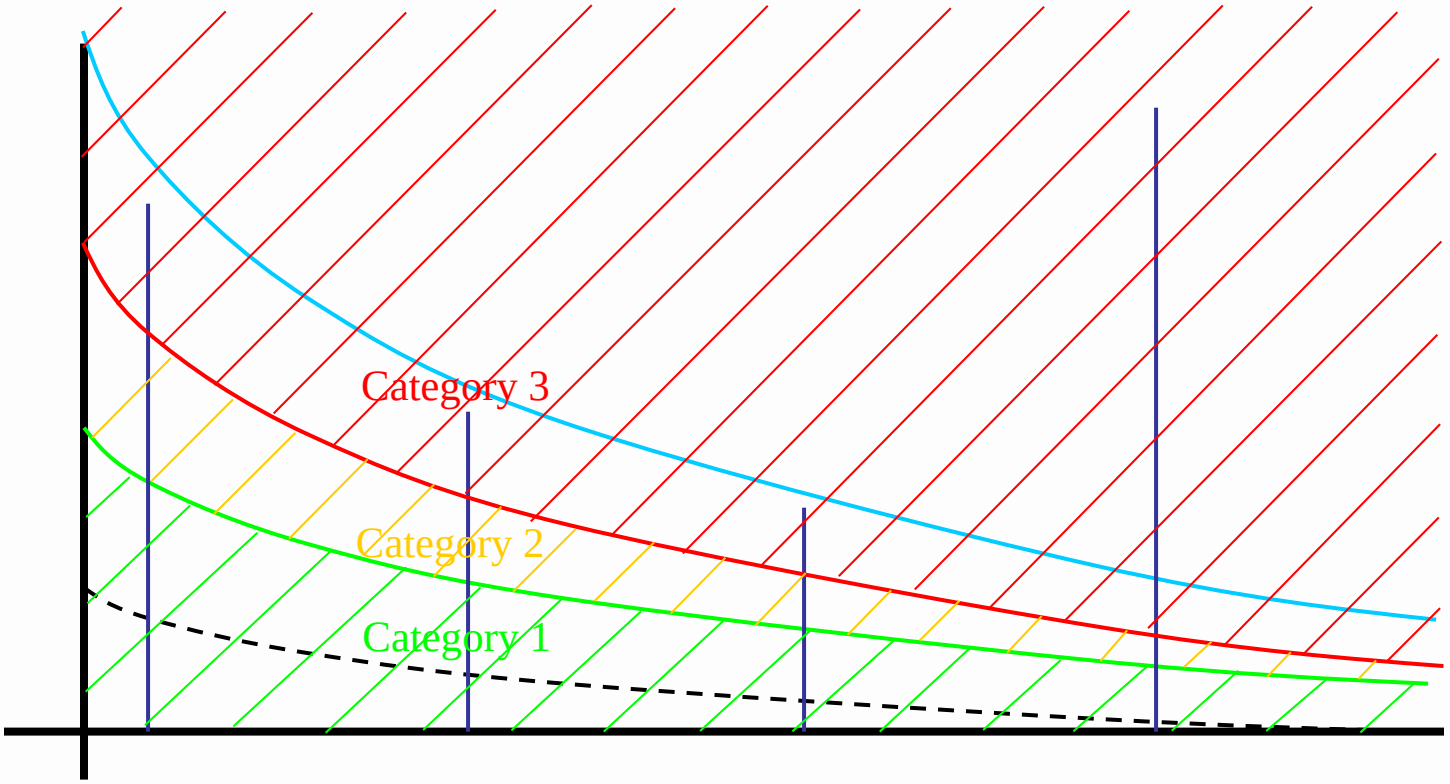
- Defect Category C, where
  - Amplitude is less than -18dB from weld signal, C = 1
  - Amplitude is between -18dB and -12dB from weld , C = 2
  - Amplitude is greater than -12dB from weld, C = 3

- Directionality Distribution D, where
  - Angular distribution is less than 45°, D = 3
  - Angular distribution is between 45° and 90°, D = 2
  - Angular distribution is between 90° and 315°, D = 1
  - Angular distribution is 360°, D = 0

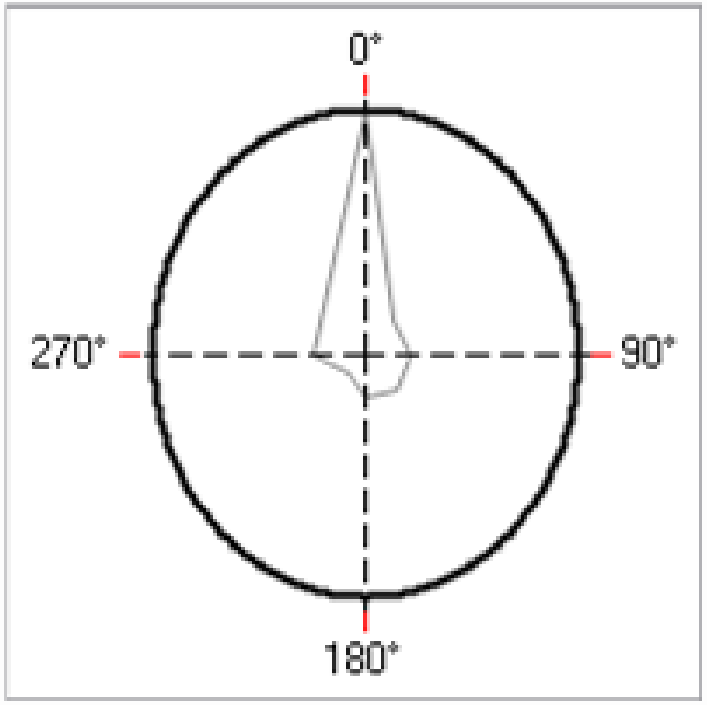
# A-scan Threshold Levels

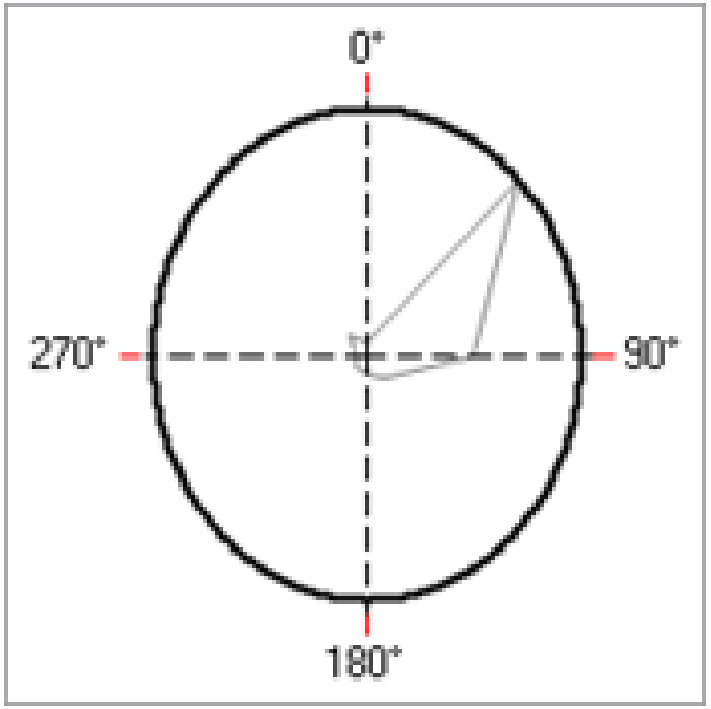


# A-Scan Threshold Levels

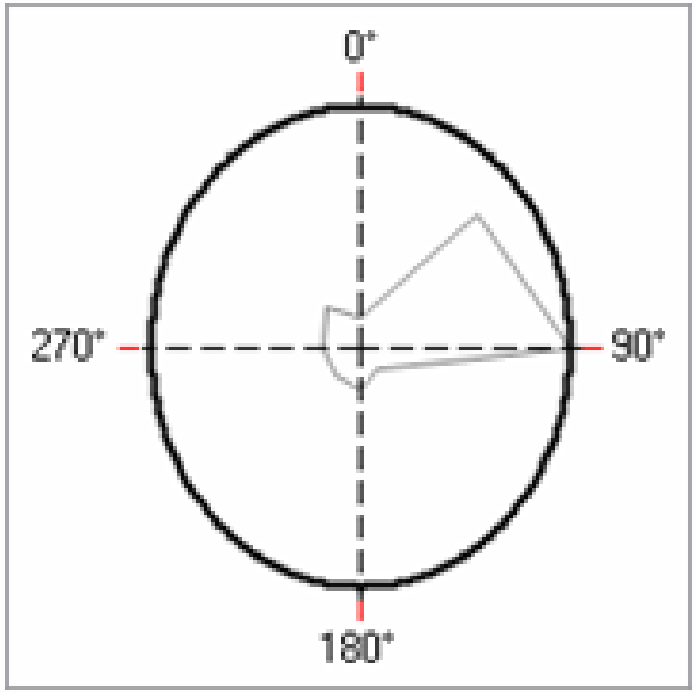


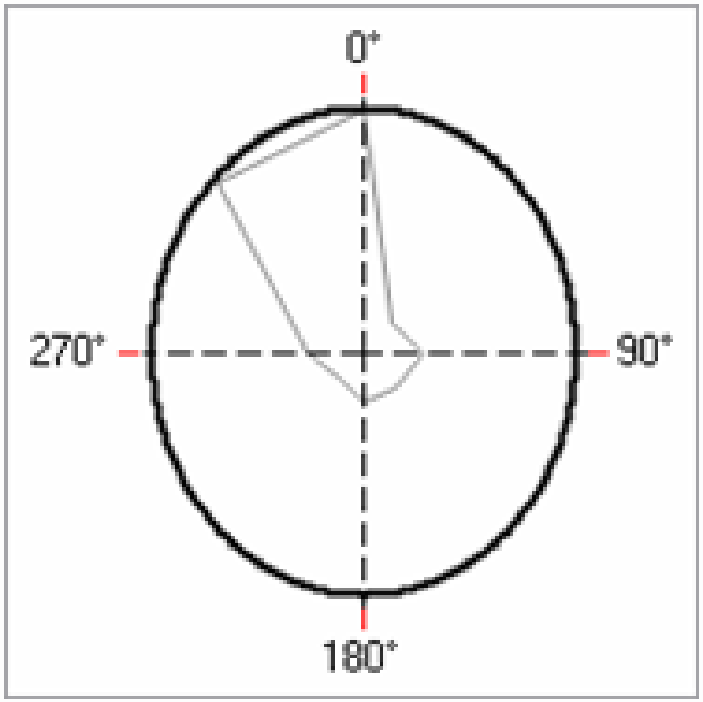
# Directionality Category 3 Defect



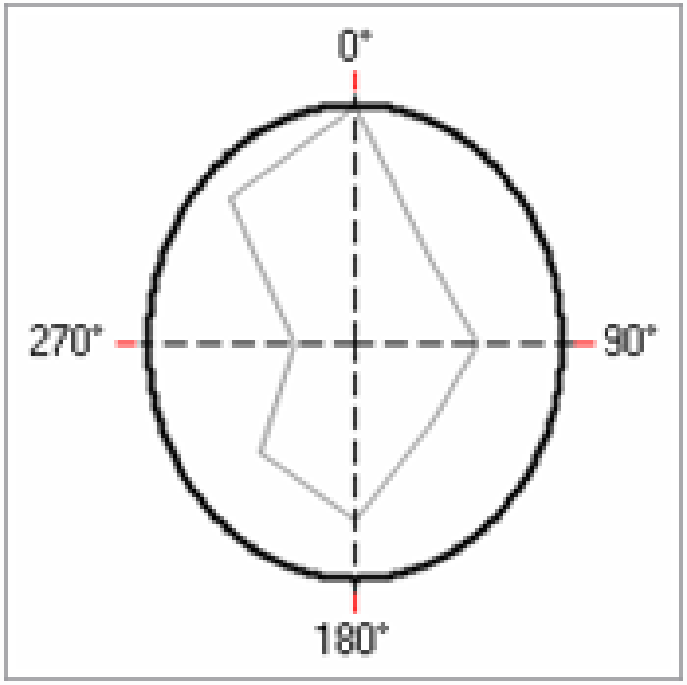



# Directionality Category 2

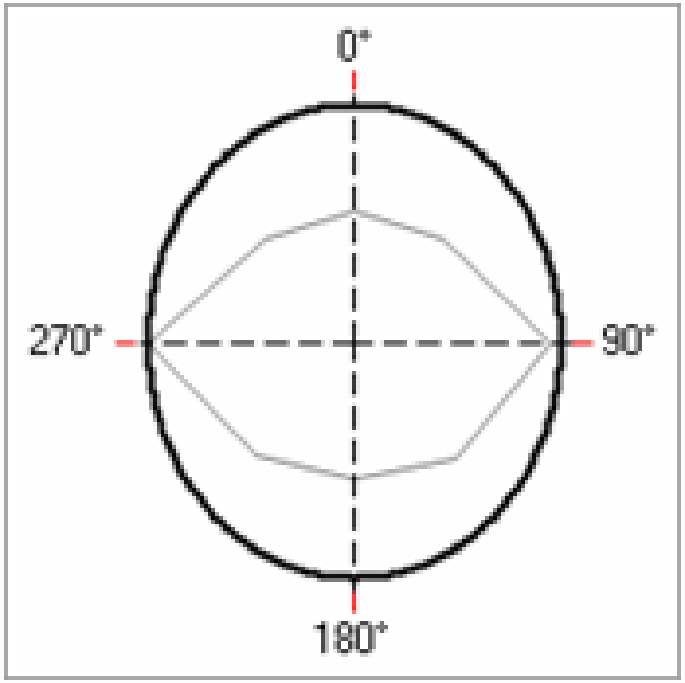


# Directionality Category 1



# Directionality Category 0



# Evaluation Matrix

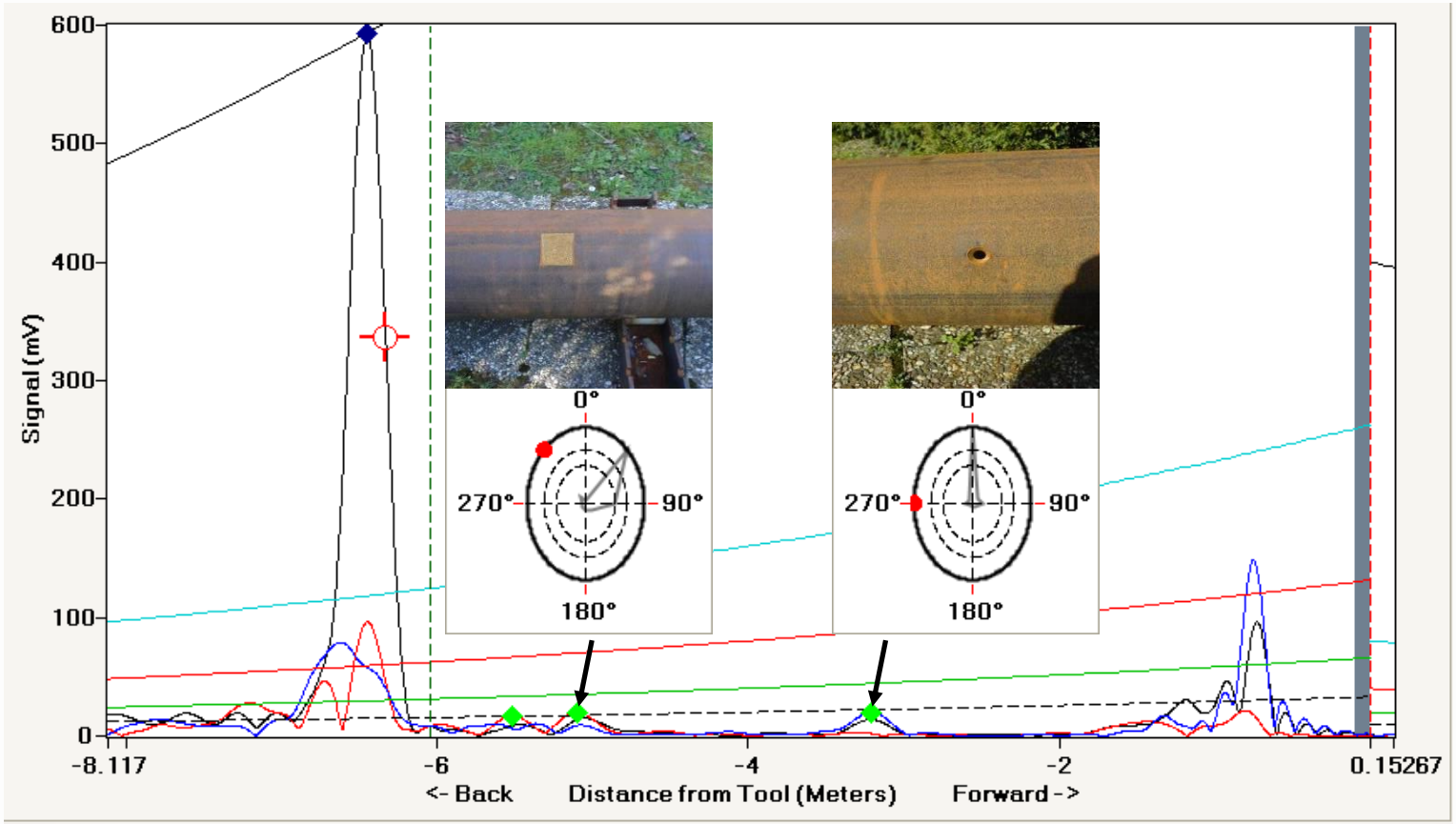
Product of C and D gives Follow up priority

| Follow up priority | | Defect Category, C | | |
|---|---|---|---|---|
| | | 1 | 2 | 3 |
| Directionality Distribution, D | 0 | 0 | 0 | 0 |
| | 1 | 1 | 2 | 3 |
| | 2 | 2 | 4 | 6 |
| | 3 | 3 | 6 | 9 |

- Low priority  Moderate priority  High priority

If C x D = 0, the response is a weld

# Usefulness of Focusing




- Information about the circumferential extents

# GWT- Cased vs. Buried

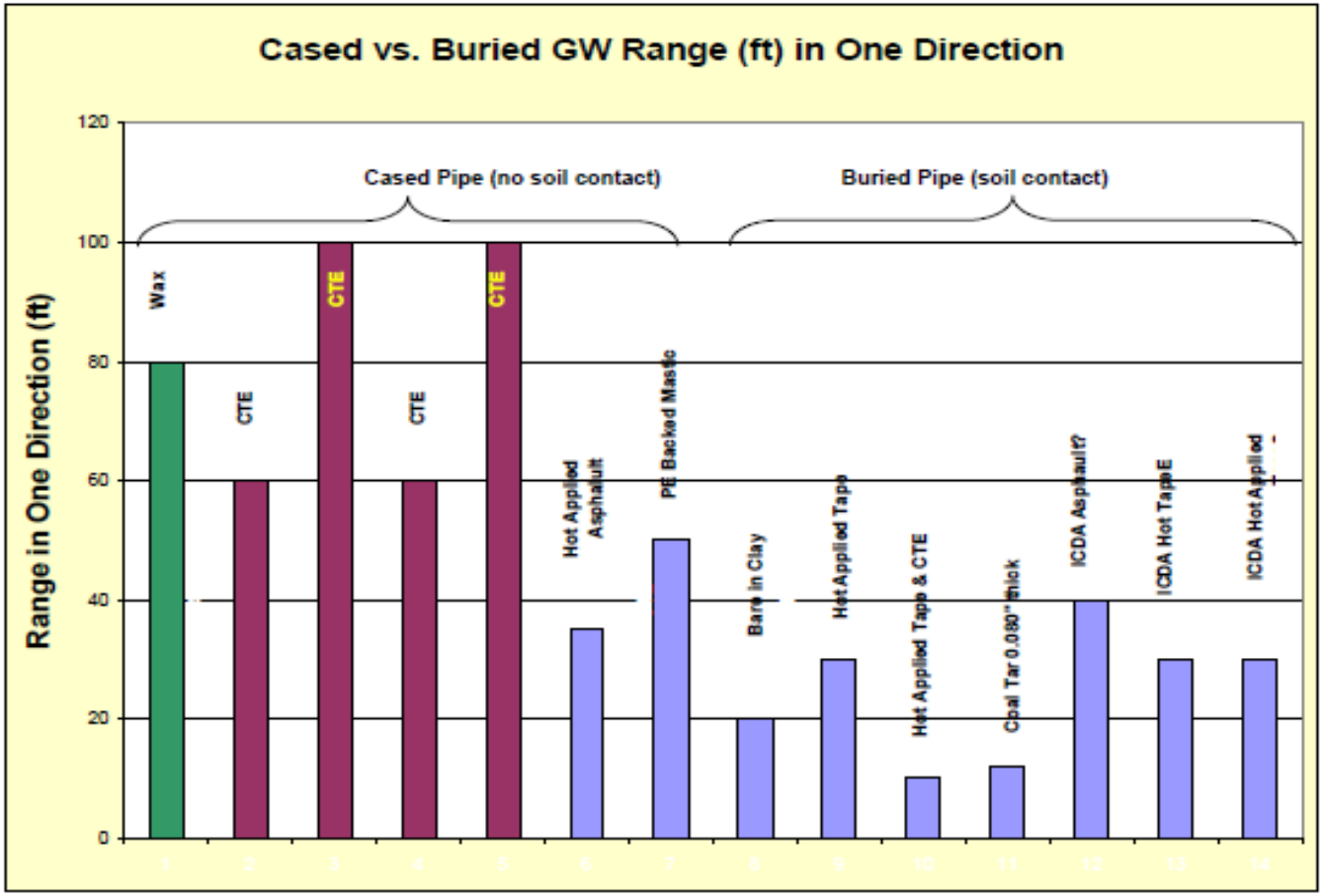
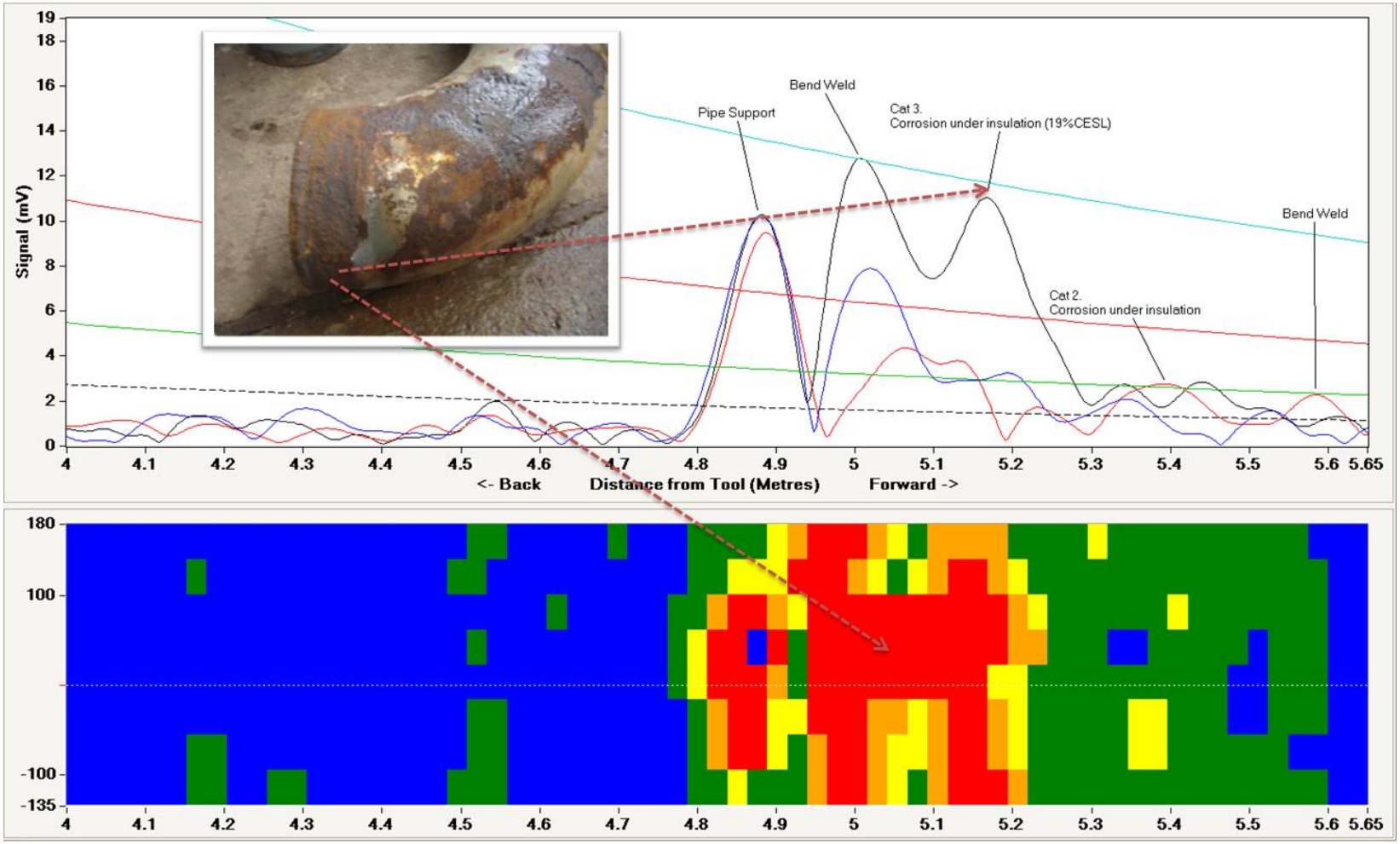
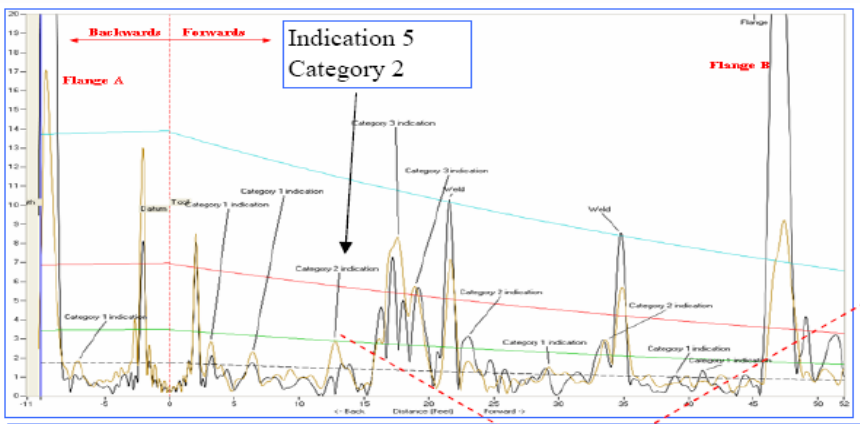


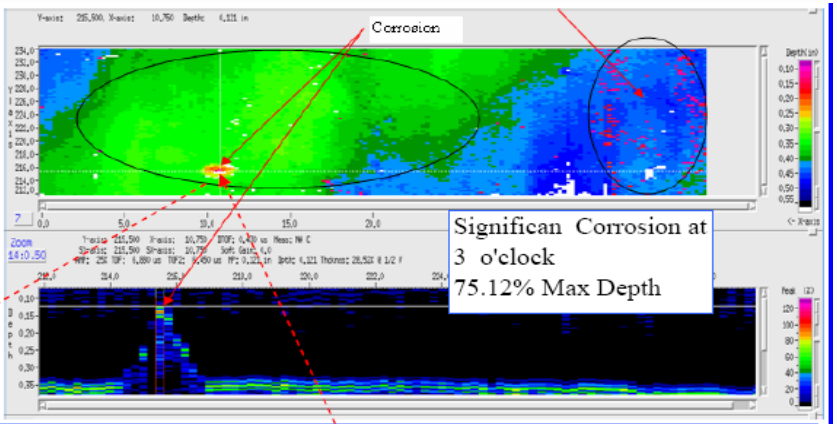

Figure 171. Cased vs. Buried GW Range in One Direction (broken out by coating type) - this arrangement better shows the dampening effects of different coatings. Note that the bare pipe example was dampened by the clay around it. Inspection distances are best determined in the field. The range can vary from a quarter joint (e.g., 10 ft) to almost 2.5 joints (100 ft) in these examples.

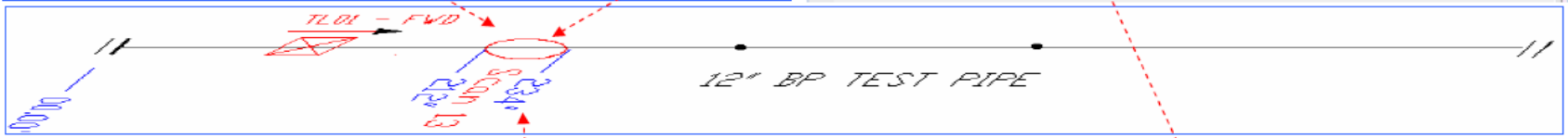
# CUI (Corrosion Under Insulation)

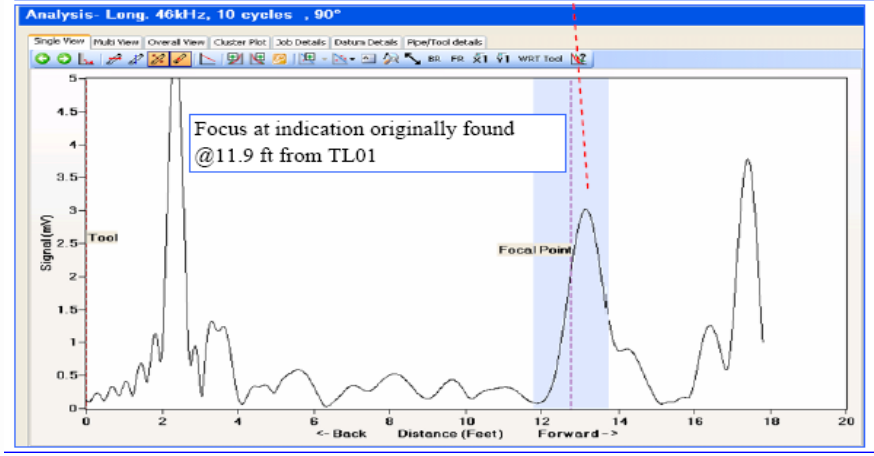


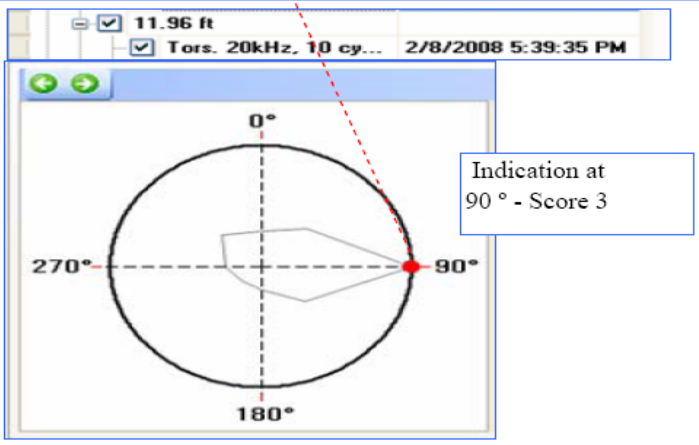
# GWT indications confirmed with AUT



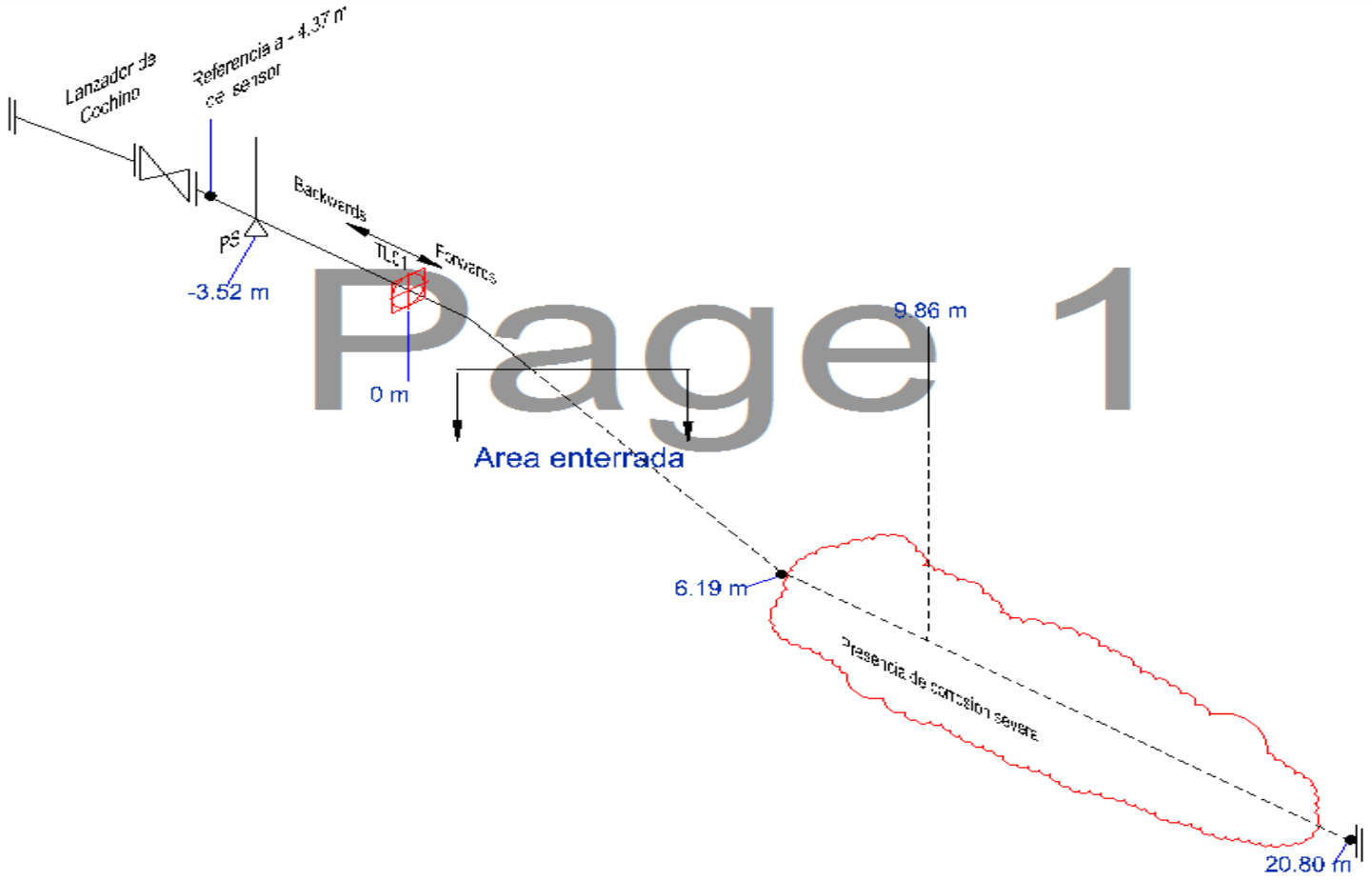



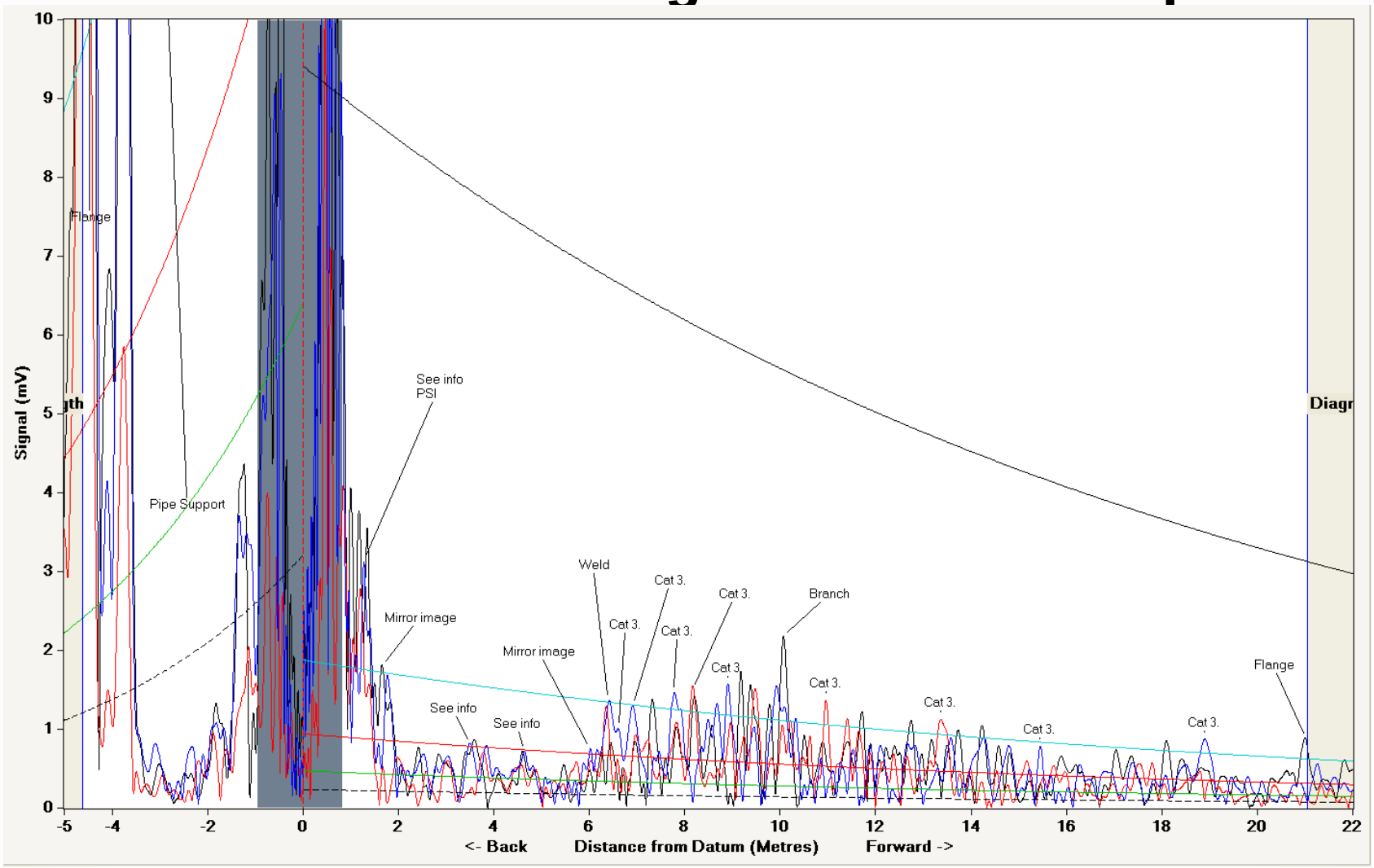



# Underground Test

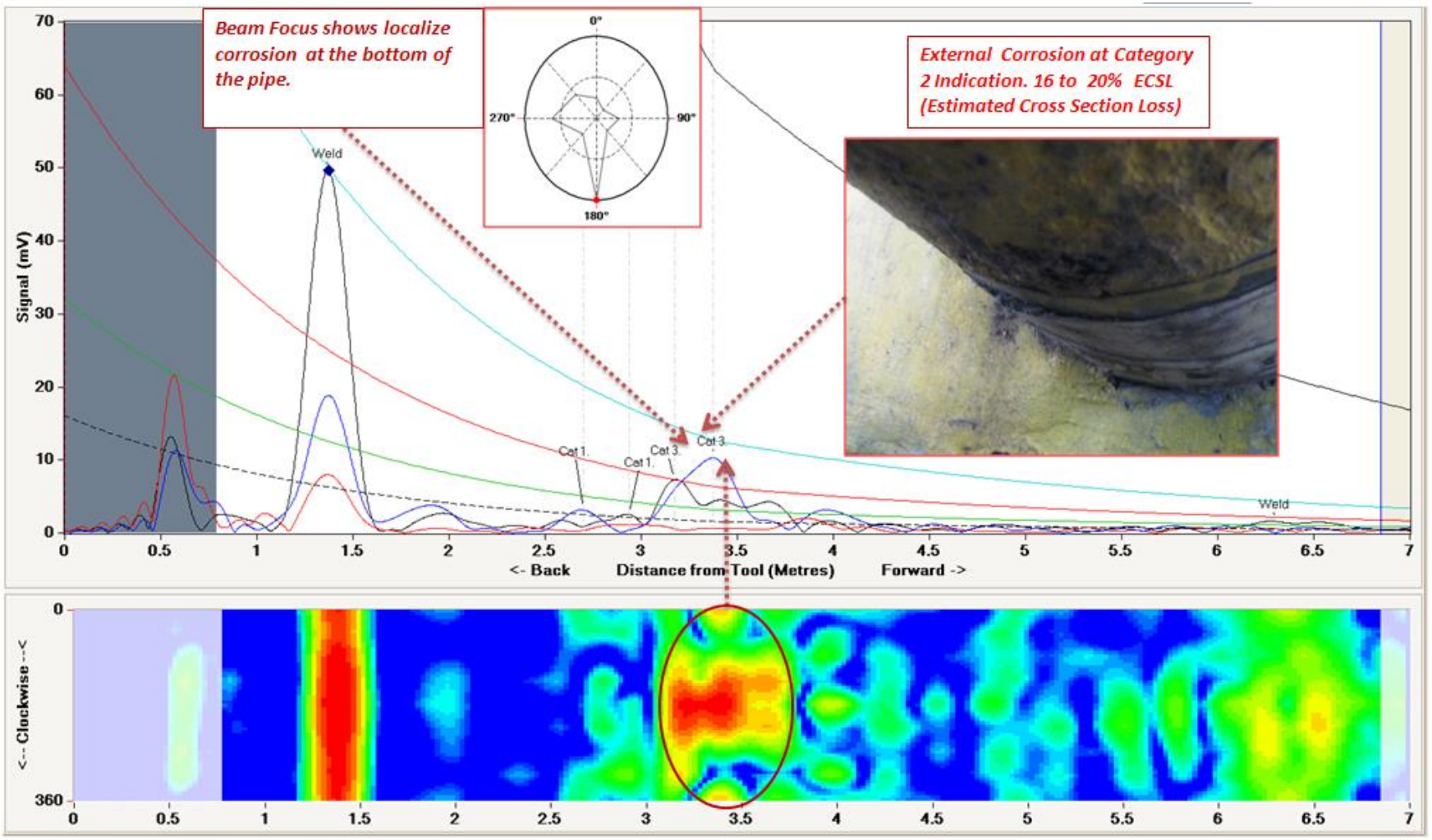


# Results of Underground Test Loop



# Bridge Crossing

# Results of Bridge Crossing Test



# Certification

- TWI Certification Ltd issued the Examination and Syllabus for the Certification of Personnel Engaged in Guided Wave Ultrasonic Inspection for the Detection of Corrosion in Pipe – outlined in the LRU Written Practice ISS 2.2 rev 0 Dated May 2007.

  - The certifying scheme is the CSWIP-ES-12-04 1st Edition Feb 2004 (Requirements for Employer Specific Certification of Personnel Engaged in NDT).

  - The certification as a minimum complies with ISO 9712 and EN 473.

  - Techcorr has eight (8) Level 2 and six (6) Level I Technicians certified under this scheme.

  - Most of our Technicians are metallurgical or mechanical engineers whom have gone through a three (3) year training process internally via our operations in Latin America.