ULTRA Analytix™

Non-Intrusive & Non-Destructive Inspection of FRP – Case Studies

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Plan

1. Introduction

2. Case Studies:
   a) Duct
   b) Vacuum Vessel
   c) Spent Acid Tank
   d) Dual Laminate

3. Summary

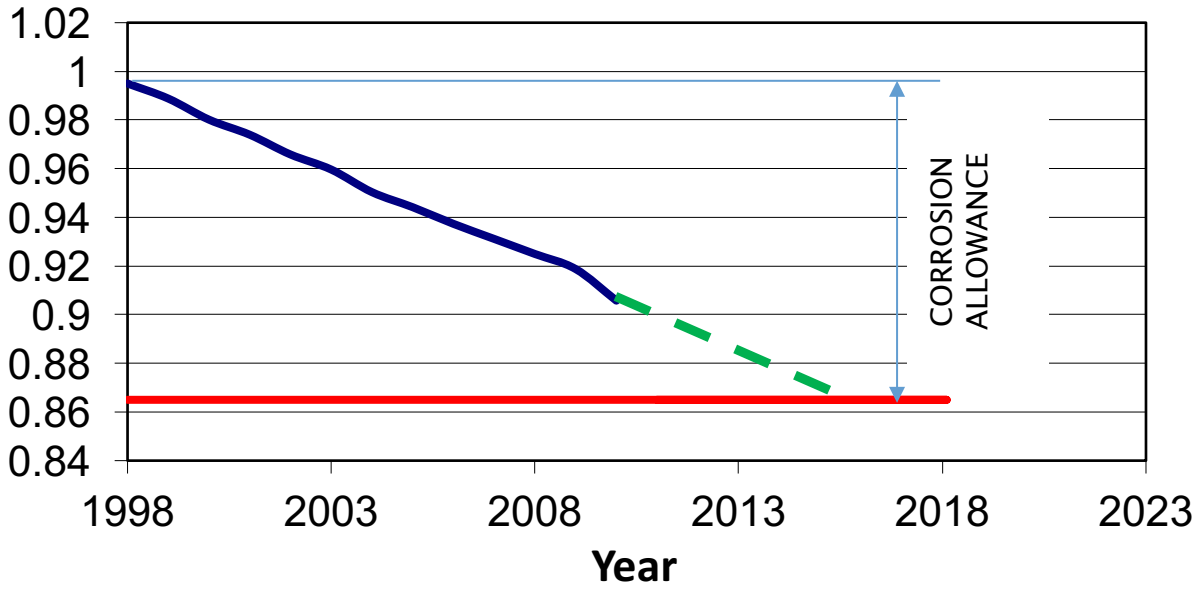
Mechanical Integrity & Fitness for Service of FRP

Can the asset continue functioning?

- **Requires:**
  - **Non-Destructive Methods**
    - Repeatable and reliable
    - Current condition of a component
  - **Objective criteria for evaluation**
    - Supported by data

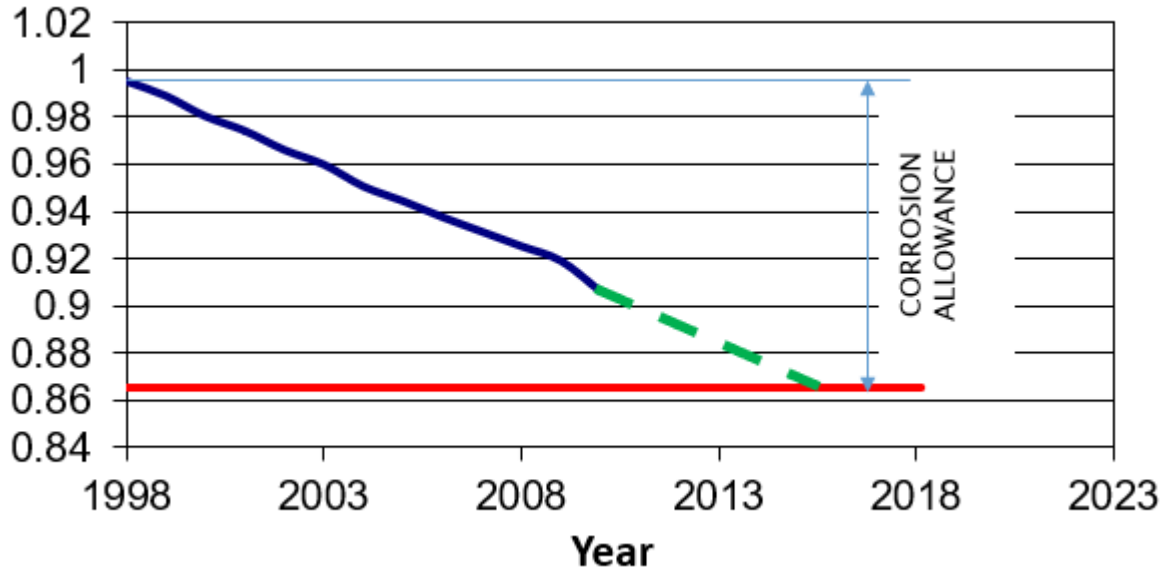
- **Desirable:**
  - **Non-Intrusive Methods**
    - Facility operating during inspection
    - Maximize safety of personnel
  - **Codes, Standards**
    - Concensus standards linked to design – not available yet

Purpose: Provide meaningful Fitness for Service (FFS) and condition assessment of FRP.



Non-destructive & Non-intrusive

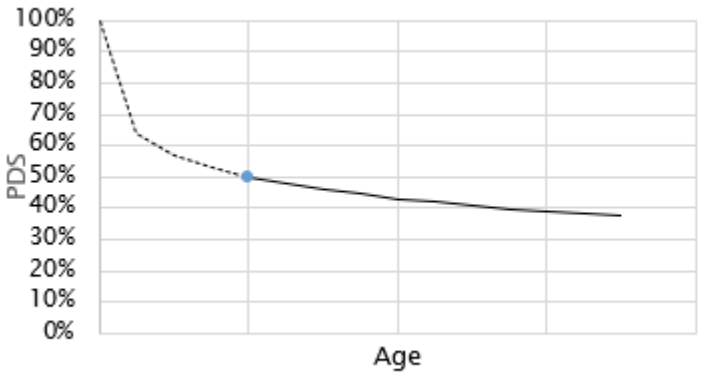
Purpose: Provide meaningful Fitness for Service (FFS) and condition assessment of FRP.



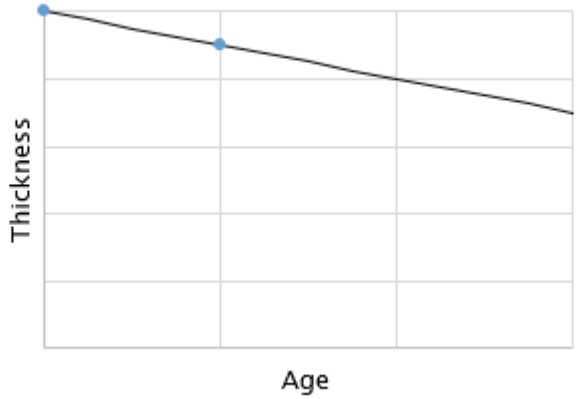
Non-destructive & Non-intrusive

Parameters Used

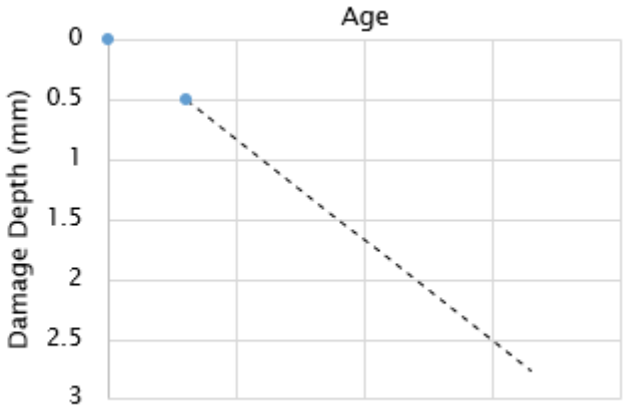
- PDS: a parameter related to structural capacity



- Thickness:



- Corrosion Barrier Damage Depth

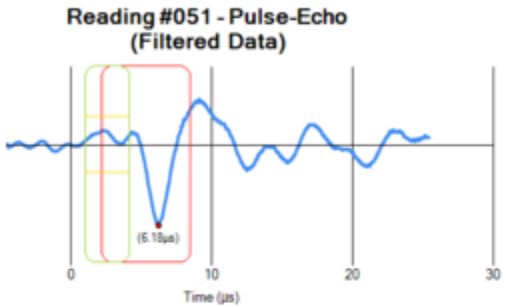


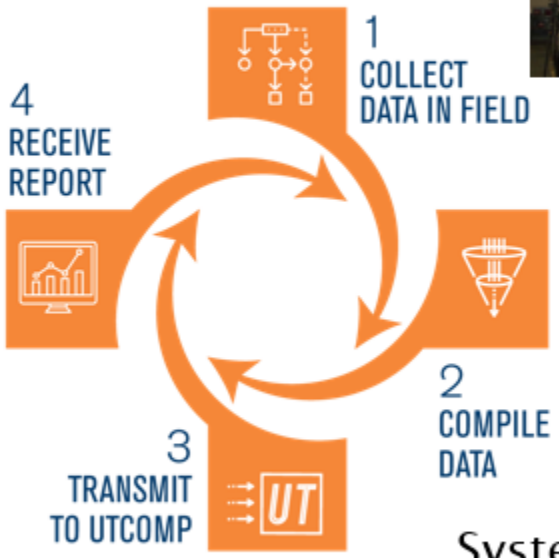
- Limits: based on experience derived from data
- *All derived from ultrasonic A-Scan*

External FRP FFS Inspection

- **Finds immediate issues**
  - *100% NON-INTRUSIVE*
  - Identifies failures and problems visible from the outside
    - Leaks
    - Failed Flanges
    - Support defects
    - Overflow defects
    - Etc.
  - Follow systematic checklist
  - Some guidance from API 653, 510, 570

How it Works





Non Destructive
Ultrasonic Readings
External visual
Non Intrusive
No downtime

Local Inspectors

Systematic
Successful Training

When Data from New FRP is Not Available

- Assume that new FRP was at 100% of original design values.
- Compare current values to 100%.
- Track changes and predict life from fastest rate of change.
- Calibration standards are NOT required.

Case Studies

Case Study – SO_2 Duct

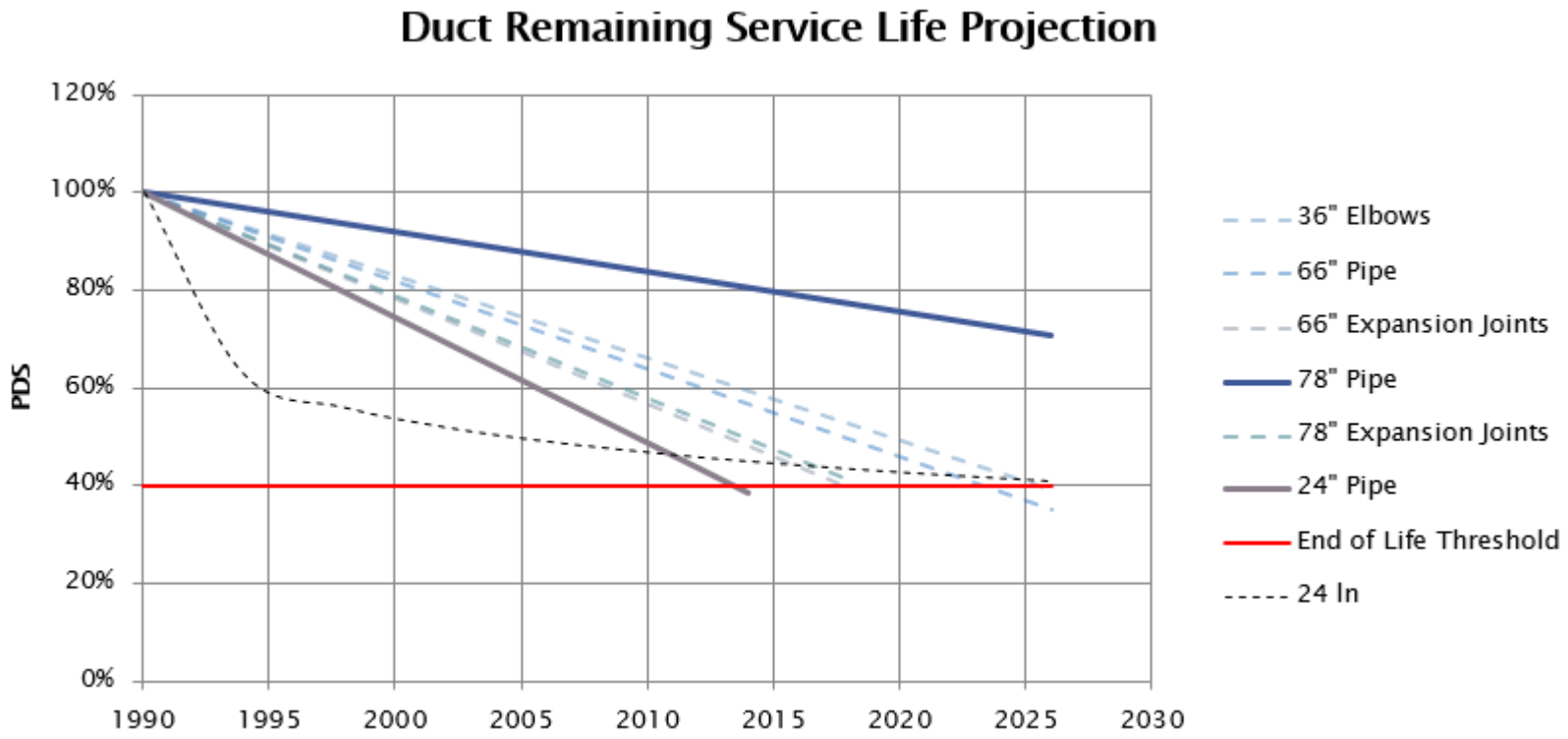
- Carrying corrosive humid SO_2, .
- Includes FRP expansion joints.
- Portions relined 2 years previously.
- Immediate replacement recommended at last internal inspection.
- “How soon do we need to replace?”

Case Study – SO_2 Duct

- Inspection:
  - Completed while facility was operating.
  - Duct outer surface temperature ~ 75C.
  - All inspection of 1,000m of duct completed in 3 days.

Case Study – SO_2 Duct

- Results:



Case Study – SO_2 Duct

- Results:
  - No need to replace 78” duct for foreseeable future.
  - Expansion joints show structural damage.
  - No damage to corrosion barrier was detected.

Case Study – Vacuum Vessel

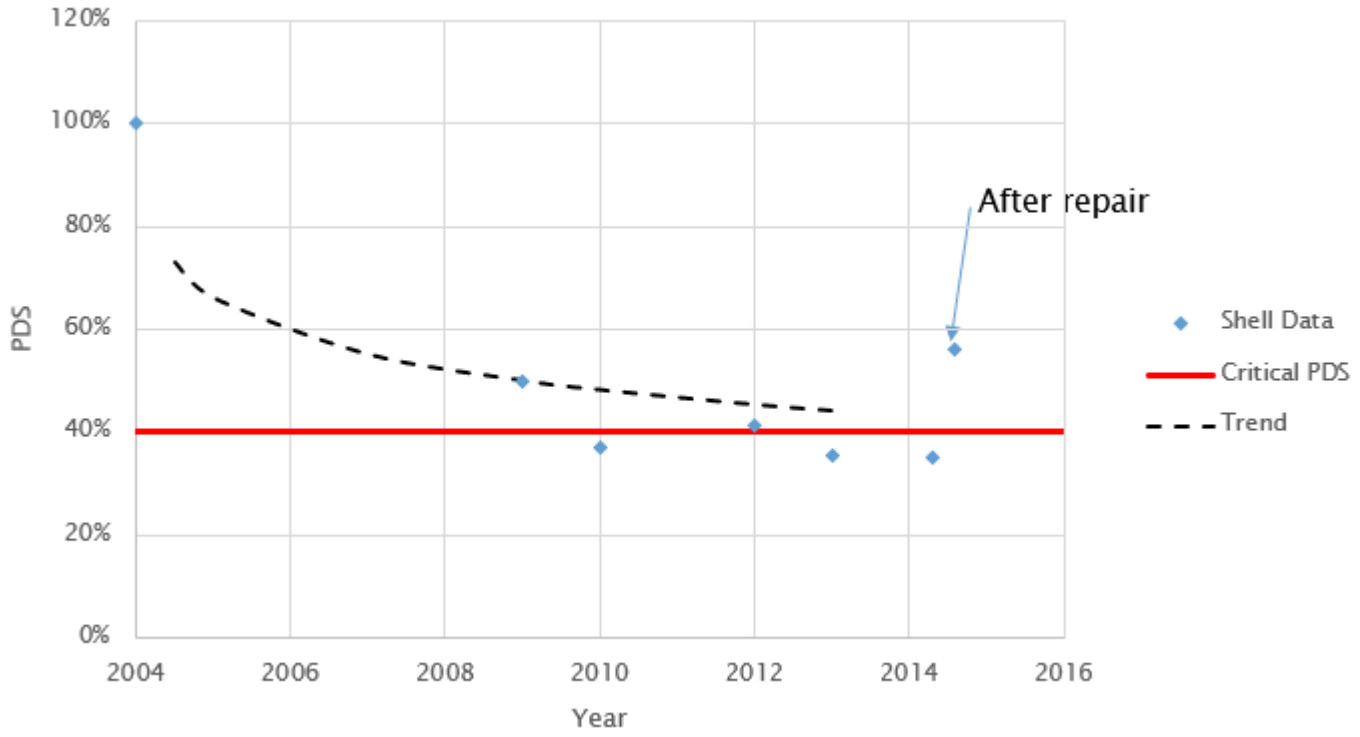
- First inspection in 2009.
- In 2010 low structural strength was noted.
- 2011 engineering analysis and repair recommended.

Case Study – Vacuum Vessel

- March 2014: Design of repairs complete and planned for May

Case Study – Vacuum Vessel

- Inspection History



Case Study – Vacuum Vessel

- Results;
  - Timely identification of need for repair.
  - When completed, re-start life prediction.

Case Study – Regenerated Acid Tank

- Pickling Acid
- 7 years old
- First inspection 2015 – ultrasonic
- Results show blisters in corrosion barrier and good structural capacity (57%; Safety factor 5.7)
- No thickness loss, no CB damage
- Several nozzles with cracked flanges

Case Study – Regenerated Acid Tank

Recommendations

- Replace damaged flanges
- Inspect again in 3 years

Case Study – Regenerated Acid Tank

- Flanges were replaced.
- Corrosion barrier appearance:
  - Blisters as predicted
  - No significant softening
  - UT does not see color change but does see damage depth such as from softening, overheating
- Put back into service.

Case Study – Dual Laminate

- Tanker:
  - Hand Layup using Novolac Resin
  - Lining: 2mm ETFE
- 22 years old
- Waste acid

Case Study – Dual Laminate

- Stains and “bleed out” at some lining welds
- $$ available to repair BUT…..
- Must assess for fitness for service.

Case Study – Dual Laminate

- Inspection and Results

PDS = 82%

PDS = 60%

PDS = 84%

PDS = 48%

PDS = 50%

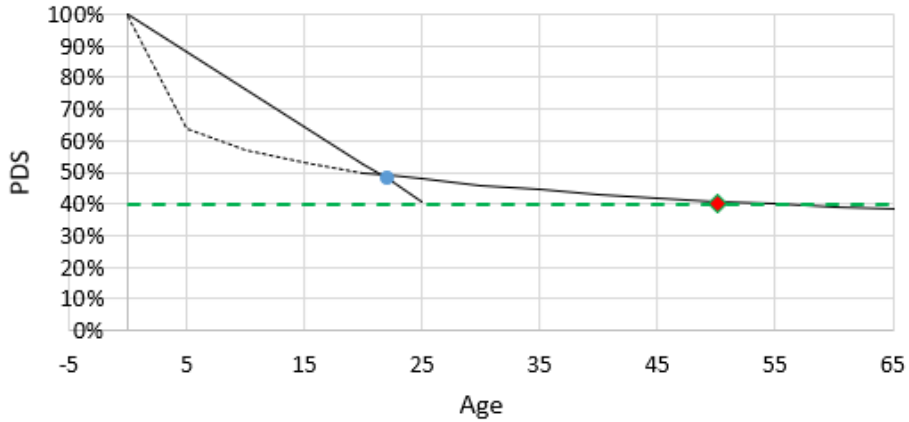
PDS = 80%

- No damage to inner surface was detected

Case Study – Dual Laminate

Results:

- No damage to FRP detected under stained welds
- No significant structural damage to FRP at carriage



- Customer chose to return to service.
- Avoided ALL lining repair cost

Limitations

- Operates best at temperatures >50°F or 10°C
- Not useable with foam cores
- Not useable with balsa core >3inch or 7.5cm
- No verification for pipe <5cm (2inch) outside diameter
- High Magnetic fields disrupt instruments
- Transducer must be in contact with FRP surface
- Accurate interpretation in the field is not available
- Scanning method has not been developed

Summary

- Safety: Significant reduction in Confined Space Entries.
- Uptime: Evaluations are usually completed while operating.
- ROI: Average savings $10 – $100 for each $1 spent on this inspection.

- Extensive history of valid and reliable results.
- Meaningful FFS results.

Questions?

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UTComp 2008-2018 10th ANNIVERSARY

CELEBRATING 10 YEARS OF FRP RELIABILITY INNOVATION

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