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ILI and CP Data Comparison and Usage

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Presentation

- Introduction
- ILI Data
- CP Data Sources
- Case Study 1
- Case Study 2
- Case Study 3
- Conclusions

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Penspen Ltd.

- Penspen is an international engineering consultancy.
- We are in the oil and gas business, specialising in pipelines and facilities.
- Our headquarters are in Richmond, Surrey, UK, but we have offices in USA, Mexico, UAE, Bangkok, Greece, Qatar, Libya, Saudi Arabia, France, etc..
- £110 million/annum business.
- We have >1000 staff around the world.

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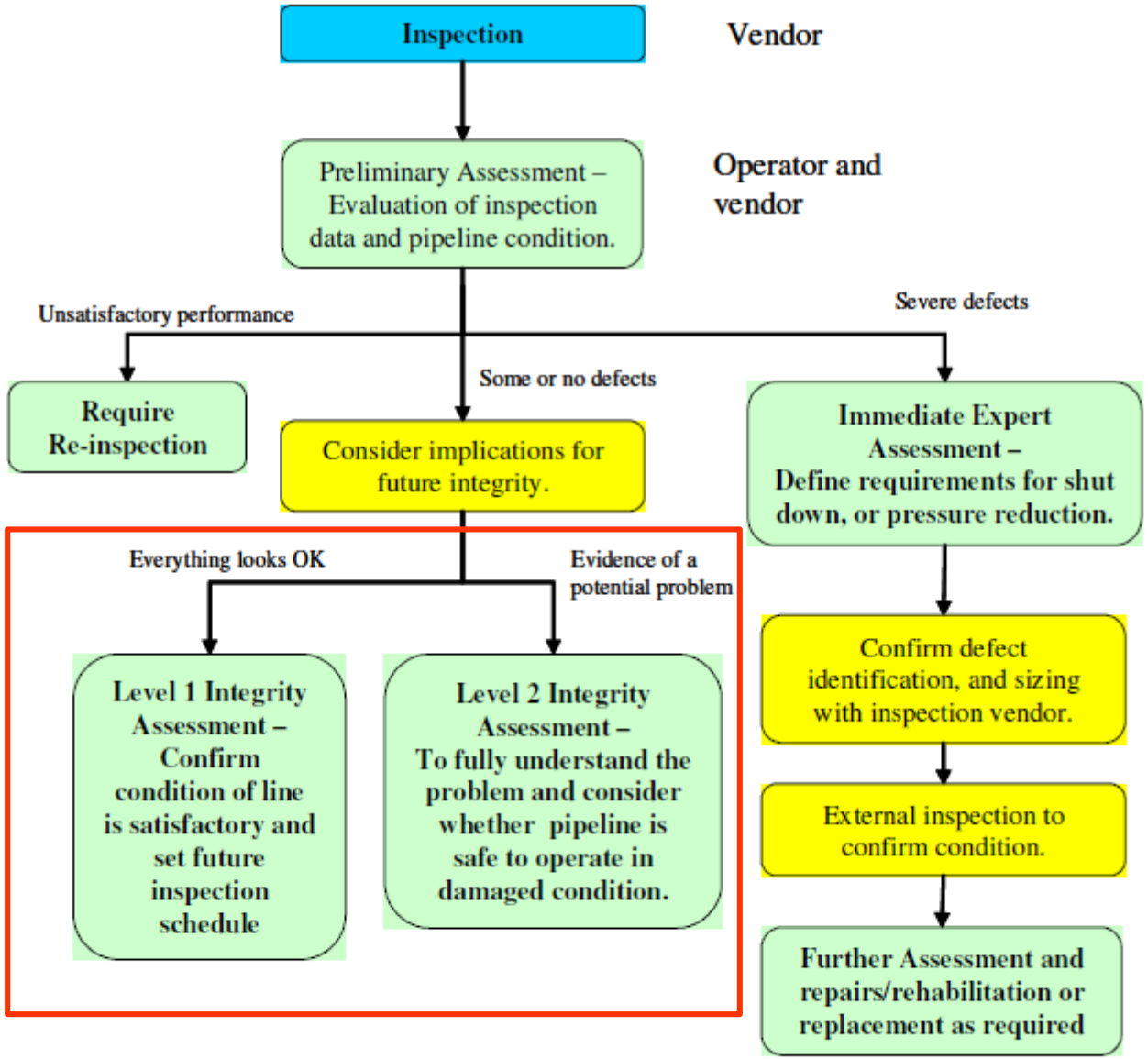
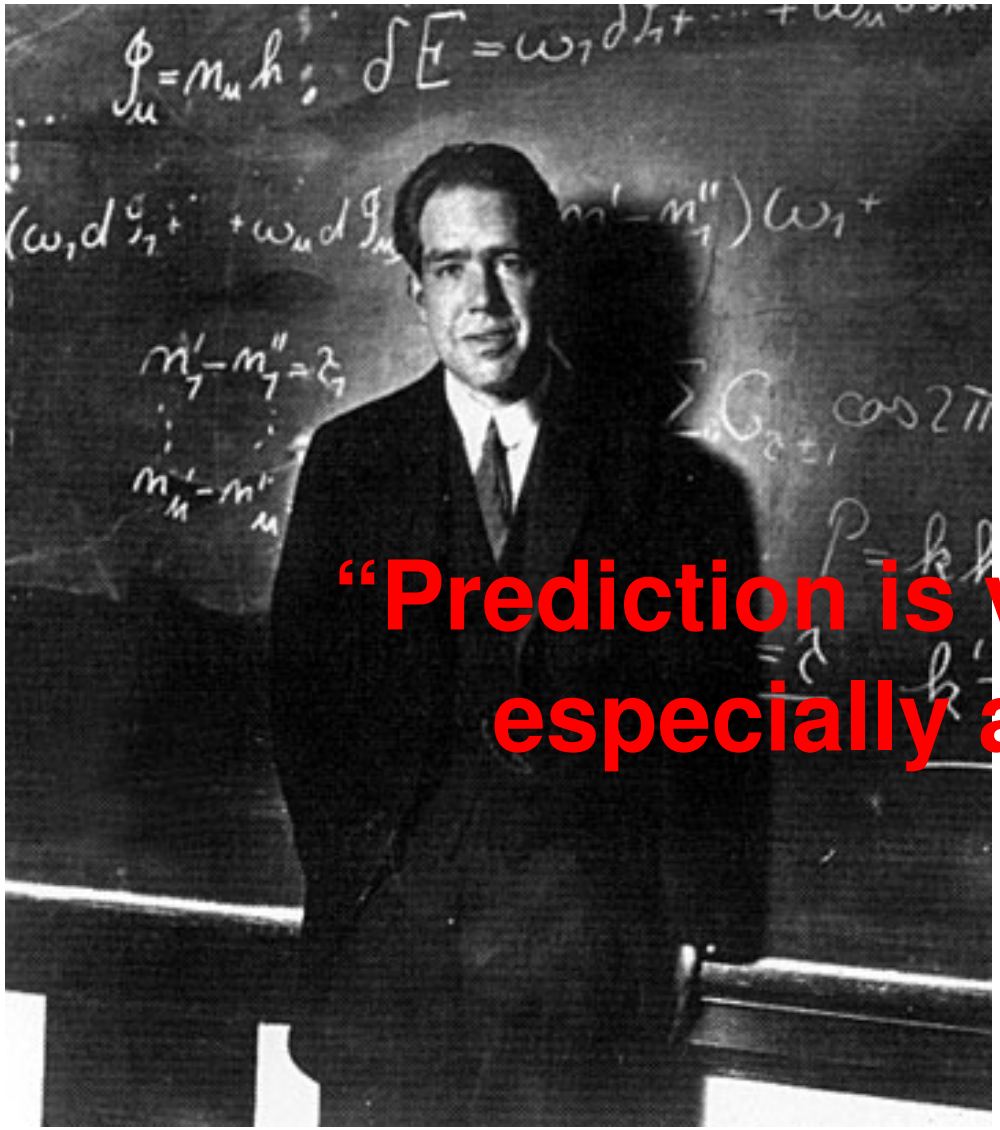
Integrity Assessments-External Corrosion

- Holistic assessment uses data from:
  - ILI
  - Coating surveys
  - CP surveys
  - Soils
  - Expert opinion





Niels Bohr

(1885 – 1962)

Nobel Prize
in Physics 1922

“Prediction is very difficult, especially about the future

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ILI Data

- Generally good for external corrosion
- Primarily used for remaining strength assessment

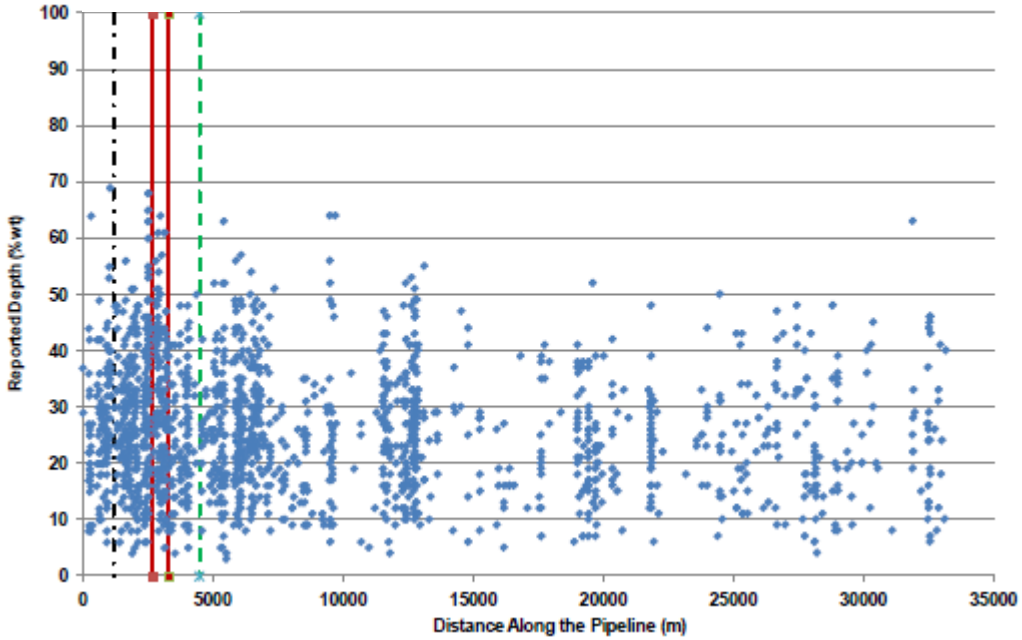
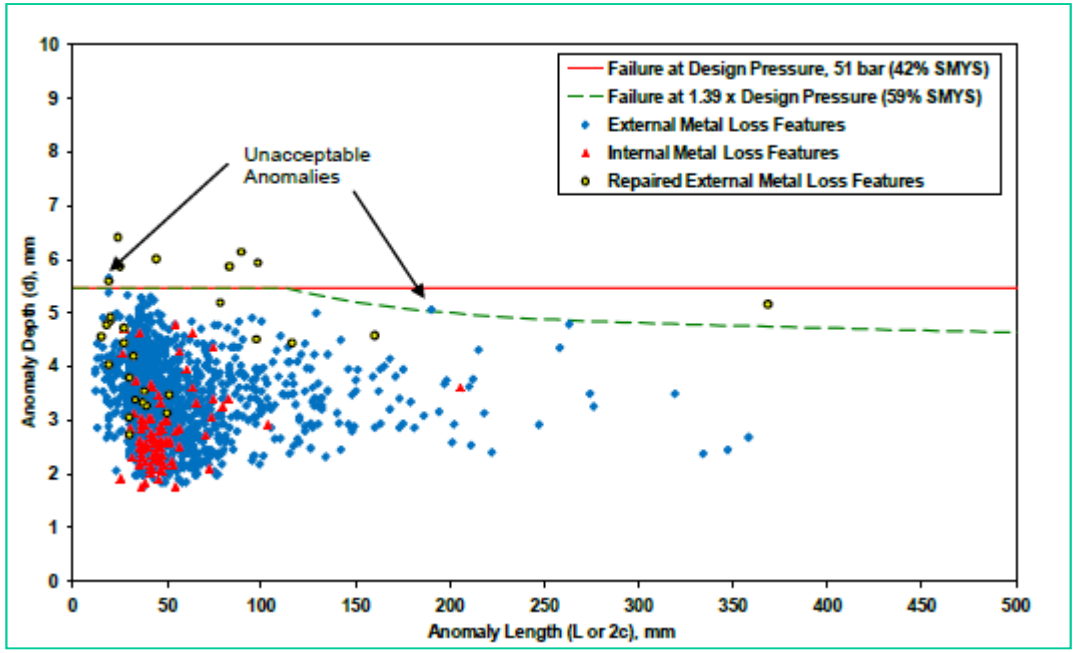


Figure 6-5 Distribution of External metal loss anomalies in relation to their depths (%wt)



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ILI data – Corrosion Orientation

- Orientation gives information on likely cause
  - Field joint coating
  - Backfill

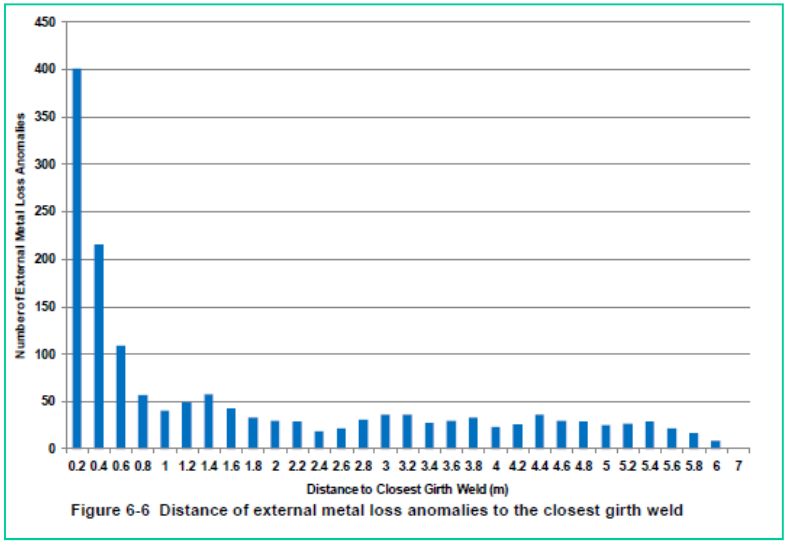
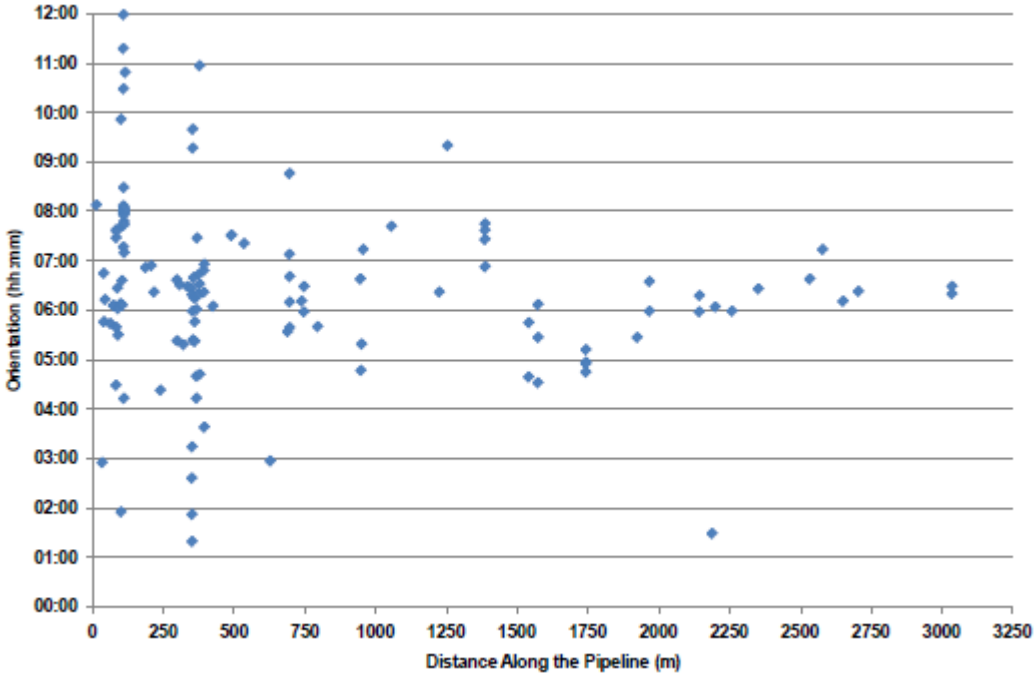


Figure 6-6 Distance of external metal loss anomalies to the closest girth weld



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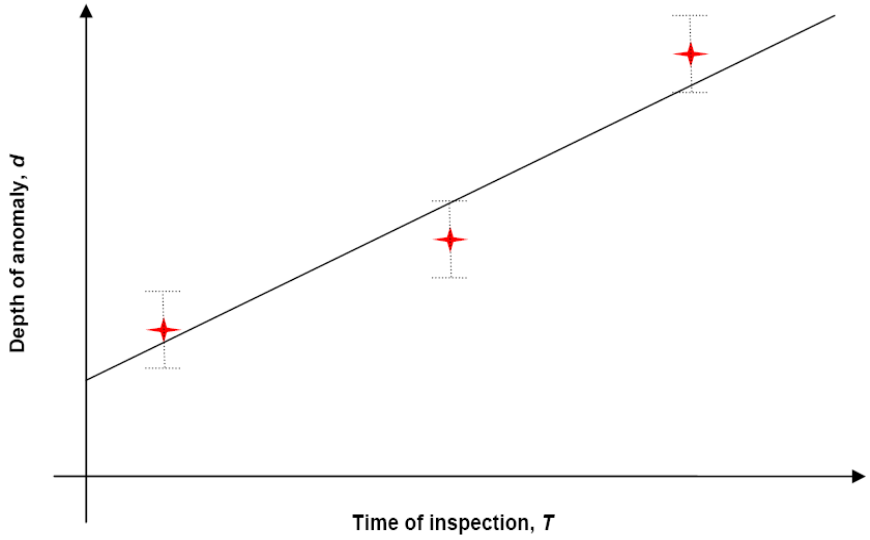
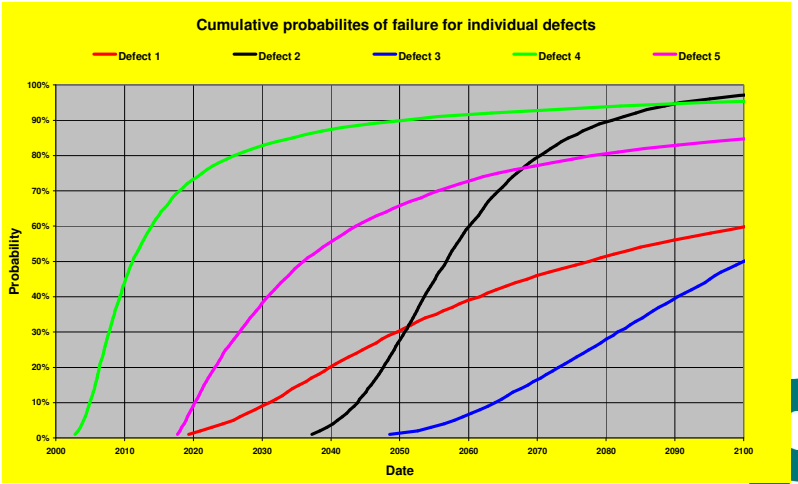
ILI Data - Corrosion Rates

- Multiple defect matching from two sets of ILI data
- Tolerances can have a big impact at low corrosion rates
- Statistician needs to be confident in the results
- Used to determine repair dates and next inspection





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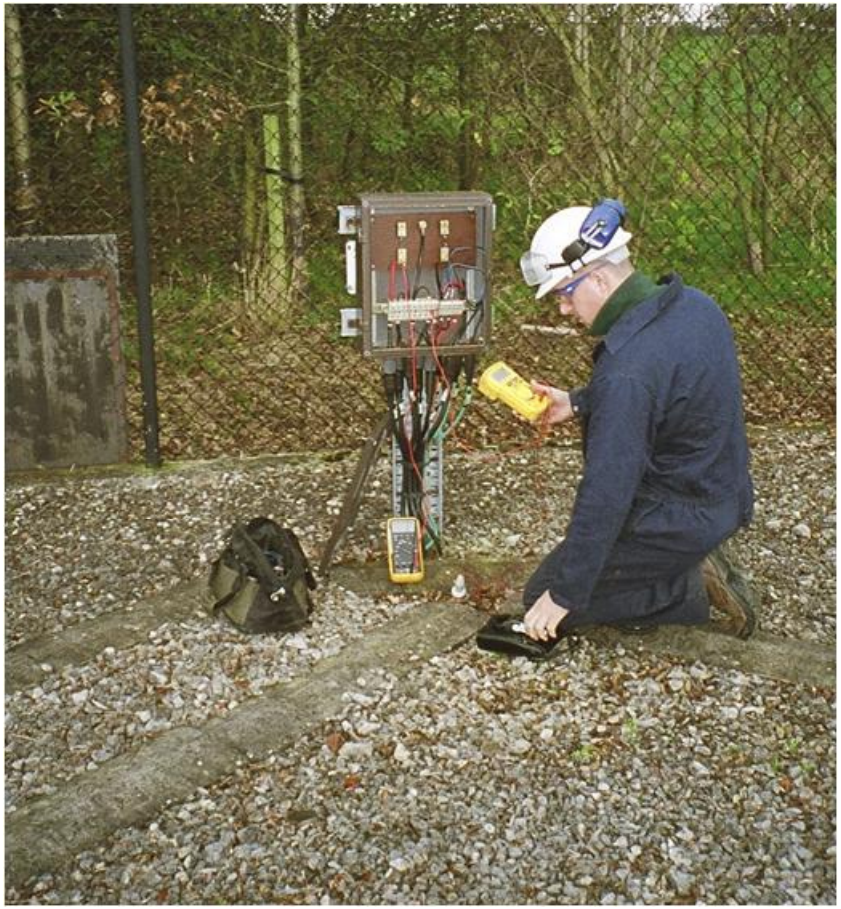
Cathodic Protection Monitoring

- Cathodic protection performance monitored using potential criterion:
  - Indicates whether corrosion can/cannot occur.
  - Gives no indication of corrosion rate
  - Leading Indicator
  - Criterion -850 or -950mV?
  - ON or OFF Potential?
- Need to consider accuracy of measurement, coating type and condition, ac corrosion.



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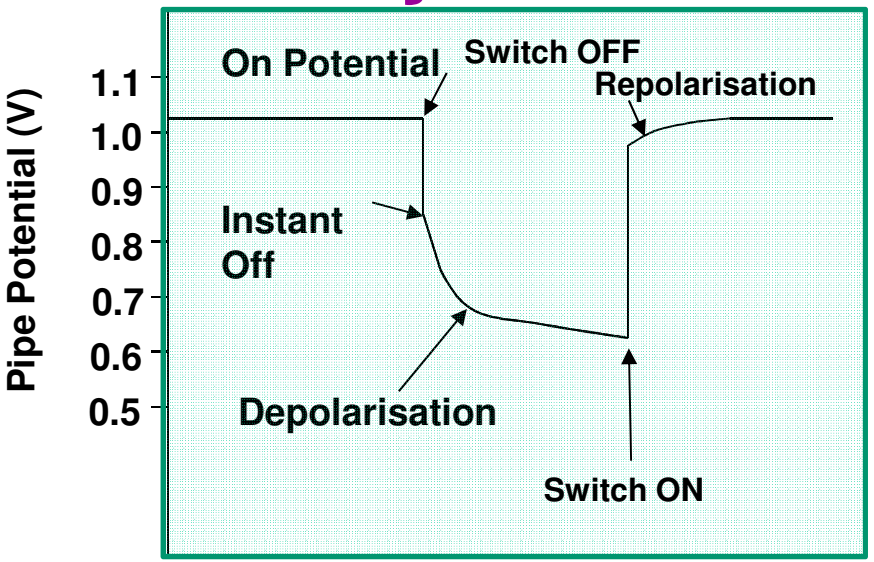
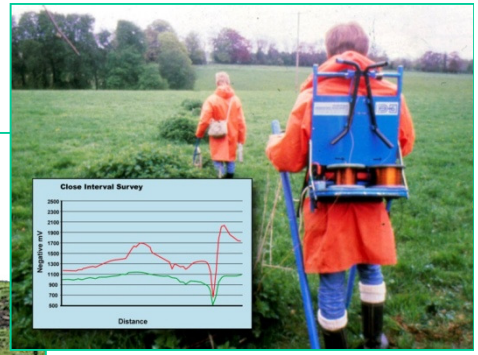
Close Interval Potential Surveys

- Provides more data
- Many possible error sources
  - Poor synchronisation of time switches.
  - Sacrificial anodes connected to the pipeline.
  - Bonds to other pipelines that are not switched.
  - Potential spikes during switching (if not allowed for).
  - Stray current from other dc sources.
  - Poor contact in the measurement circuit.
  - Excessive manipulation of raw data
- Assessing data quality is important
- Snapshot in time





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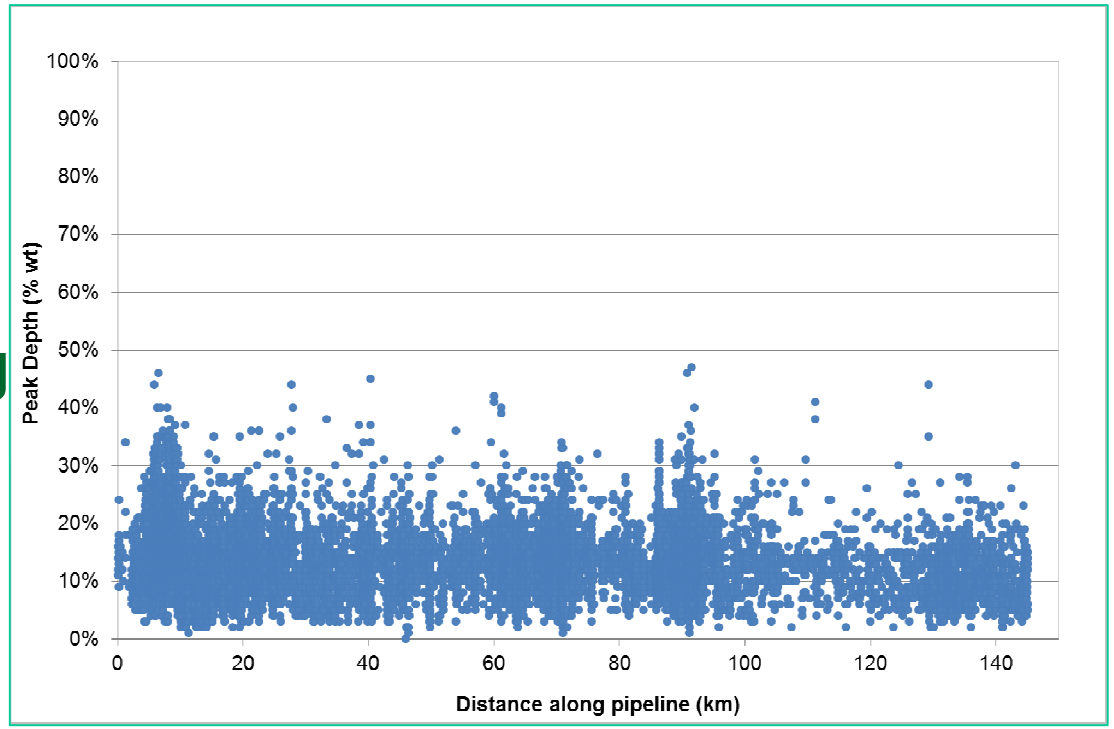
Case Study 1

- 20 inch x 140km pipeline
- Age 51 years
- Plycoflex coating
- Impressed current CP
- Rocky ground conditions



Corrosion along full length of pipeline

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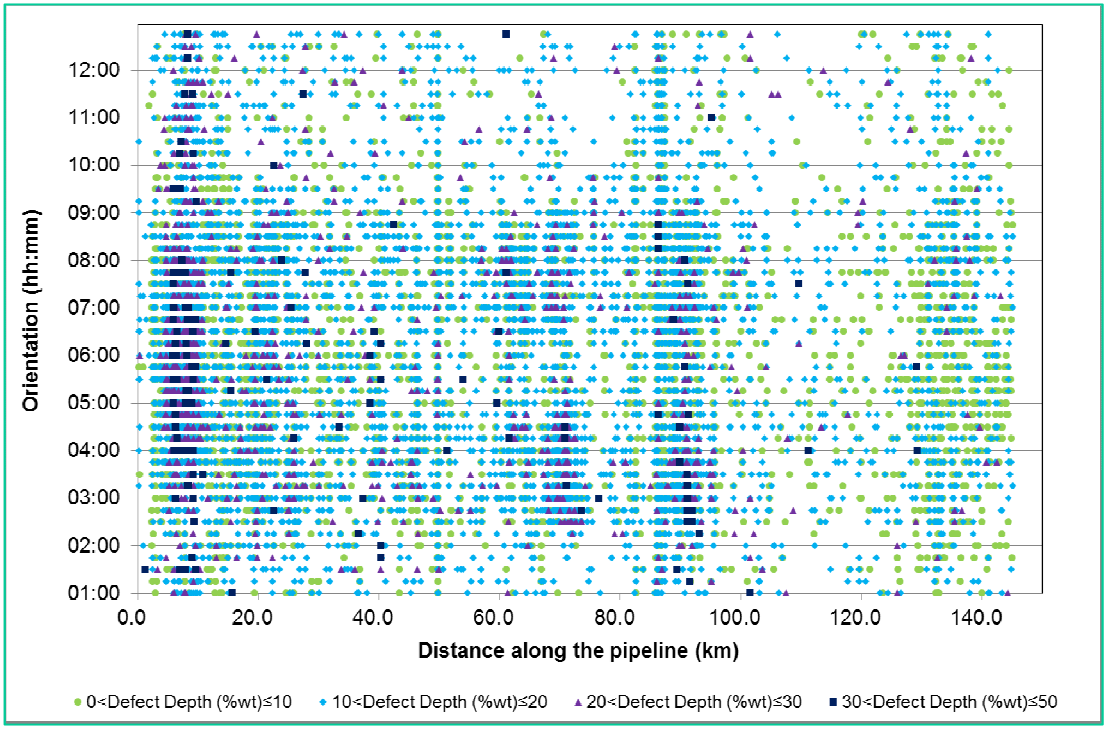
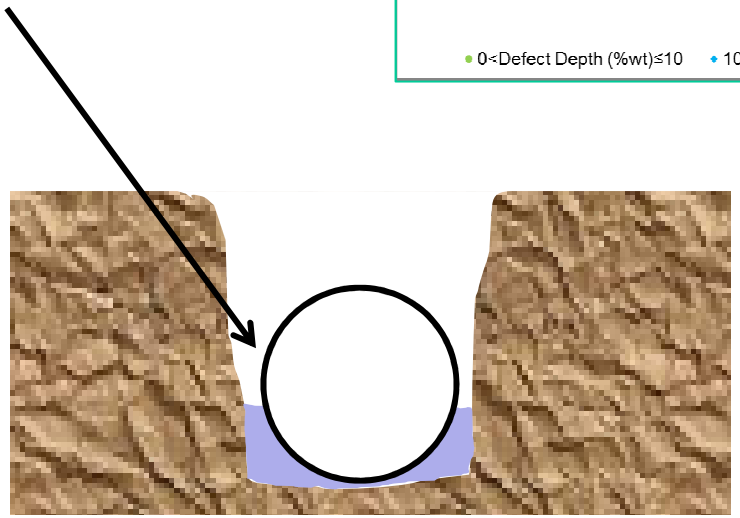
ILI Data Orientation

- Corrosion around full circumference
- Higher rate in lower half
- Wetter in lower half





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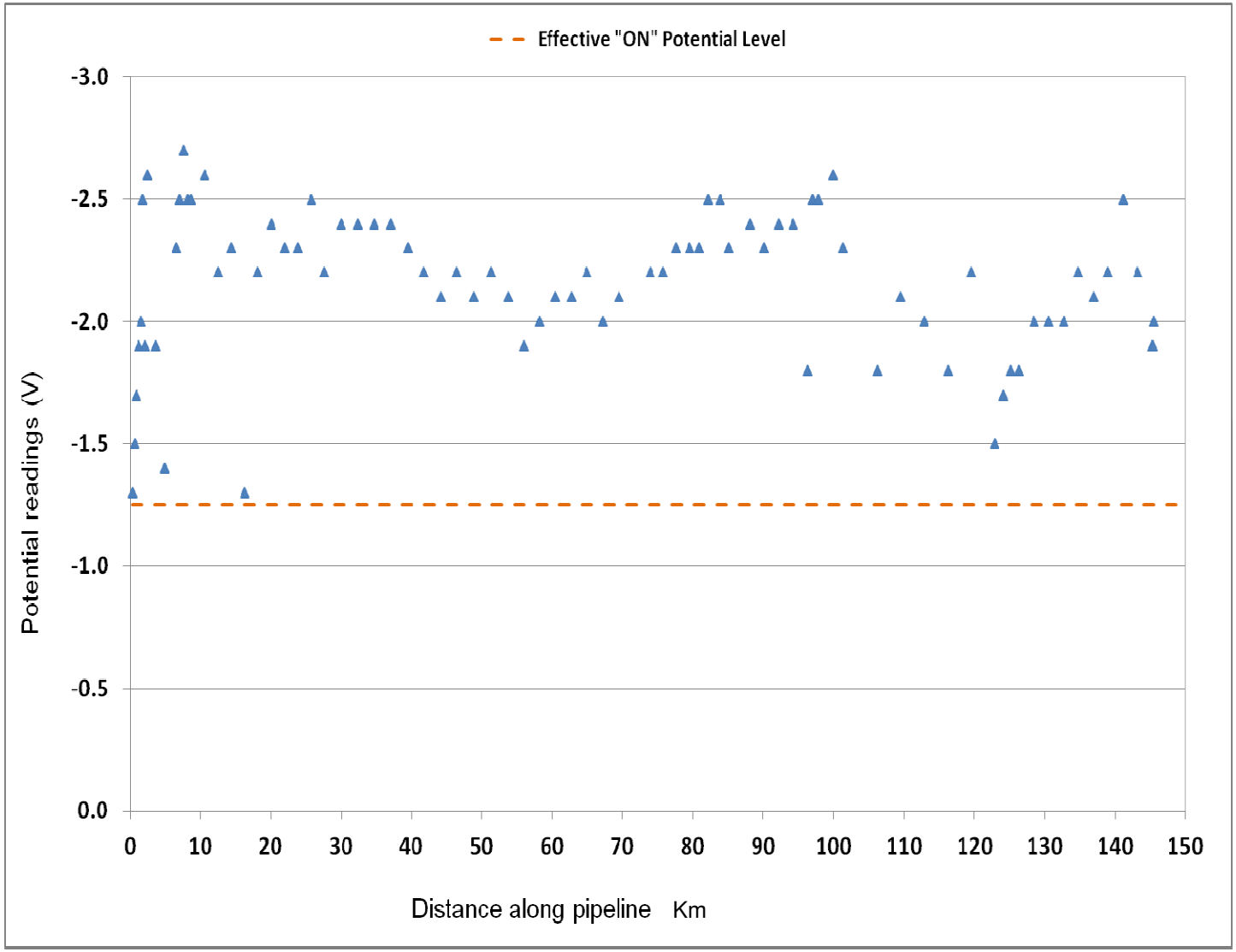
Cathodic Protection Data – ON only



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Tape Coating Failure Mode

- Early type PE butyl rubber tape
- Poor adhesion at the overlap
- Soil stresses cause wrinkling and sagging
- Moisture ingress around full circumference

Conclusion:
- Verification digs to confirm assessment
- CIPS survey to better assess CP
- CP will always struggle due to shielding

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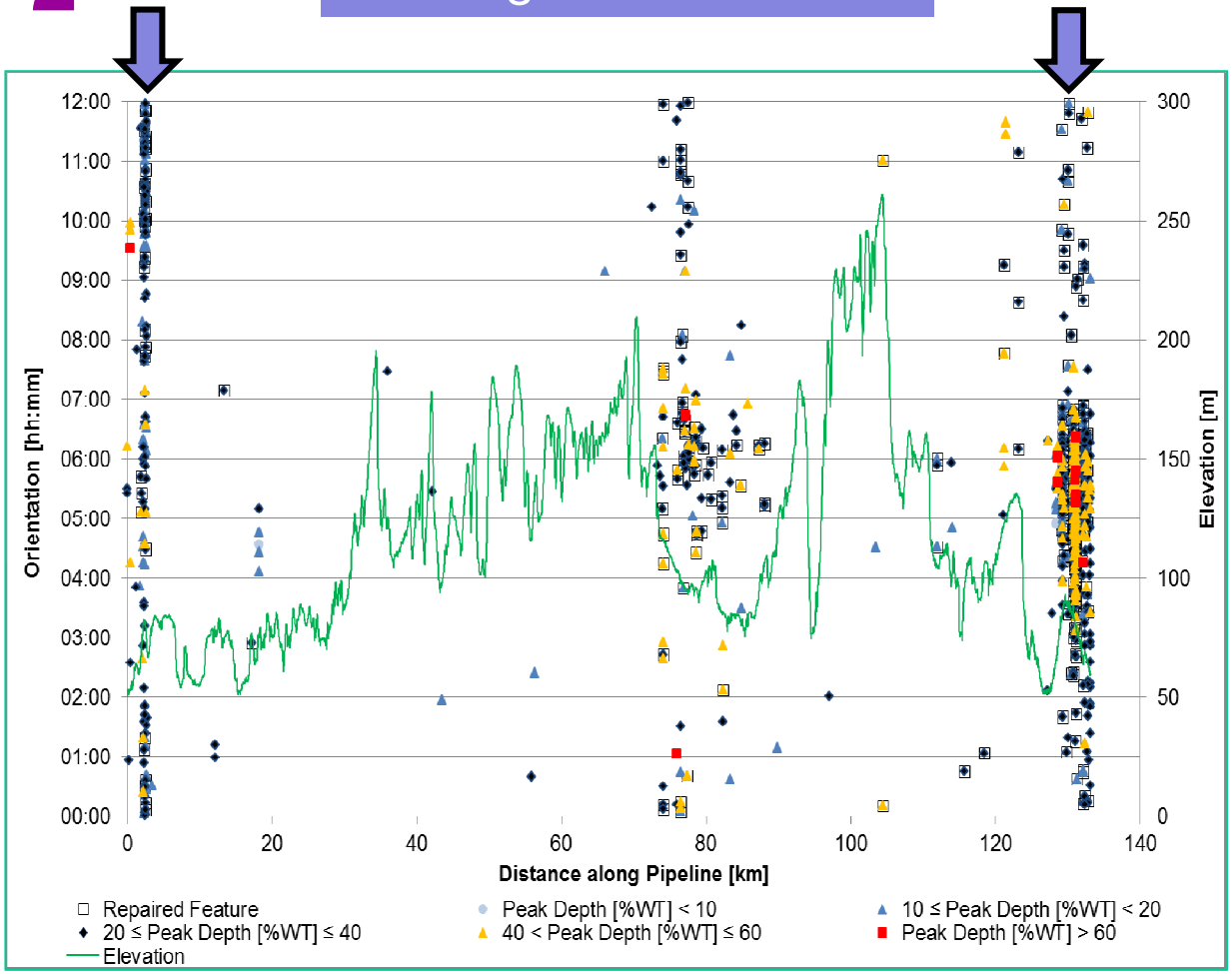
Case Study 2

- 6 inch pipeline
- ~52 years old
- Coating coal tar enamel
- Impressed current CP

Above ground sections



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Above Ground Sections

- Corrosion under pipe supports where access is not easy.
- Corrosion rate 0.12 – 0.38 mm/yr
- Typical corrosion rate under pipe supports in coastal environment.
- Water and soluble salts can be retained in the crevice between the pipe and support.

From adulca.com

Stoprust.com

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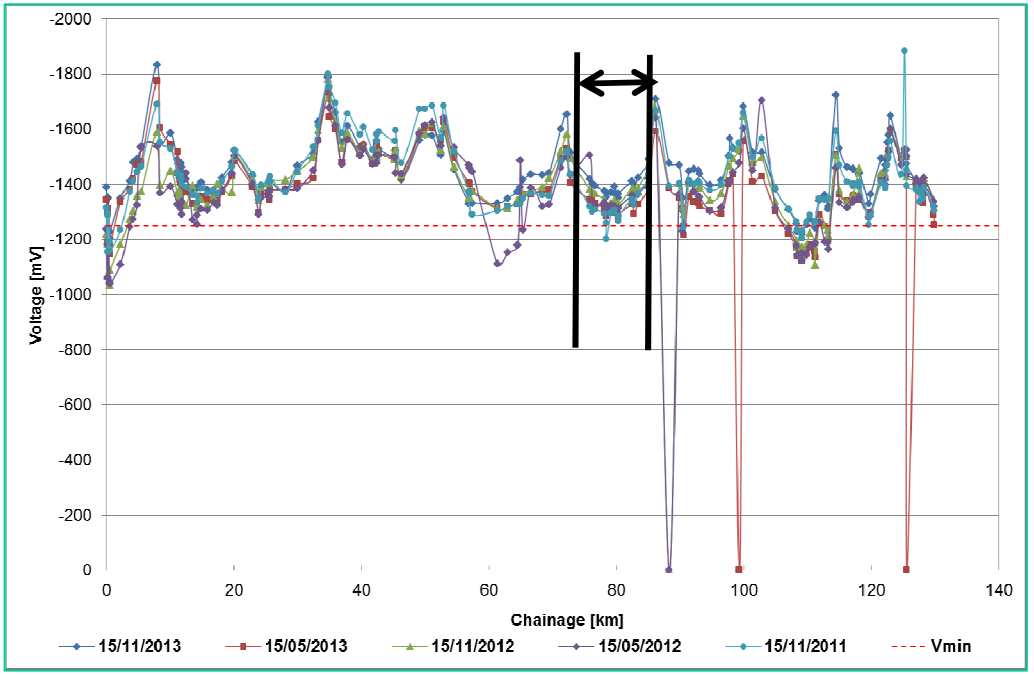
Below Ground Sections

Area of corrosion anomalies

- Corrosion rate low 0.04 -0.07mm/yr
- Only ON potential data available
- Look OK but misleading.
- Corresponds with low elevation on pipeline with chalk high points either side
- Between CP stations



Conclusions:

- Move and recoat under pipe supports
- Verification digs
- CIP Survey needed
- CP needs adjustment
- OFF potentials should be routine

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Case Study 3

- 10 inch pipeline
- ~70 years old
- Coating asphalt enamel – site applied
- Impressed current CP – 13 stations over 33km
- Shared same trench with other pipelines

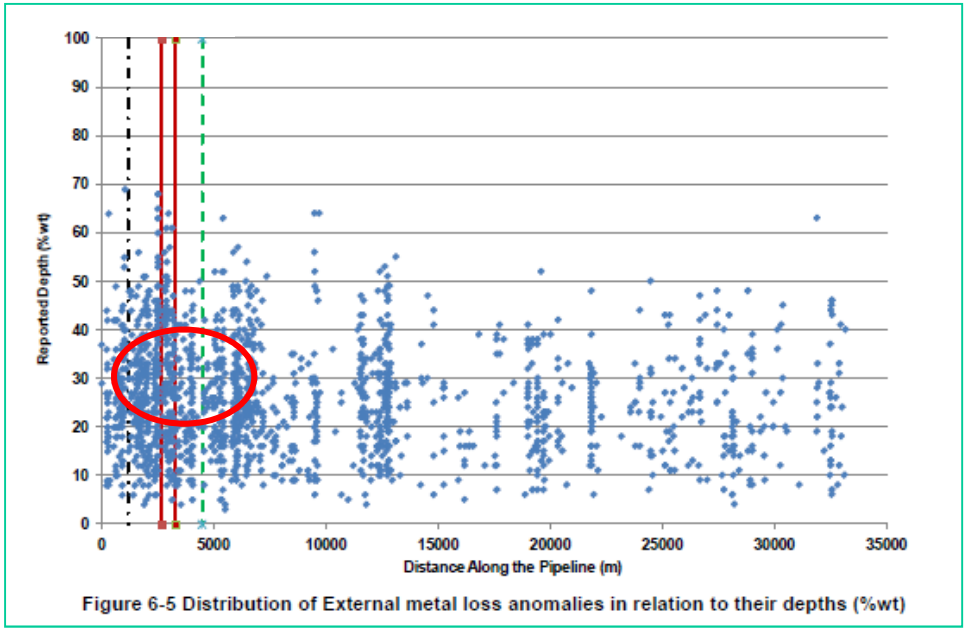

Figure 6-5 Distribution of External metal loss anomalies in relation to their depths (%wt)

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Field Joint Coating

- Concentration of external corrosion features at field joints
- Field joint coated hand applied hot enamel
- Still significant number of defects elsewhere

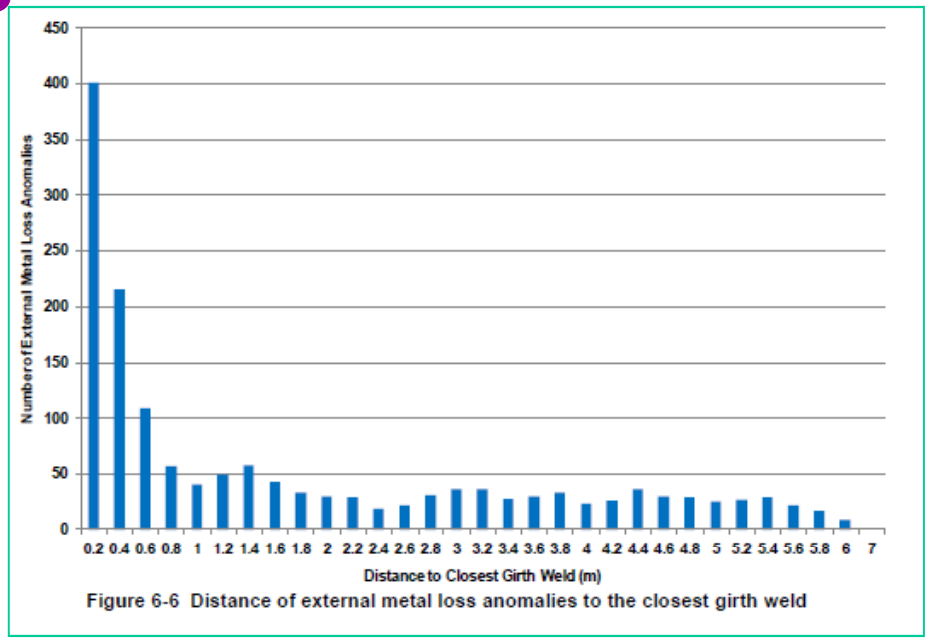

Figure 6-6 Distance of external metal loss anomalies to the closest girth weld

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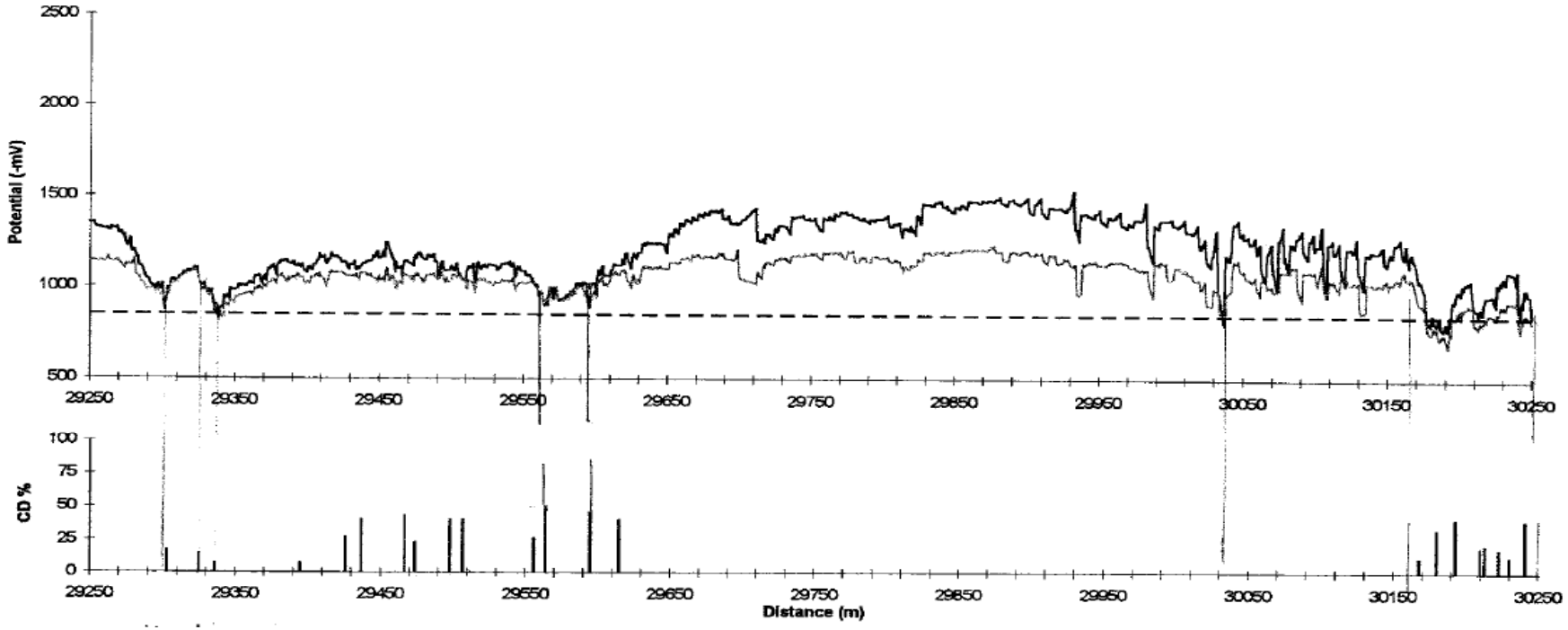
Historic CIPS Data 1996



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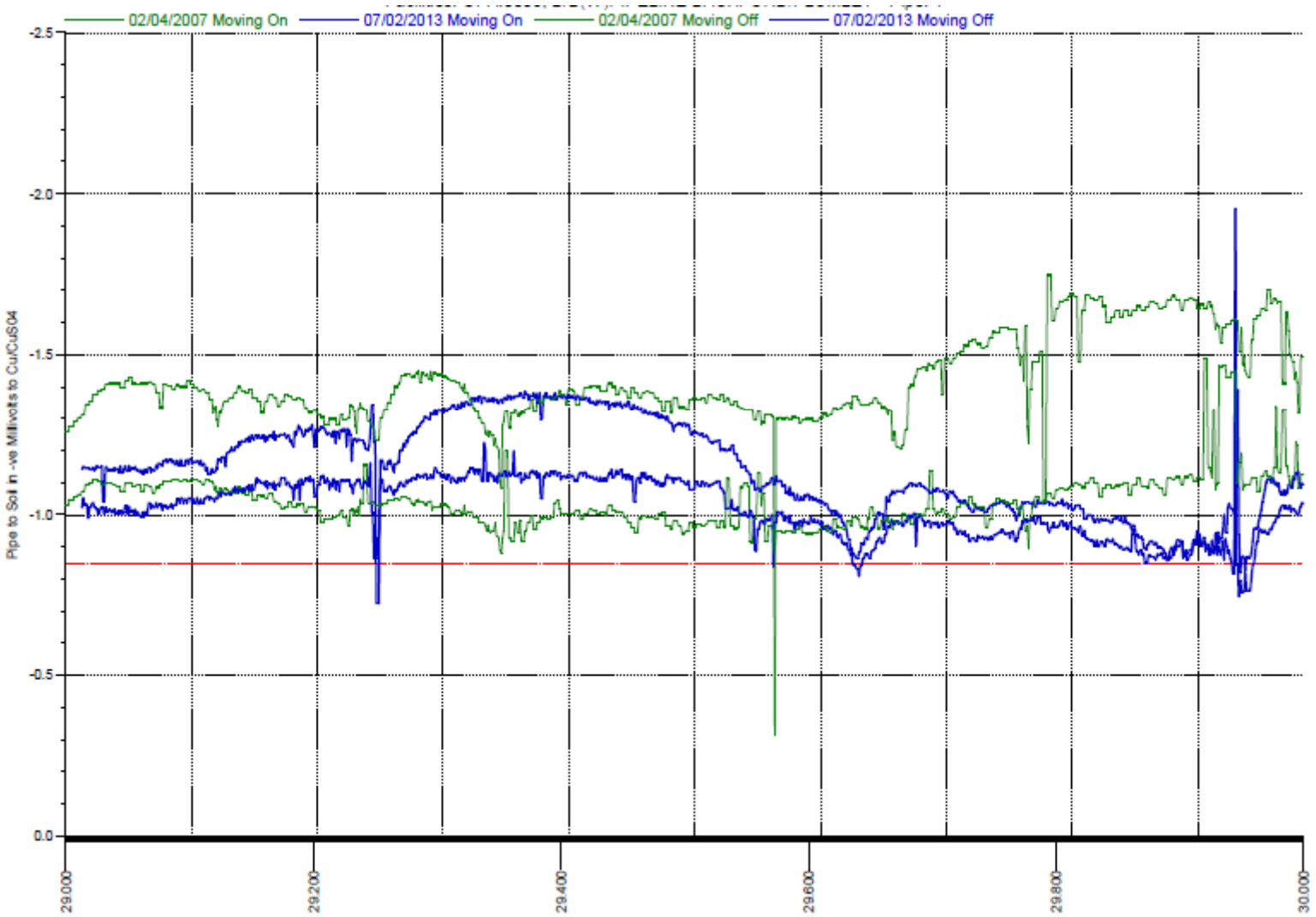
CIPS Data 2007 and 2013



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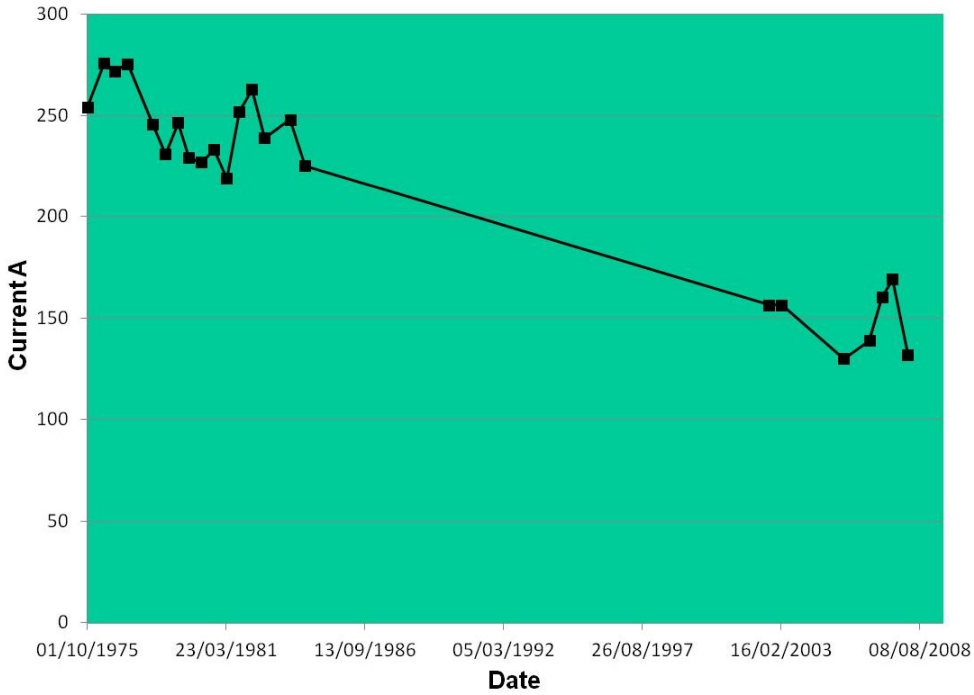
Cathodic Protection - History

- Limited data available
- CP Station outputs reviewed
- Outputs declined over year due to aging groundbeds and misinformed adjustment



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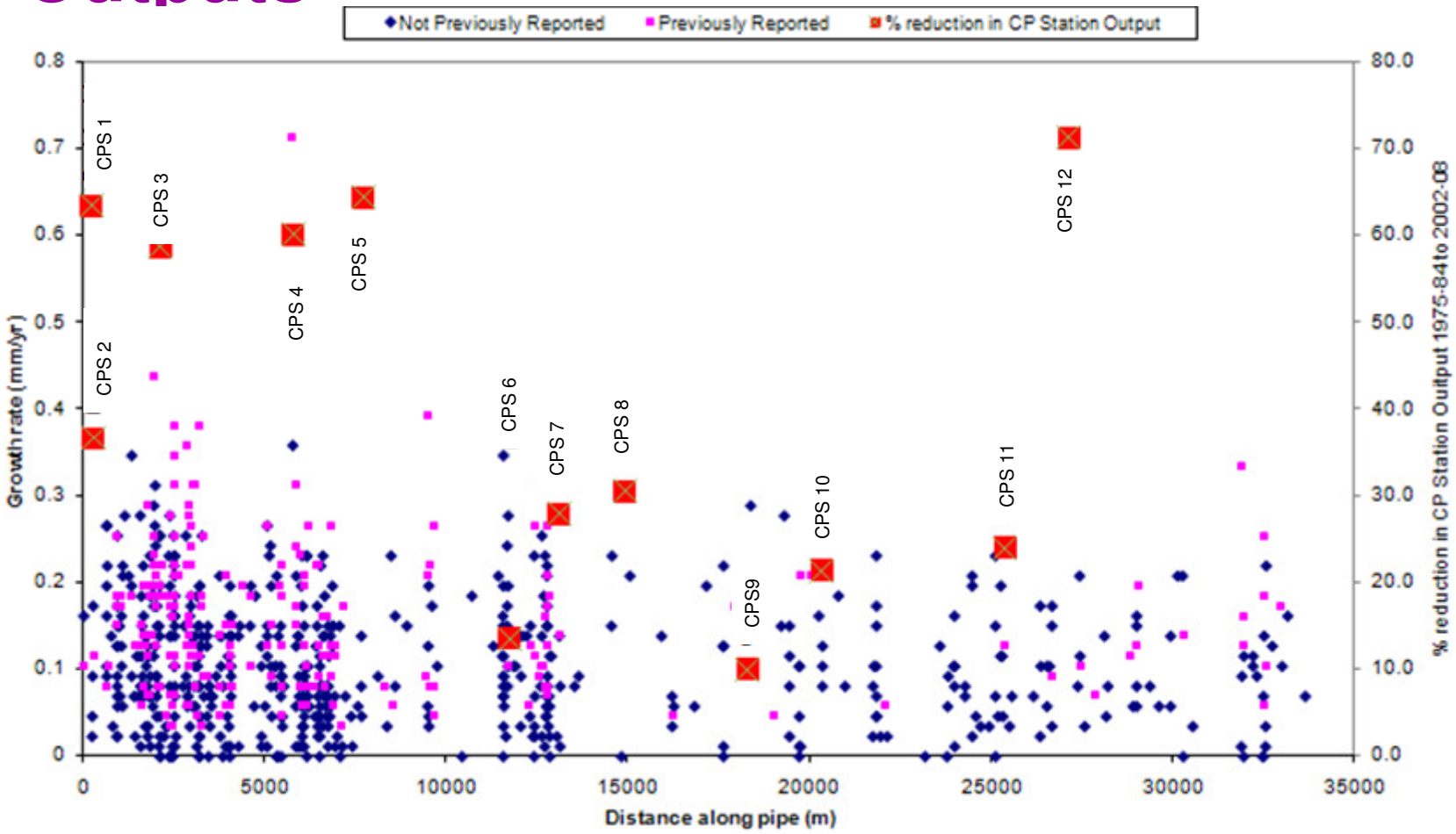
Overlaying ILI Defect Data and CP Station Outputs



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Case Study 3

- Verification digs found coating contained coke particles
- Coke forms a galvanic couple with the steel causing high corrosion rates
- -850 mV not enough
- -950 mV not enough

Conclusion:
•Coating coked during application
•Potential criterion used inappropriate
•Restoration of CP Station current capacity ++ a priority

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Conclusions

- ILI data can give a good picture of a pipelines condition
- Detailed statistical analysis of the data is a key step:
  - Corrosion distribution
  - Corrosion orientation
  - Corrosion rate ⟹ Re-inspection interval, repair programme
  - Confidence level
- Input from an experienced pipeline corrosion engineer:
  - Enables integration and interpretation of CP and coating data
  - Enhances the confidence level
  - Identifies the most probable cause
  - Enables mitigation measures to be developed

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Close

- **Thank you for your attention.**

Contact Points:

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