PPSA 2010 Technical Seminar- Aberdeen

Pipeline Integrity Management

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a GE Oil & Gas and Al Shaheen joint venture

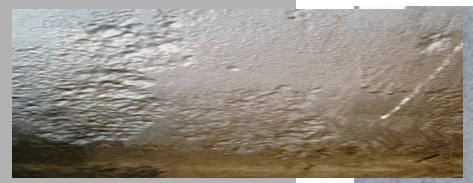
Engineering Consultancy Services for Pipeline Integrity Review and recommendations for Selected Offshore Pipelines

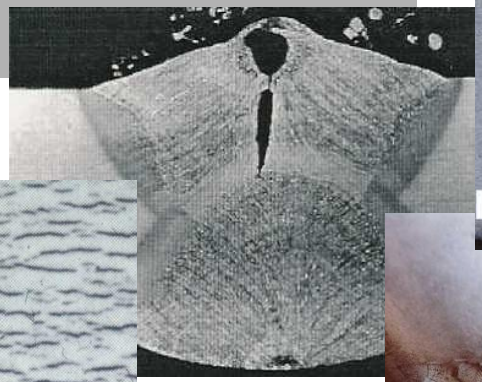
What is pipeline integrity management?

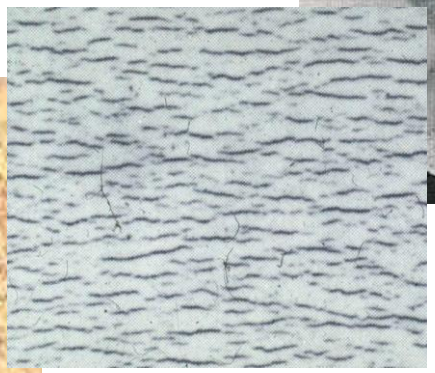
- PIM is a subset of the Operations & Maintenance (O&M) function of Pipeline Operations
- It comprises those actions focused on preventing pipeline failures and ensuring:
    - Public and employee safety
    - Protection of the environment
    - Reliable service
- These actions generally include the following:
    - Inspection of the pipeline
    - Integrity assessment
    - Repair and remediation
    - Risk prevention and mitigation programs
    - Continual integrity assessment planning

In summary, we want to prevent these things ….

- Corrosion (Internal/External)
- Mechanical Damage
- Incorrect Operations
- Loss of Ground Support
- Stress Corrosion Cracking

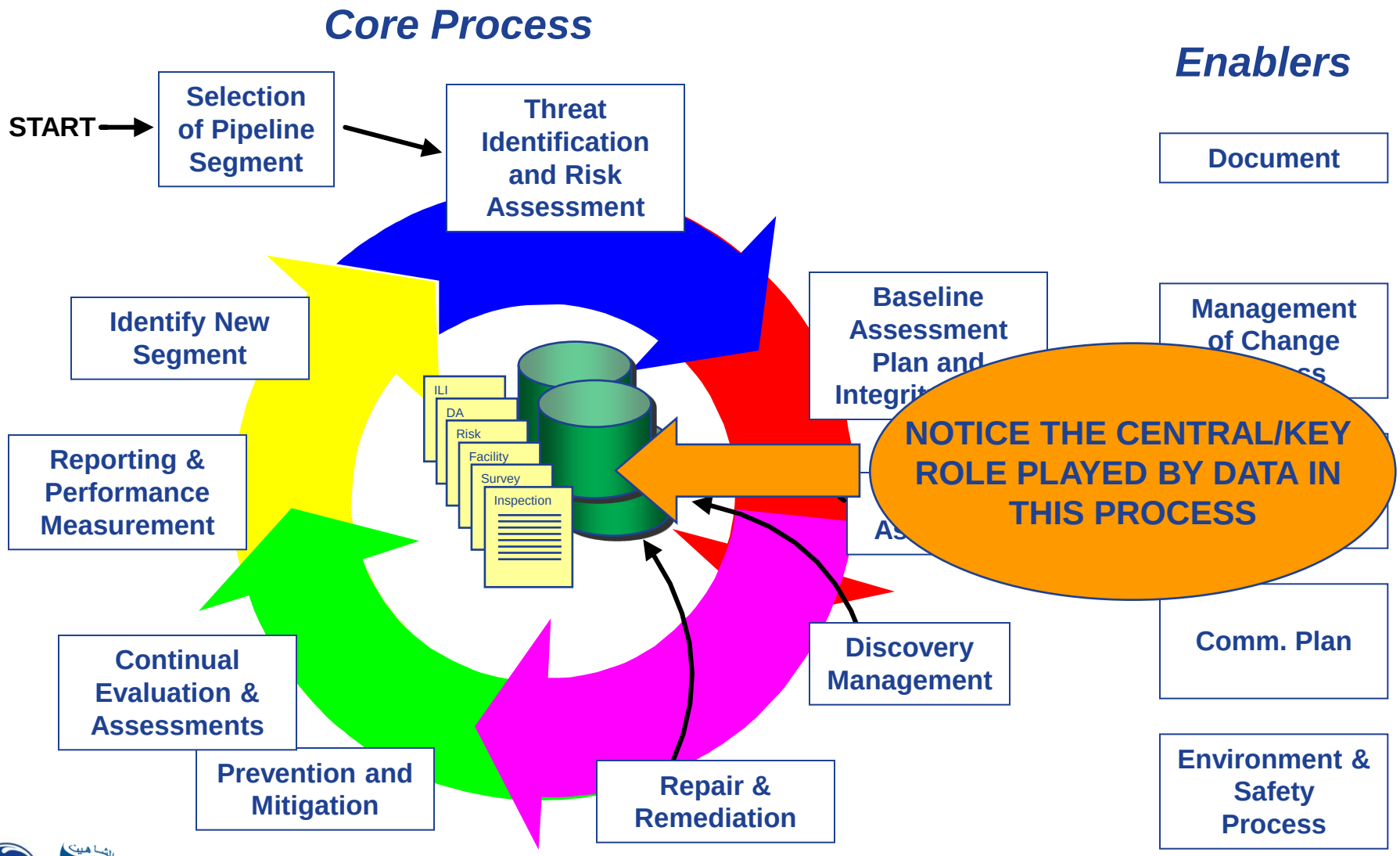






… from causing these things

Pipeline Integrity Management Process



Case Study - QP Selected Offshore Pipeline Integrity Assessment

- **Engineering Consultancy study follows the methodology laid out by QP. The overall objective of the study is to:**
  - Evaluate the condition of the 51 selected offshore pipelines
  - Establish their fitness-for-purpose and need for any remedial work
  - Determine the level of risk associated with continuing operating life
  - Identify the remedial measures and costs required to bring operation risks in line with standard industry practice levels
- **The production of individual pipeline study reports**
- **Overall Pipeline Integrity Study Report (PIR)**

Other deliverables:

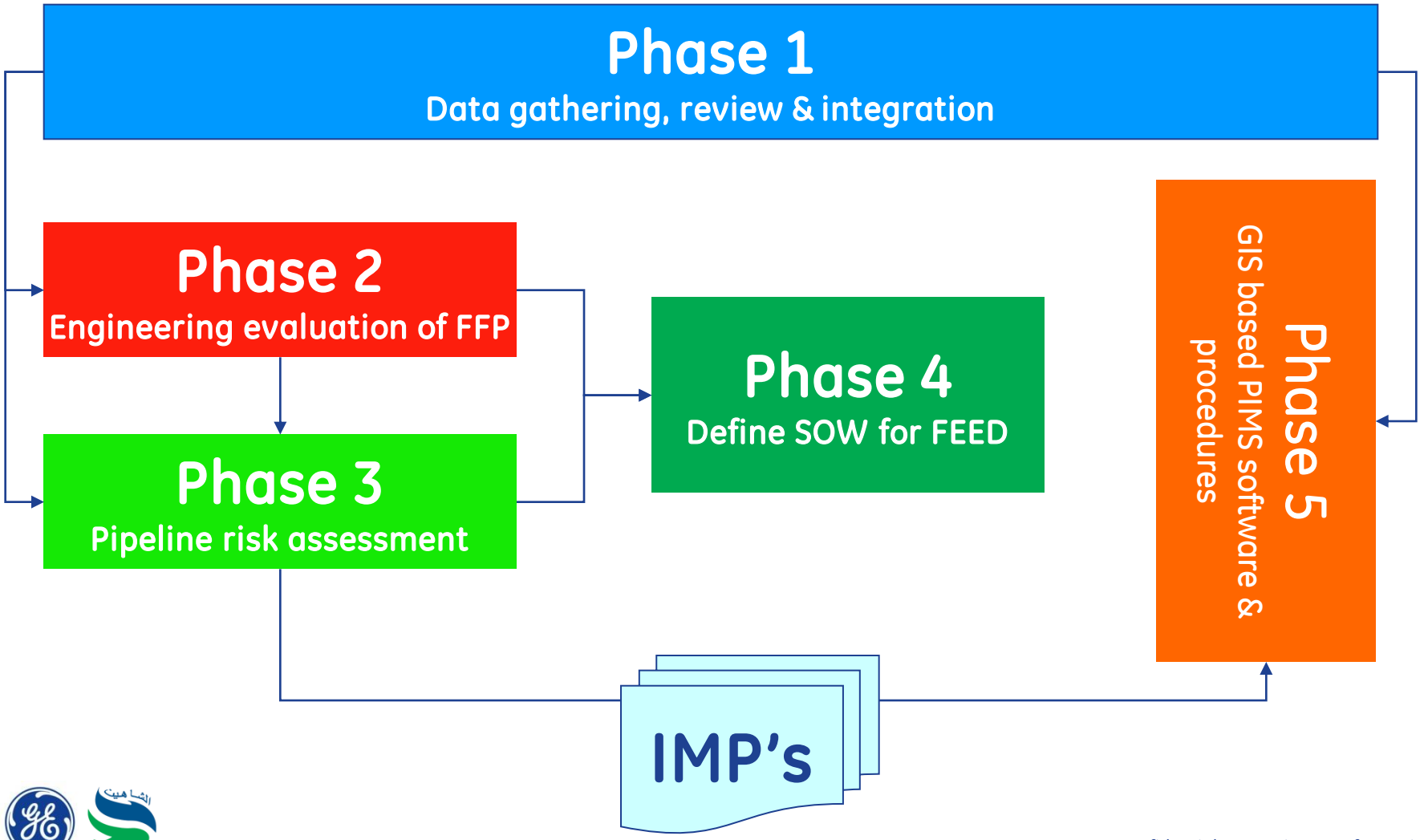
- PIM document philosophy (Corporate Philosophy and Codes of Practices)
- GIS based Pipeline Management Integrity System (PIMS)

Study approach & methodology

The work is being carried out in five phases:

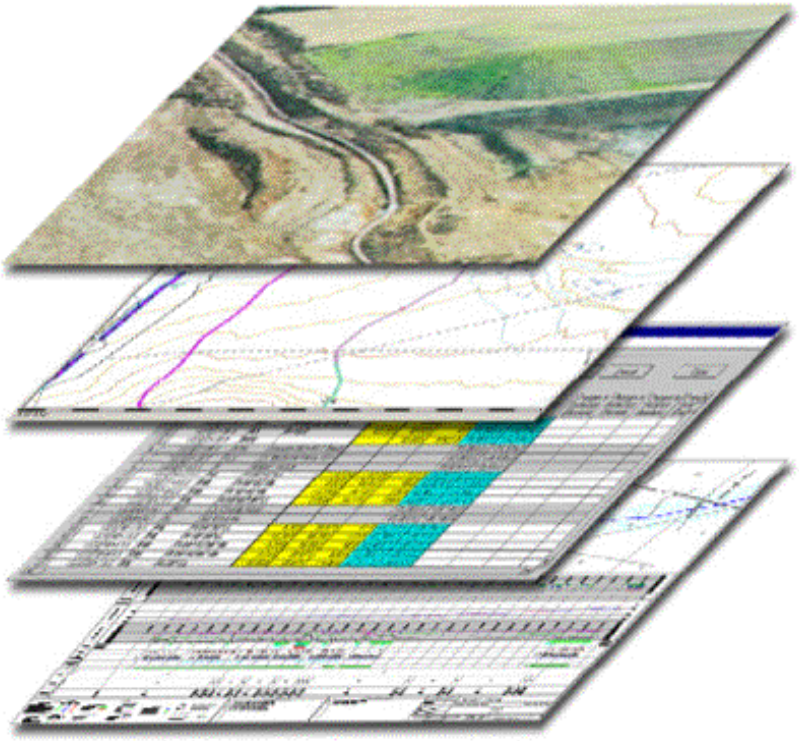
- Phase 1: Data gathering, review & integration
- Phase 2: Engineering evaluation of FFP
- Phase 3: Risk assessment
- Phase 4: Define SOW for FEED
- Phase 5: Development GIS based PIMS software

Study approach & methodology



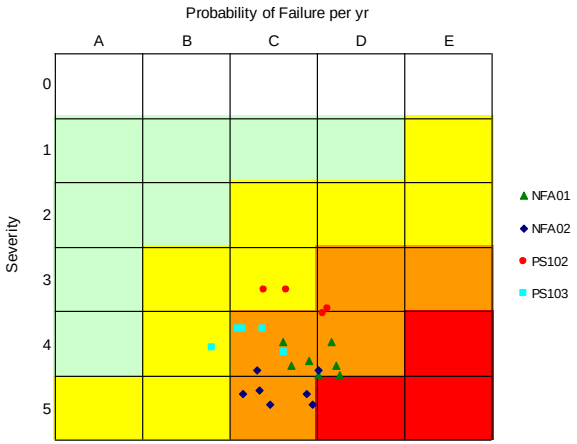
Volume of data…

- More than 5 GB of data gathered, checked & loaded including:
  - Alignment sheets for 51 pipelines (total of 965 km)
  - Centerlines set up
  - Survey results imported:
    - 107 ROV reports
    - 85 external UT reports
    - 9 ILI reports
  - Data elements for more thar 90 attributes entered for multiple line segments (~40,000 individual entries)



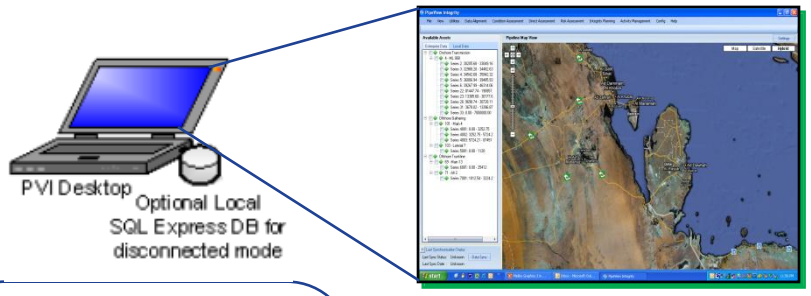
Engineering evaluation

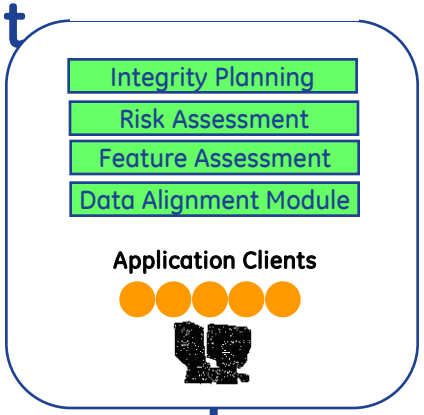
- Evaluation of the severity of over:
  - 600,000 ILI anomalies
  - 4,600 pipeline spans
  - 500 crossings
  - 100 stabilizations
  - 600 anodes (CP)
- Written deliverables…more than
  - 350 reports prepared
  - 250 risk profiles (before & after remediation)
  - 51 IMP's developed
- Identified & provided cost estimate for:
  - Over 800 remediation activities



Supply of GIS Based PIMS System

- **GIS Facility Data Management system (based on ESRI's ArcGIS)**
- **Web Access Software**
- **Pipeline Integrity Management Software**
  - Risk Assessment module
  - Data Alignment module
  - Feature Assessment Module
  - Integrity Planning Module



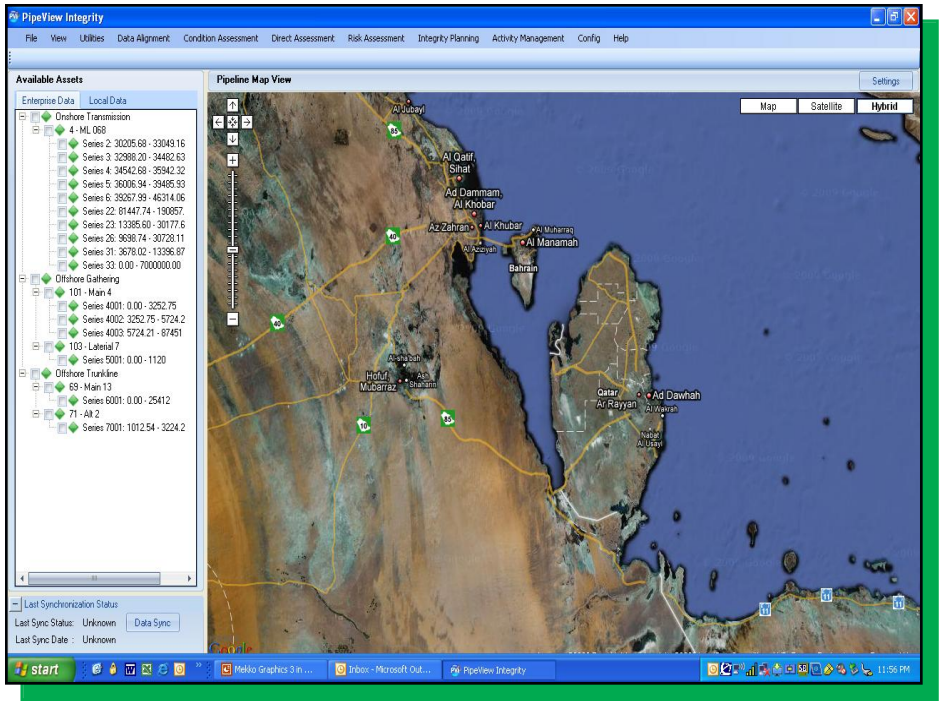


Facility/GIS Database

Enterprise Integrity Database

Web Server

Integrity Management Software



➢ Data Alignment Module

- Load and align various data sets to enhance analysis and visualization of pipeline data

➢ ILI Feature Assessment

- Perform in-depth feature analysis for an understanding of current and future condition

➢ Risk Assessment

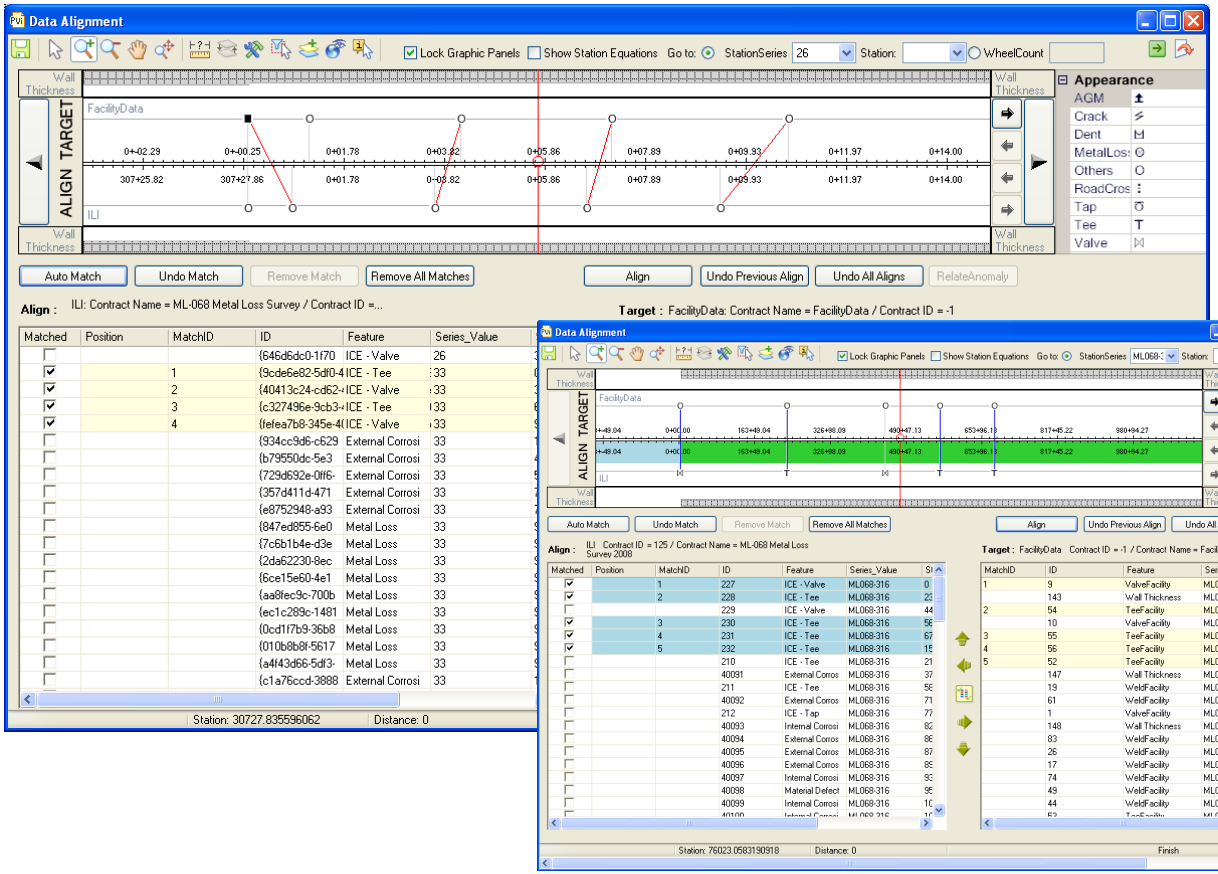
- Accurately rank and forecast risk for cost-effective, long-term pipeline management

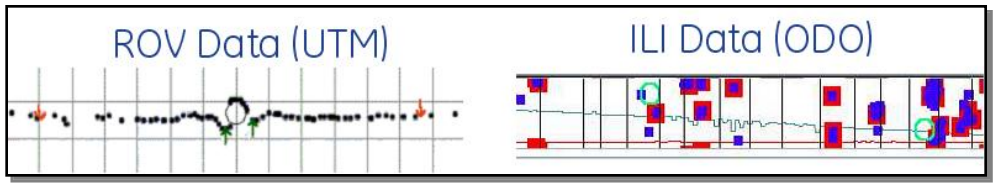
➢ Integrity Planning

- Automatically and / or manually generate scenarios consisting of proposed mitigation actions. Compare between various scenarios based on risk reductions, costs and KPI performance

Data Alignment

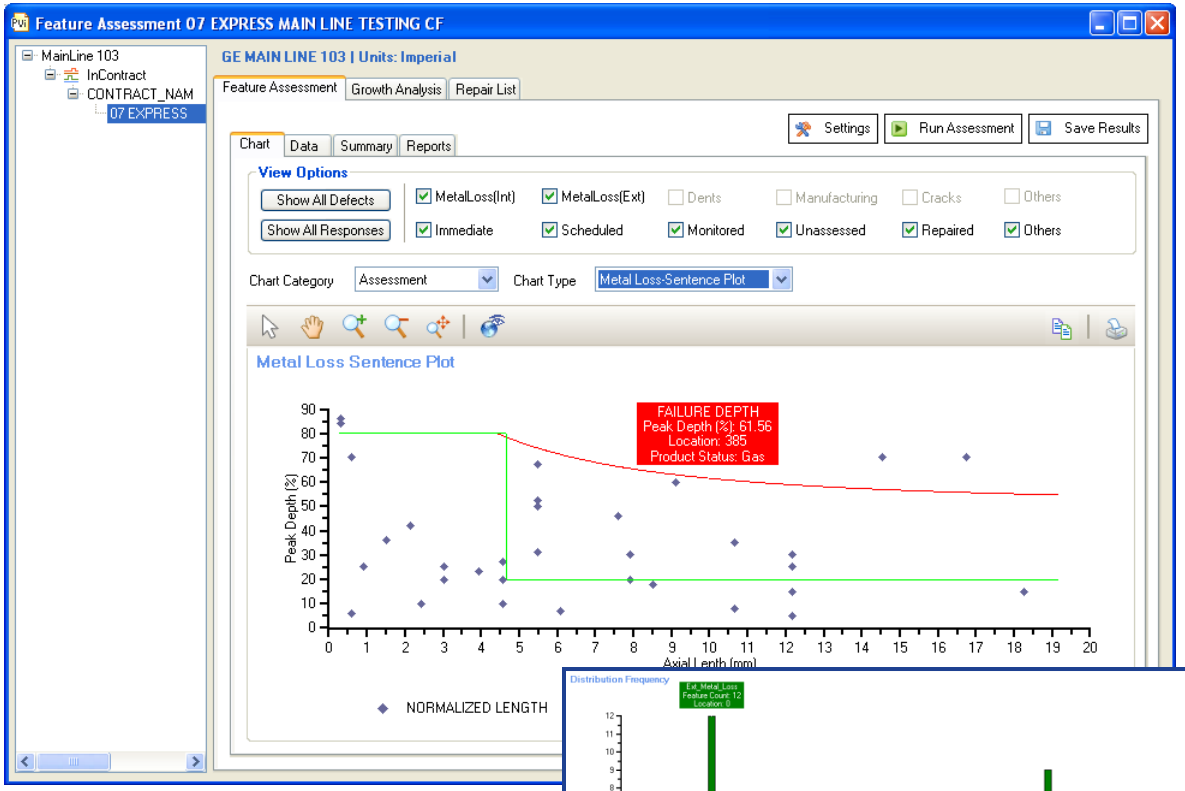
- Tools to load & align data various data types and formats – in-line & above-ground inspections – for subsequent analysis & visualization
- Align new data to centerline or other inspection data
- Automatically or interactively establish matches or common features
- Immediate feedback of alignment based on user-established tolerances
- Graphic and tabular interface to target & align data





Feature Assessment

- Analyze and prioritize data for more effective prioritization and management of repairs
- Engineering critical analysis of feature data
  - –Probability of Exceedance
  - –Deterministic: (B31G, modified B31G, DNV)
  - –Corrosion growth
- Configurable repair criteria including
  - –API 1160
  - –B31.8S
- Repair management

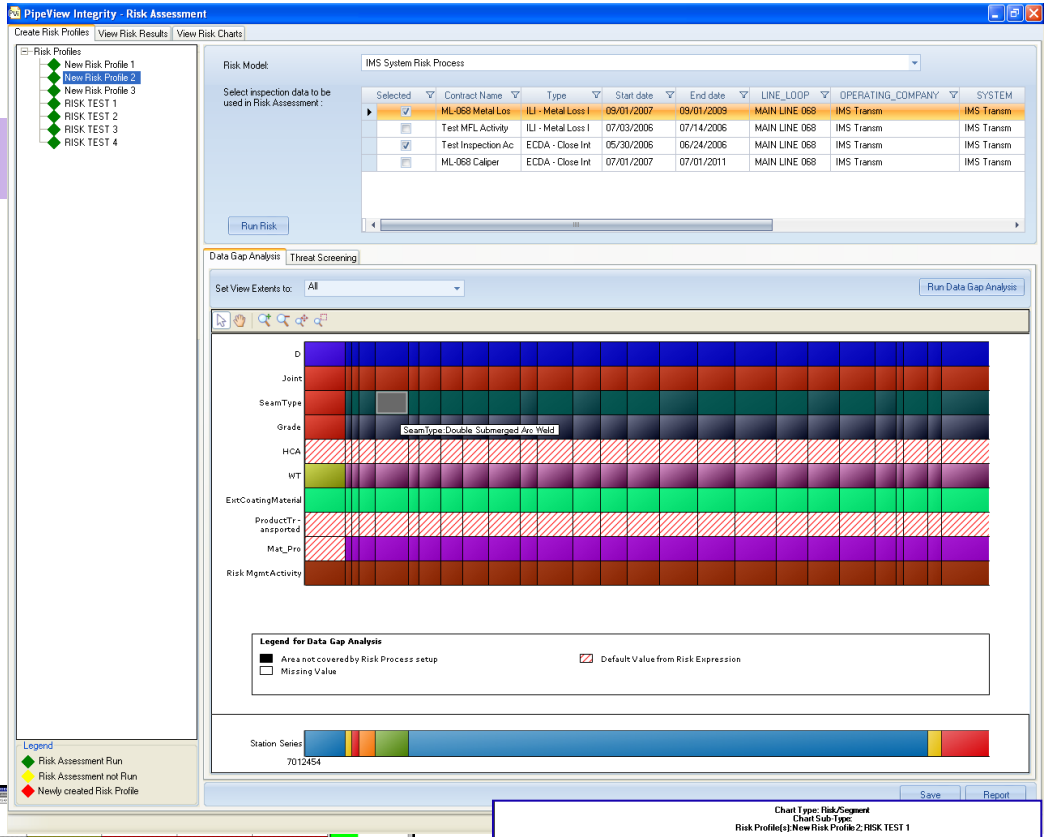


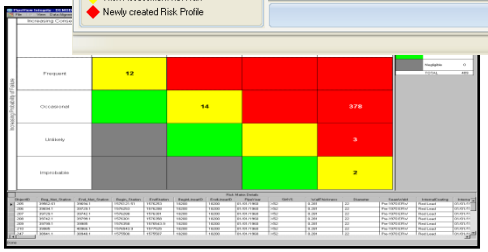
Summary of Features for ILI - Metal Loss Inspection Survey fro

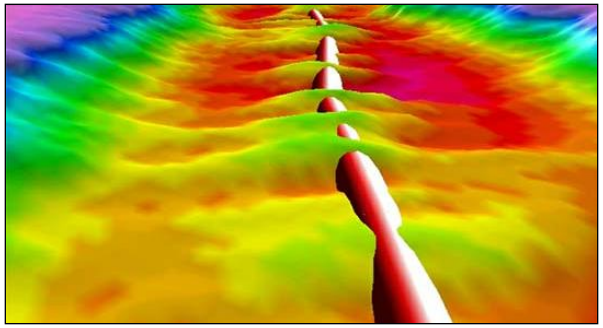
Response	Metal Loss (Int)	Metal Loss (Ext)	Dents			
All	10	44	9	0	3	66
Immediate	1	10	0	0	1	12
Scheduled	5	18	0	0	0	23
Monitored	4	16	9	0	0	29
No Action Required	0	0	0	0	2	2
Unassessed	0	0	0	0	0	0

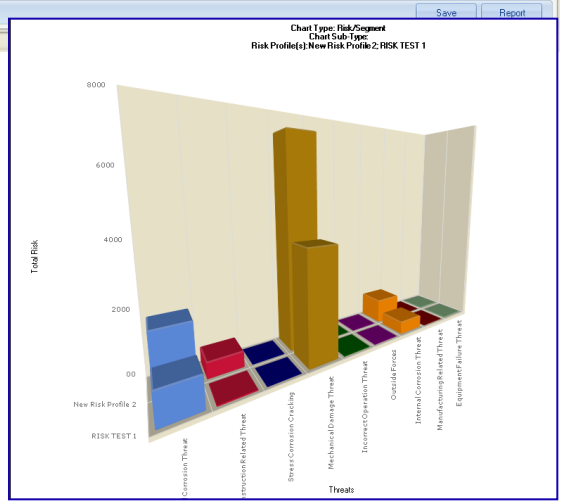
Risk Assessment

- Generate a risk profile including histogram of risk algorithm results and condition assessment results
- Perform threat screening
- Perform a data gap analysis with ability to directly edit pipeline data
- View and compare multiple risk results
- Generate output in charts and customizable reports



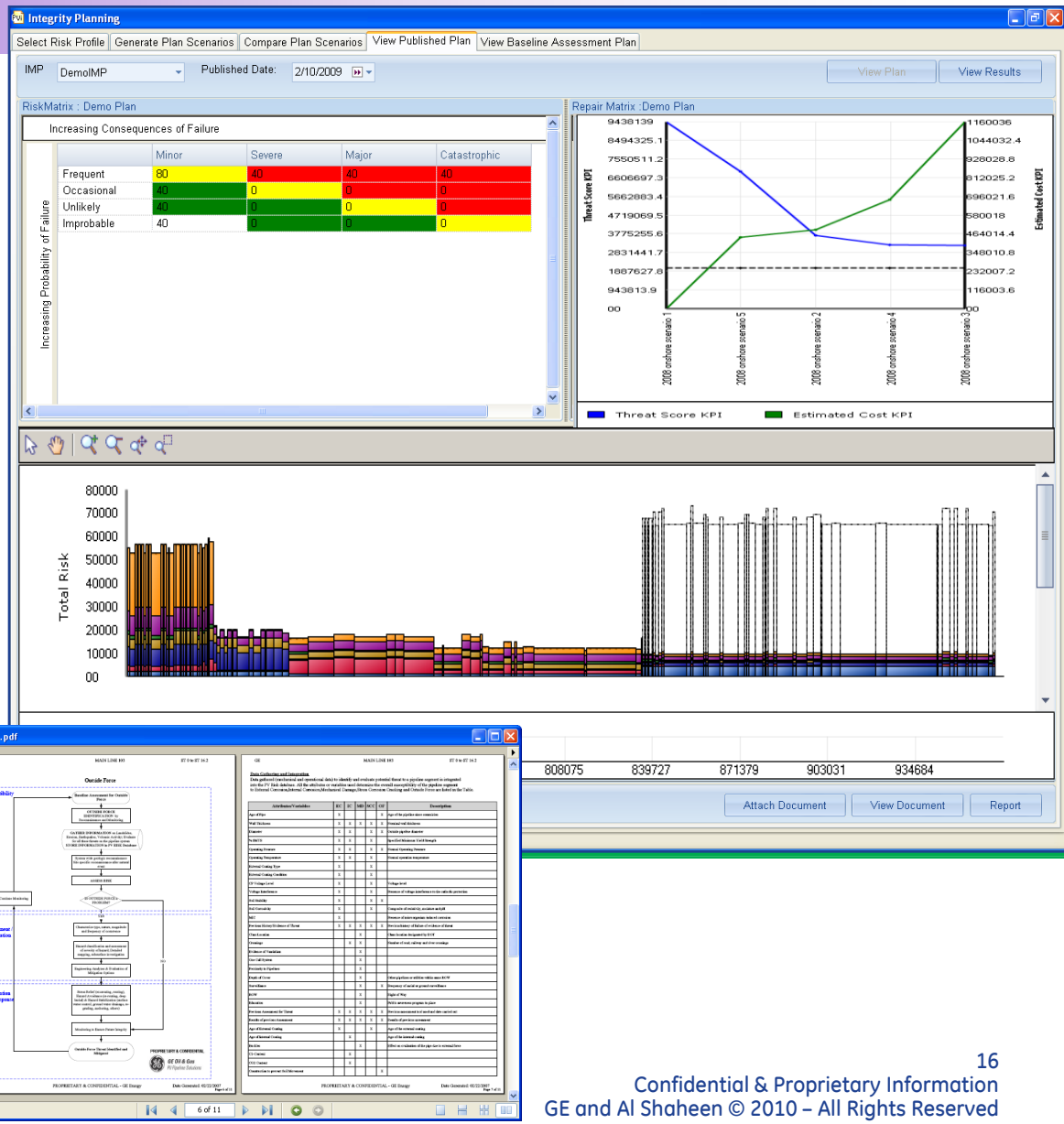






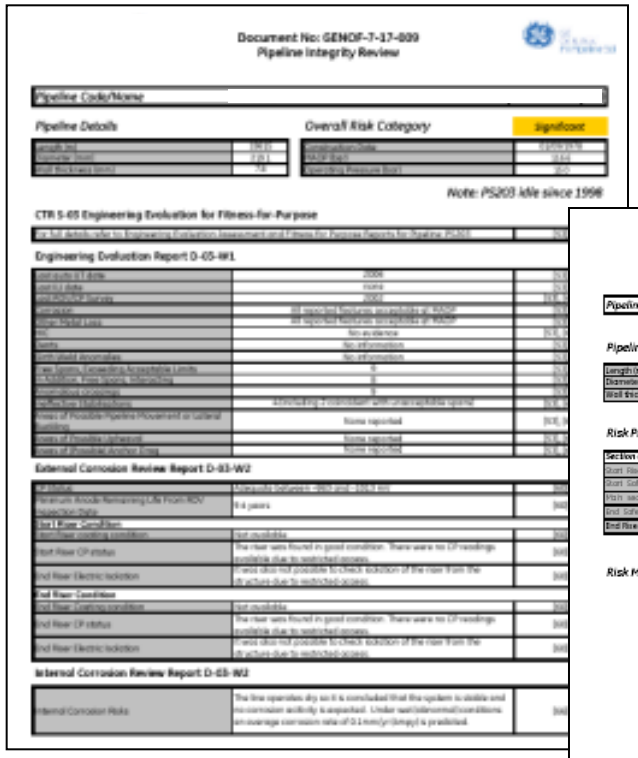
Integrity Planning

- PipeView Integrity provides the ability to generate integrity plans
- Create an auditable documented process for integrity management that is compliant with regulations
- Ensure company standards are achieved by incorporating the client's guidelines on best-practices for mitigation and remediation
- Calculate the most cost-effective mitigation strategies for the client's pipelines



51 Integrity Management Plans (Example)

1. FFP Evaluation


Document No: GENOF-7-17-009
Pipeline Integrity Review

Pipeline Code/Name

Pipeline Details

Overall Risk Category

Significant

Note: PS203 idle since 1998

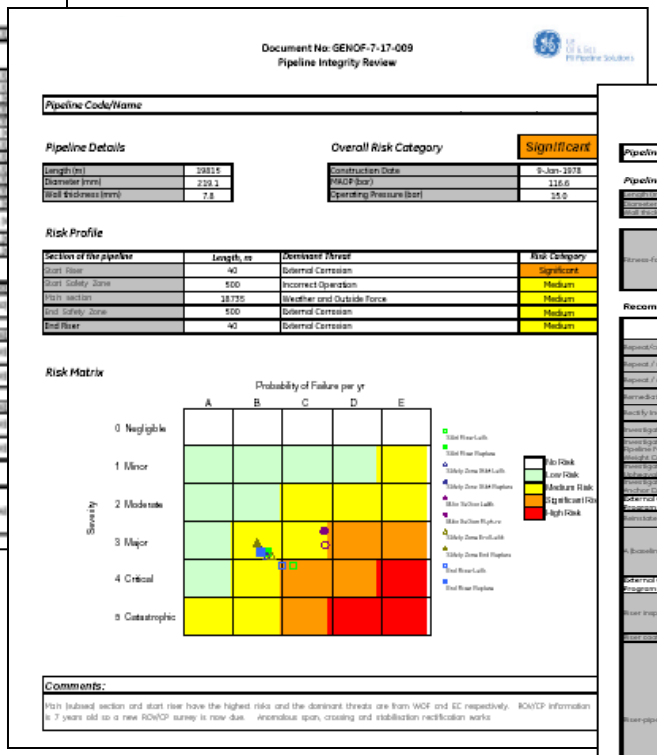
CTR S-05 Engineering Evaluation for Fitness-for-Purpose

Engineering Evaluation Report D-05-W1

External Corrosion Review Report D-03-W2

Internal Corrosion Review Report D-03-W2

2. Threat identification & risk profile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Pipeline Integrity Review

Pipeline Code/Name

Pipeline Details

Length (m)	19815
Diameter (mm)	229.1
Wall thickness (mm)	7.8

Overall Risk Category

Significant

Construction Date	9-Jan-1978
MAOP (bar)	116.6
Operating Pressure (bar)	15.0

Risk Profile

Section of the pipeline	Length, m	Dominant Threat	Risk Category
Start Riser	40	External Corrosion	Significant
Start Safety Zone	500	Incorrect Operation	Medium
Main section	18795	Weather and Outside Force	Medium
End Safety Zone	500	External Corrosion	Medium
End Riser	40	External Corrosion	Medium

Risk Matrix

Probability of Failure per yr

A B C D E

0 Negligible
1 Minor
2 Moderate
3 Major
4 Critical
5 Catastrophic

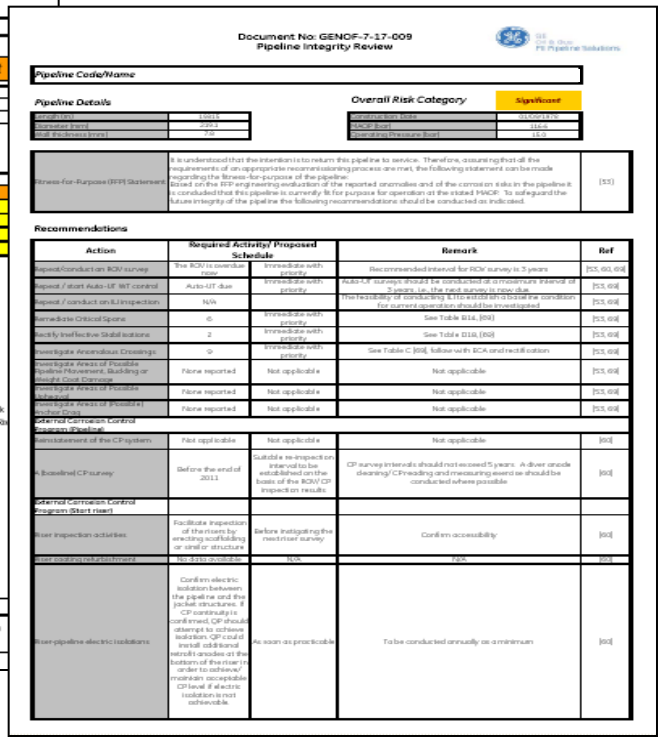
Severity

No Risk
Low Risk
Medium Risk
Significant Risk
High Risk

Comments:

Main (subsea) section and start riser have the highest risks and the dominant threats are from WOF and EC respectively. ROV/CP information is 7 years old so a new ROV/CP survey is now due. Anomalous span, crossing and stabilization rectification works

3. Recommended remediation activities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Pipeline Code/Name

Pipeline Details

Overall Risk Category

Significant

Recommendations

Action	Required Activity/ Proposed Schedule		Remark	Ref
Repeat/Conduct an ROV survey	The ROV is overdue now	Immediate with priority	Recommended interval for ROV survey is 3 years	[53, 60, 69]
Repeat / start Auto-UT WT control	Auto-UT due	Immediate with priority	Auto-UT surveys should be conducted at a maximum interval of 5 years, i.e., the next survey is now due	[53, 69]
Repeat / conduct an ILI inspection	N/A		The feasibility of conducting ILI to establish a baseline condition for current operation should be investigated	[53, 69]
Remediate Critical Spans	6	Immediate with priority	See Table B1.1, [69]	[53, 69]
Rectify Ineffective Stabilizations	2	Immediate with priority	See Table D1.1, [69]	[53, 69]
Investigate Anomalous Crossings	9	Immediate with priority	See Table C [69], follow with ECA and rectification	[53, 69]
Investigate Areas of Possible Pipeline Movement, Buckling or Weight Coat Damage	None reported	Not applicable	Not applicable	[53, 69]
Investigate Areas of Possible Upheaval	None reported	Not applicable	Not applicable	[53, 69]
Investigate Areas of Possible Anchor Drag	None reported	Not applicable	Not applicable	[53, 69]
External Corrosion Control Program (Pipeline)				
Reinstatement of the CP system	Not applicable	Not applicable	Not applicable	[60]
As Baseline CP survey	Before the end of 2011	Suitable re-inspection interval to be established on the basis of the ROV/CP inspection results	CP survey intervals should not exceed 5 years. A diver anode cleaning/ CP reading and measuring event se should be conducted where possible	[60]
External Corrosion Control Program (Start riser)				
Riser inspection activities	Facilitate inspection of the risers by erecting scaffolding or similar structure	Before instigating the next riser survey	Confirm accessibility	[60]
Riser coating refurbishment	No data available	N/A	N/A	[60]
Riser-pipeline electric isolations	Confirm electric isolation between the pipeline and the jacket structures. If CP continuity is confirmed, CP should attempt to achieve isolation. CP could install additional retrofit anodes at the bottom of the riser in order to achieve/ maintain acceptable CP level if electric isolation is not achievable.	As soon as practicable	To be conducted annually as a minimum	[60]

Pipeline Life Extension

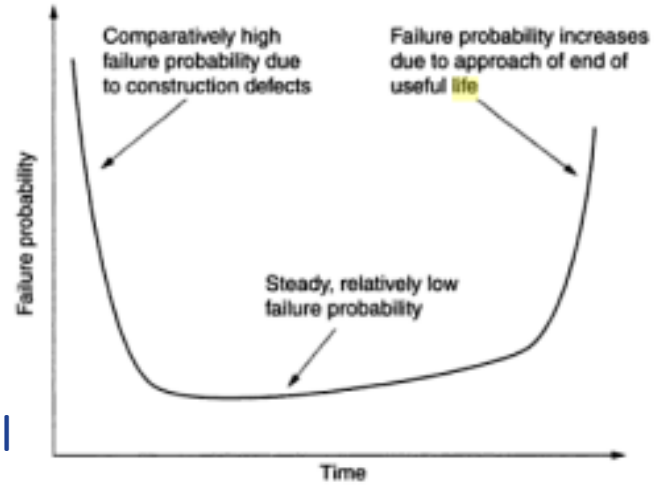

FIGURE 3.3 Bathtub curve of pipe performance with age.

- Notional design life is 25 years
- 38 pipelines have exceeded 25 years design life
- Main concerns (of this study) to remaining useful life are time dependent threats:

	Mitigated/Monitored by …
• Internal corrosion	→ ILI/auto UT/inhibition/sampling
• External corrosion rehab	→ CP surveys/anode retrofits/coating
• Stability	→ Repair anomalous spans, crossings
• Sour cracking	→ Control internal corrosion risk

- As long as pipelines are regularly monitored for all relevant threats, maintained & remediated as required they can continue to be operated beyond design life indefinitely until economically unviable
- Life extension relies more and more heavily on effective use of increasing volumes of data as the life extension process matures.