A TALE OF TWO PLATFORMS

- Welcome & Introduction
- The EI - Global Reach with Local Focus
- This Morning's Running Schedule
- Thanks & Close

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THE EI - GLOBAL REACH WITH LOCAL FOCUS

- **AHI Branch 2022 Events Programme**
  - Diverse technical program & visit schedule - see www.energyinst.org/ei-near-me/uk/aberdeen
- **Membership Support**
  - Branch advisors available to assist for membership & development support - aberdeenmea@energyinst.org
- **Branch Partnership/Sponsorship Opportunities for 2022/23**
  - Align your company's brand with the EI locally, leveraging bespoke benefits tailored to your needs - aberdeen@energyinst.org
- **We Both Value and Listen To Our Membership**
  - We actively encourage our membership to be active with us and tell us what they want to see more of - aberdeen@energyinst.org
- **EI Connect Program (Mentoring)**
  - Encouraging & facilitating mentoring opportunities - www.energyinst.org/membership-and-careers/ei-connect
- **EI Assist Program (Confidential Advice & Support Service)**
  - Supporting the EI community with free and confidential advice - www.energyinst.org/membership-and-careers/ei-assist

Recognising & Celebrating Our Branch Partners

IMRANDD

RUNNING SCHEDULE

- **A Tale of Two Platforms Presentation**
  - Adam Lea-Bischinger
- **Driving the Difference with Data**
  - Mark Stone
- **Panel Session**
  - Chaired by Innes Auchterlonie
- **Q&A / Close**

DRIVEN BY DATA
POWERED BY ANALYTICS

A Tale of Two Platforms

Adam Lea-Bischinger - Integrity Team Lead

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INTELLIGENCE WITH INTEGRITY

Imrandd – what's in a name?

- Integrity
- Management
- Research
- AND
- Development

We push the boundaries of traditional integrity management, unravelling complex problems, identifying and delivering the best solution, whilst keeping asset performance at the forefront

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“It was the best of times…

…It was the worst of times,
It was the age of wisdom,
It was the age of a lack of integrity data insights”
- Charles Dickens, A Tale of Two Cities (mostly)

- A journey into the life of a platform through a recent case study
- looking at the different road taken and the results that ensued, compared to the normal course

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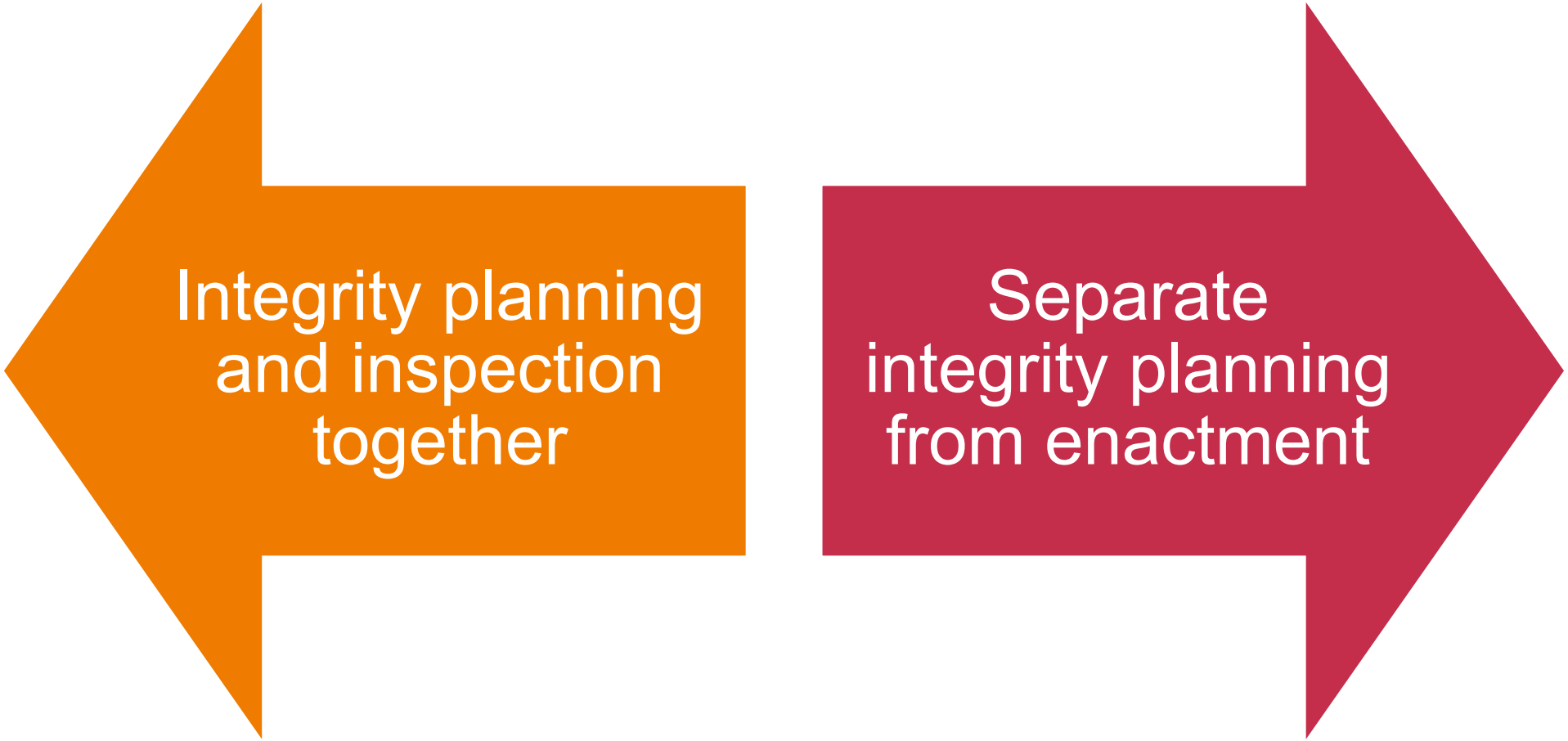
Integrity management contract structure



The worst of times – a lack of insights

Integrity management is a challenge – everything keeps changing!	New or old assets – incomplete drawings and meta data	Poor handover from projects to operations	Process condition vary – reservoir / well changes
Plant modifications / upgrades	Communication between departments	Data sitting in spreadsheets	Little spatial correlation

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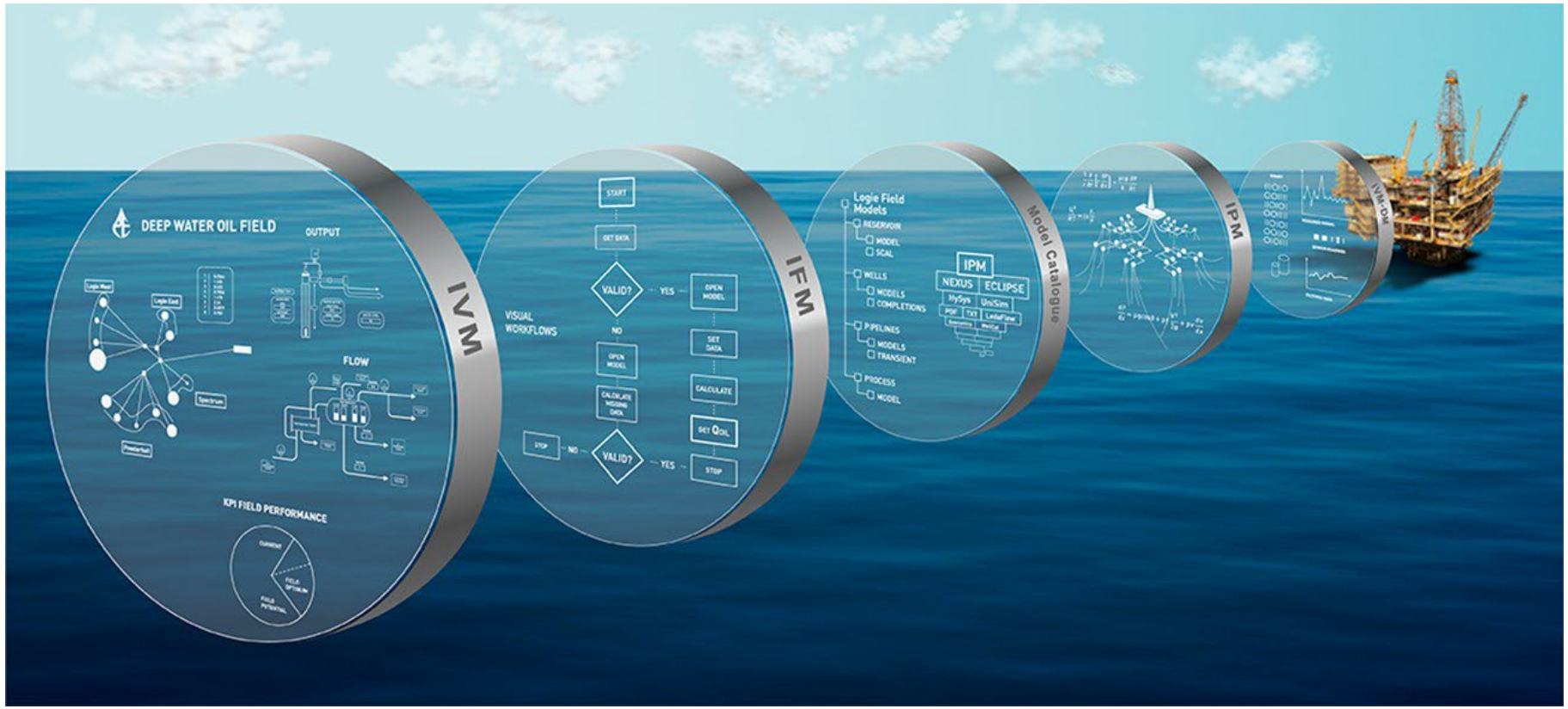
The best of times: an age of wisdom and foresight



The journey so far

Operator challenges

- Aging assets
- Lots of inspection – is it value added?
- Data silos
  - Wall thickness data base
  - Piping and vessel database
  - Drawings in folders
  - Anomalies in a separate database
- Cost pressures and drive to reduce offshore beds / helicopter visits
- Migrating all topside data to a single system

Situation overview

April 2021

- Imrandd took over an established integrity / inspection contract
- Mature asset base
- 2 assets close to COP
- Client felt a deep dive data analytics approach would target inspection
- SAP CMMS used for issuing work orders
- Estimates time / cost / interval of inspection
- Separate database for meta data, drawings and written schemes
- Another database for corrosion data

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Migrating people and data

- Integrate existing team
- Migrated historical data
- Access to client's system
- Training of personnel

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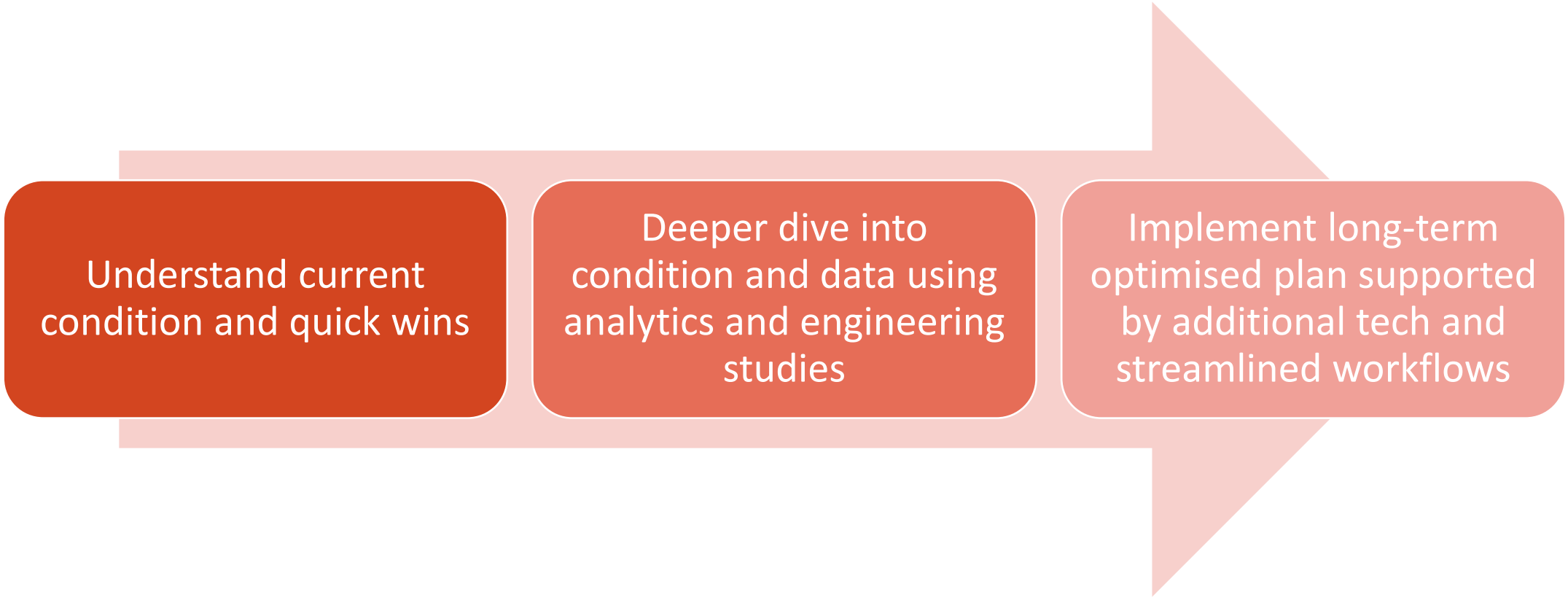
Approaching Integrity Management differently

Our approach – opportunities for improvement



Trust, but verify

- Started with a review of planned vs. actually hours in CMMS for circuits
- Hours in SAP used for annual planning
- Hours = offshore personnel = bed and helicopters

- Applied norms per work scope as per WSE
- External visual inspection
- Internal NDT thickness readings + inboard / overside factors
- Not factoring permits / downtime / weather or prep

- Cross referenced with historical actual hours to verify
- Shared with client to confirm

- Removed over 17,000 hours for 2022 work plan

Trust, but verify

Started with a review of planned vs. actually hours in CMMS for circuits	
Hours in SAP used for annual planning	Hours = offshore personnel = bed and helicopters

↓

Applied norms per work scope as per WSE		
External visual inspection	Internal NDT thickness readings + inboard / overside factors	Not factoring permits / downtime / weather or prep

↓

17,000+ hours removed from 2022 work plan

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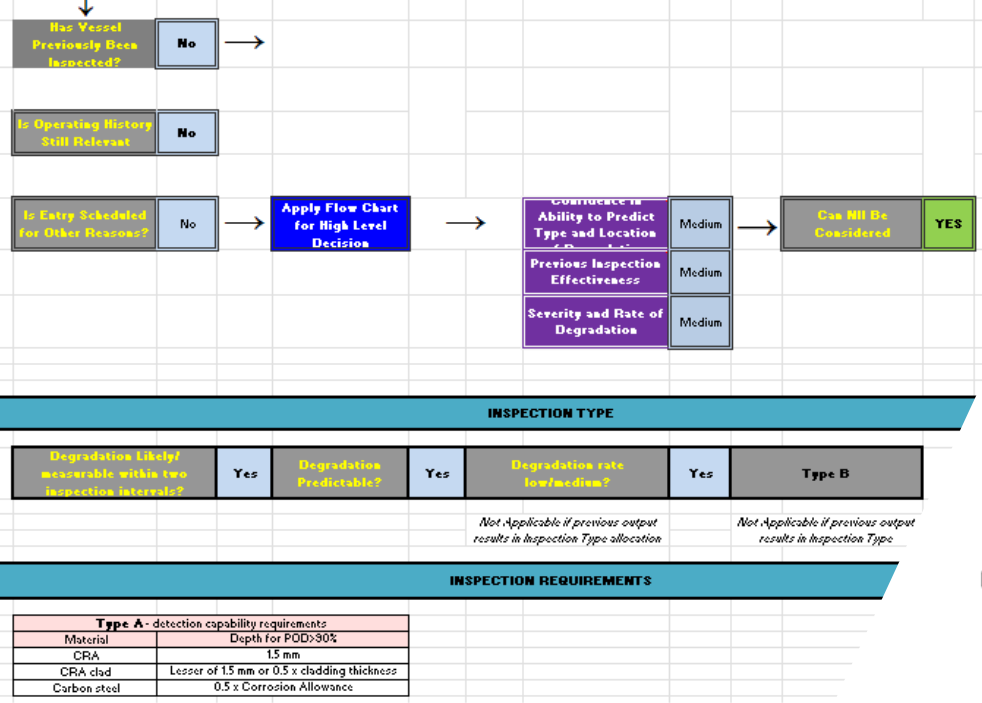
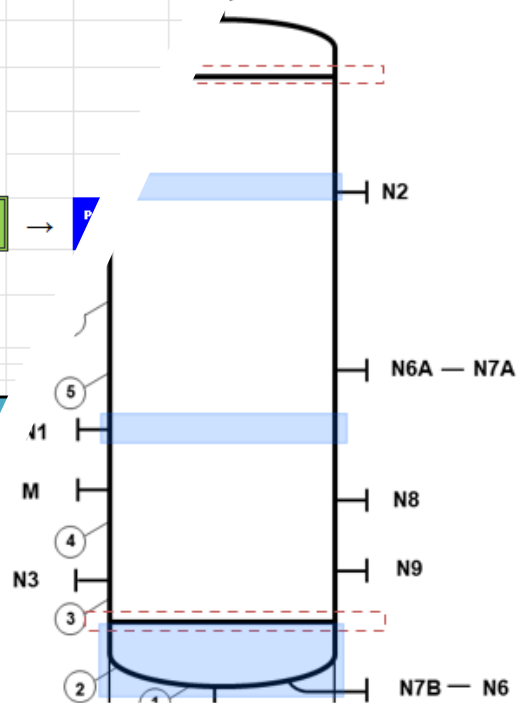
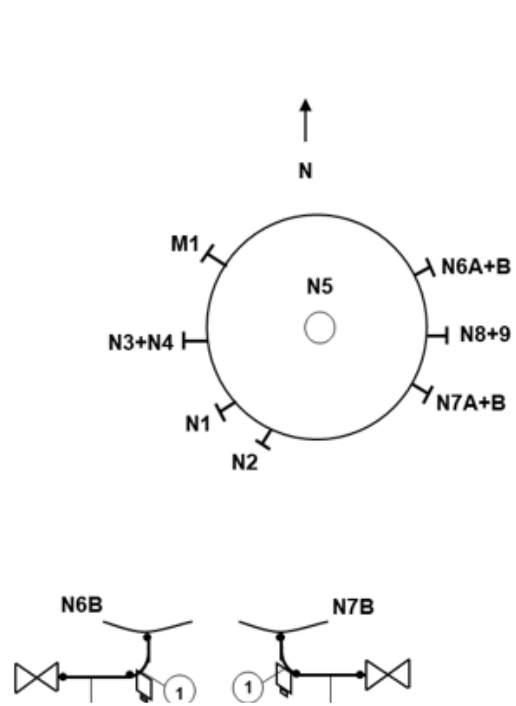
Do we need to go inside?

- Attention turned to vessel inspection
- HSE issues
- Critical path for shutdowns
- Potential damage to inside
- We applied Non-Intrusive Inspection RP G-103
- Reviewed selected vessels in 2022 scope
- Removed 33 vessels from the annual inspection plan







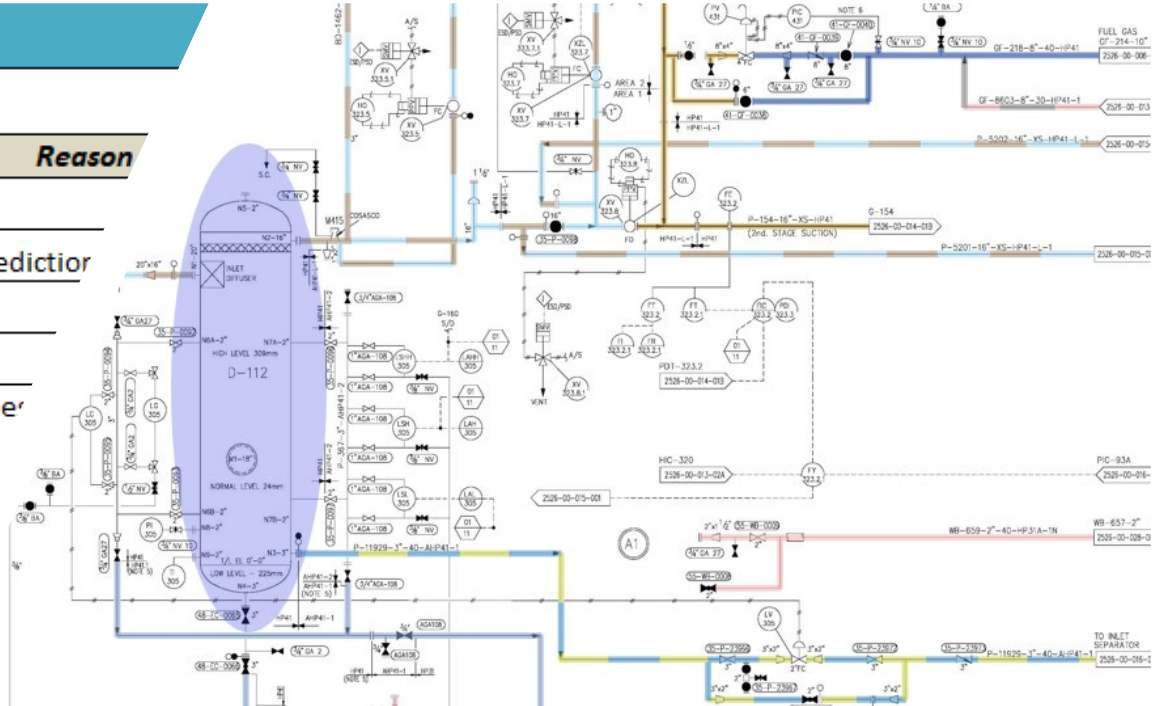
Nozzle	Size	SERVICE
N1	16"	GAS INLET
N2	16"	GAS OUTLET
N3	3"	CONDENSATE OUTLET
N4	3"	DRAIN
N5	2"	BLOWDOWN
N6 A& B	2"	INSTRUMENT YOKE
N7 A & E	2"	INSTRUMENT YOKE
N8	2"	PRESSURE GAUGE
N9	2"	THERMOMETER

KEY	
	Zero Degree Corrosion Mapping
	Time of Flight Diffraction (Sampling)
	Corrosion Mapping
	Line Scan and Manual UT
	Radiography
	M-Skip

COVERAGE for Type-B Inspection Zone

$$C_R = F_{COV} \times F_{ACC} \times F_{LC} \times F_{CONS} \times F_{SH} \times F_{ZONE} \times C_1$$

Factor		Result	Reason
Base Coverage	C_1	25%	Fixed value
Coverage Modifier	F_{COV}	1	Medium confidence in degradation predictior
Consequence of Failure Modifier	F_{CONS}	1	High taken from WSE
Zone Area Modifier	F_{ZONE}	1	Vessle surface area A≈29.37 m2
Accuracy Modifier (Type B)	F_{ACC}	1.15	Medium: 80% tolerance for wall thickne than ±0.4 mm
Tolerance to Degradation Modifier	F_{LC}	1	Medium: The known or predicted de consideration are such as to be obs expected to threaten the vessel d
Spatial Homogeneity Modifier	F_{SH}	1.25	Low (from inspection history an
Coverage Required	C_R	36%	



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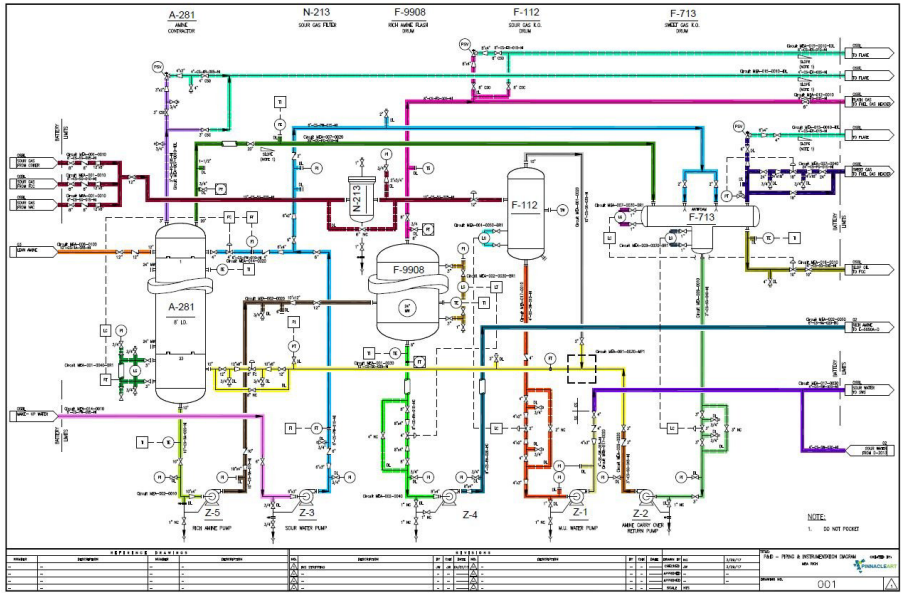
Review of Corrosion loops

- Tweaks and changes over the years
- Each loop has a work pack
- Independent review of corrosion circuits
- Reduced total number by ~20%
- Munising onshore work pack prep
- Better managing threats and risks



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Data Consolidation

- Operator decided to move to a single integrity management system
- Consolidation of multiple data sources
- Simplified work flows
- Review and approvals in one system
- Offshore work packs on tablets
- Anomaly tracking
- IMRANDD helping with data migration
- Data gap analysis

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Data Conditioning

Data conditioning in preparation for analysis brings its own benefits:

- Realistic resource allocation in CMMS
- Data properly structured and more easily interpreted
- Many data errors corrected – PMC, NWT, MAWT
- Data ready for analysis and trending

Remember the other platform?

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Remember the other platform?

- Historical data not analyzed
- CMMS assumed to be correct
- Inspection frequencies unchanged / intervals the same
- Inspecting burden only growing
- Knowledge gaps – *little or no justification for not inspecting some pipework*

The next phase…

Bringing in the expertise of the operational data analytics team

DRIVEN BY DATA
POWERED BY ANALYTICS

Optimising pipework inspection strategies for a global operator

Mark Stone – Operational Data Team Lead

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Optimisation

Development of inspection strategies that are:

- Cost efficient
- Effective in risk management
- Consider the requirements to COP

Data analytics and the insights provided drive the improvements

Pipework integrity management

The assets included in the optimisation scope have a large amount of pipework

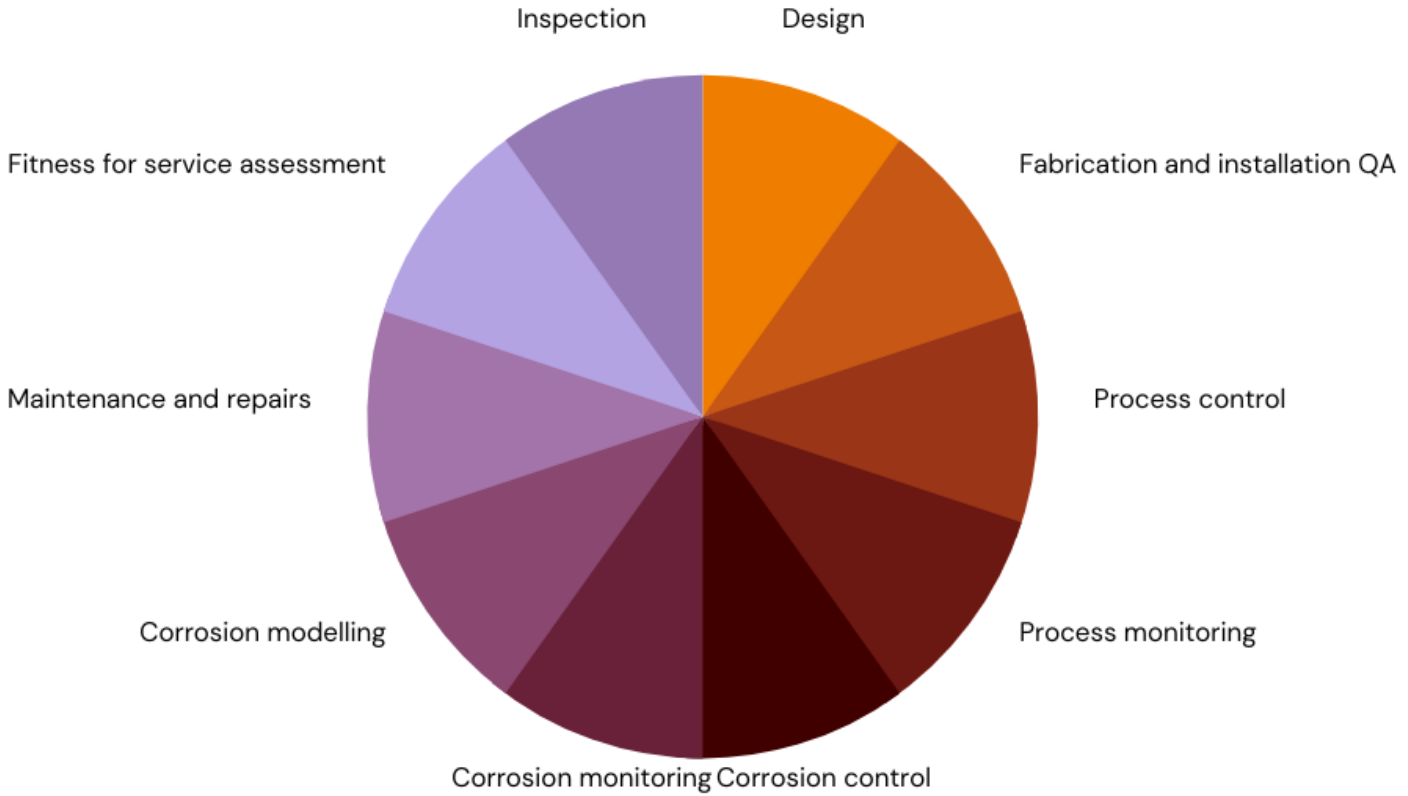
- Essential to the production process
- Conveys hazardous fluids under pressure
- Typically high consequences of failure
- Subject to degradation, e.g. corrosion, in-service
- Ageing assets - probability of failure tends to increase over time

Pipework is major focus of the integrity management activity

Pipework integrity management

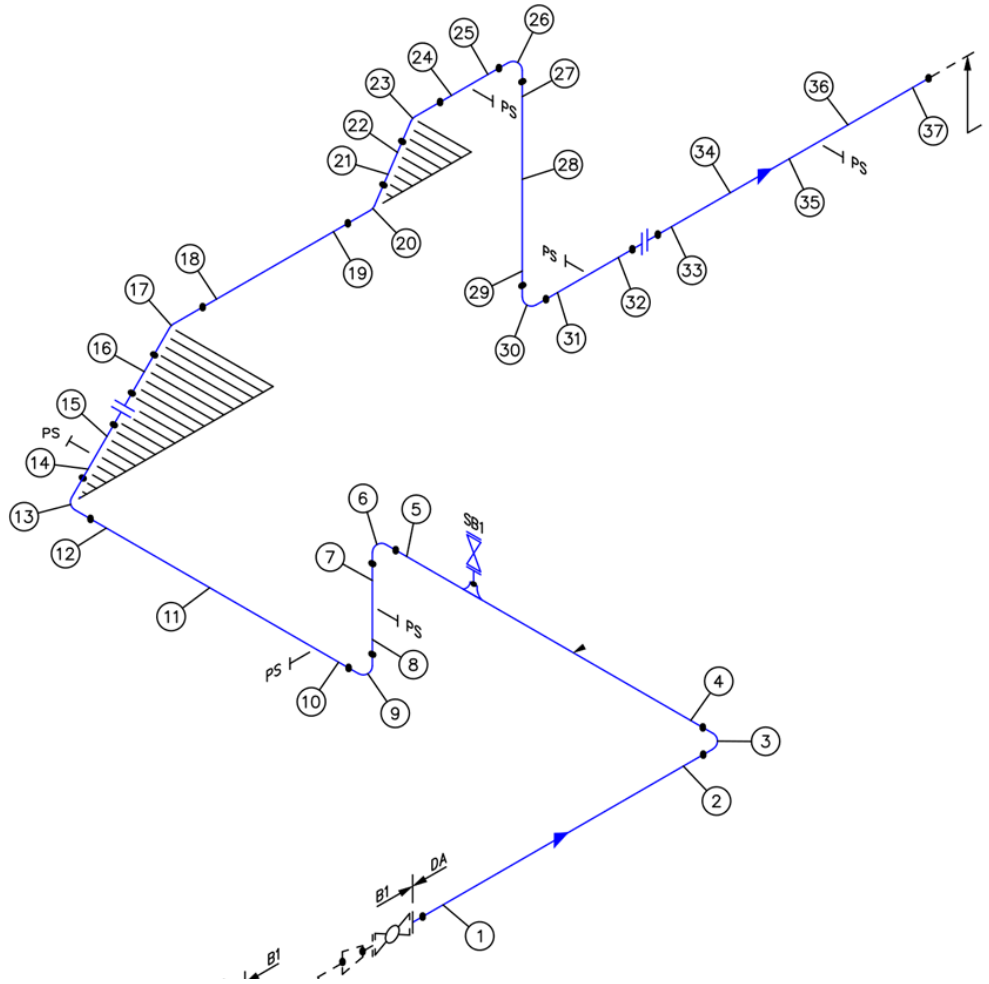
Integrity management is multi-faceted, relying on multiple barriers and mitigations

Inspection plays a key role: it is the only input to integrity management that provides direct information on the actual condition of pipework



Pipework inspection (internal corrosion)

- Approach already in place followed industry practice, i.e. wall thickness measurements at selected test points
- This is a sampling process (not possible to inspect everywhere)
- Test points are selected based on a combination of targeting higher threat locations *and* aiming to get a representative sample
- Inspection isometrics used as the basis for locating and identifying test points
- Re-inspection is carried out at intervals so that changes in thickness can be monitored and trends identified

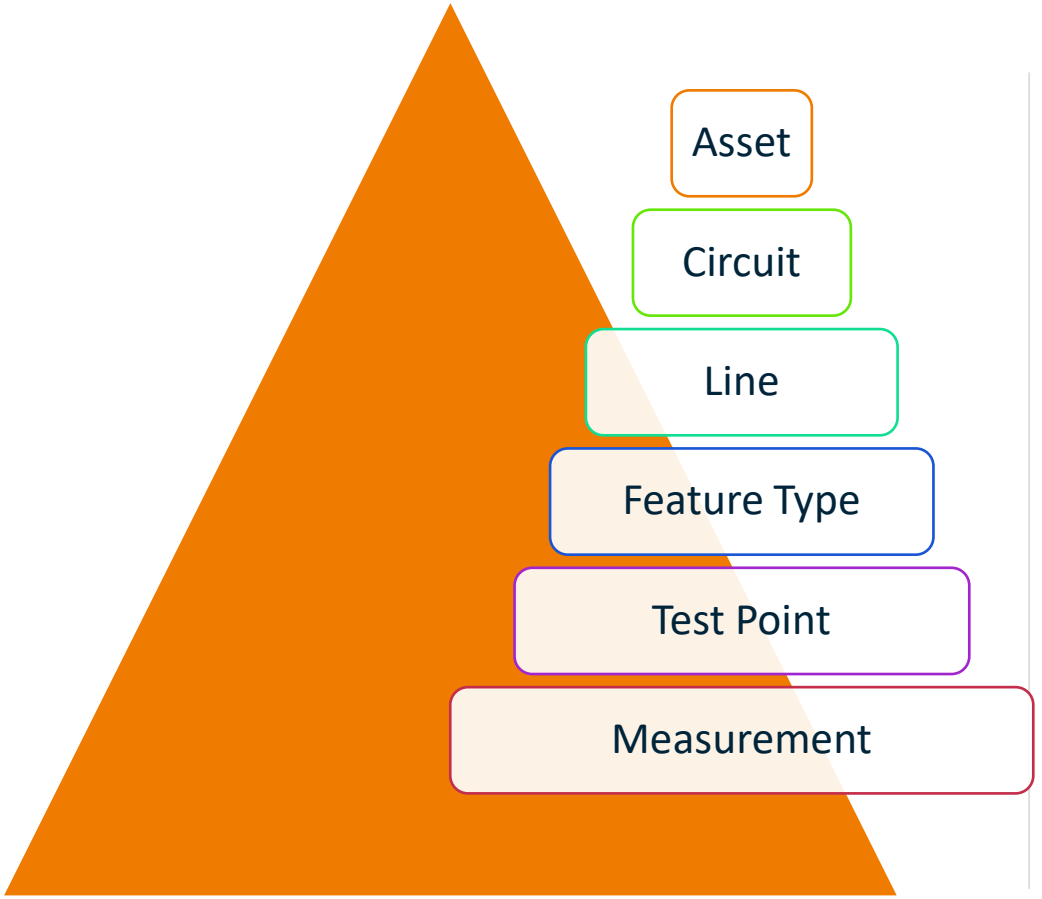


Pipework inspection (external corrosion)

- External corrosion is the primary integrity threat for many of the systems
- This is increasingly so as the assets age
- Close visual inspection is used to establish the condition of pipework
- Aim was 100% coverage at intervals set by the RBI (but typically driven by matching to the interval for interval inspection)
- Damage classification used as basis for reporting (Cat 5 = coating in good condition → Cat 1 = severe corrosion and scale)
- Inspection (damage classification result) was used to drive the need for fabric maintenance and repair
- Process was mainly reactive to reported classification data
- Limited wider use of classification data to make estimates of future condition and set intervals

Available inspection data

- Some variation across assets but typically for an asset
  - Pipework length in the 10km's
  - 10's to 100's of circuits with different corrosion behaviours
  - 100's-1000's of individual lines
  - >10k inspection test points
  - >>10k total inspections over history
- A large amount of data relating to internal and external inspection!
- But how had the data been used historically?
  - Taken to indicate test points are acceptable at time of inspection
  - Test points treated individually
  - Limited amalgamation to determine trends at the line or circuit level
  - Limited insight into wider behaviour and threats
  - Some movement towards more detailed analysis of data but on a limited scale
- Advances in computing and data analytics allow full value of data to be extracted



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Tools supporting analytics for optimisation

- EXTRACT is a module for extraction and organisation of data that is not already in a structured database
- EXACT is an advanced inspection data analytics tool developed by IMRANDD as part of its AIDA software suite
- EXACT is designed specifically for pipework inspection data analytics
  - Accepts inspection and system data from any existing database by using a mapping process
  - Uses the inspection data to obtain results at the test point level and specified amalgamations
  - Is central to analysis supporting inspection optimisation

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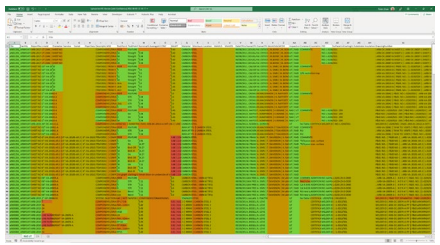
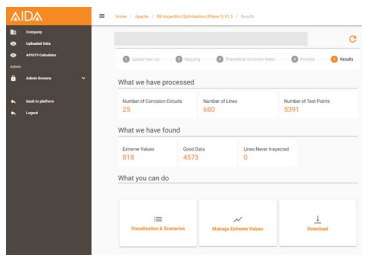
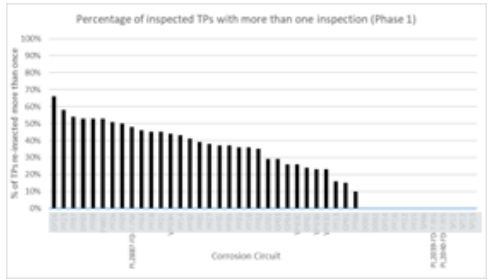
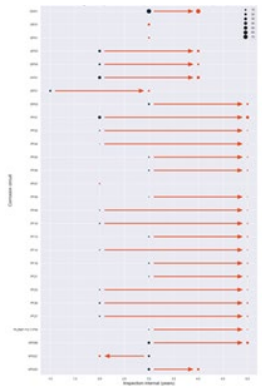
Steps in each inspection optimisation project









Data preparation and cleansing

- Input data from a range of sources (not just inspection)
- Analysis outputs are only as robust as the inputs
- Measurement data is a key input but system data reliability has a major impact
- Examples:
  - Nominal wall thickness
  - Minimum allowable thickness
  - Piping diameter for the test point location
  - Corrosion circuit assignment
  - Material
  - Replacements
- Substantial effort is put into ensuring inputs are as robust as possible
- This is assisted by software routines that check data
- *Typically represents up to 25% of the time taken to complete a project*

Data analysis (internal corrosion)

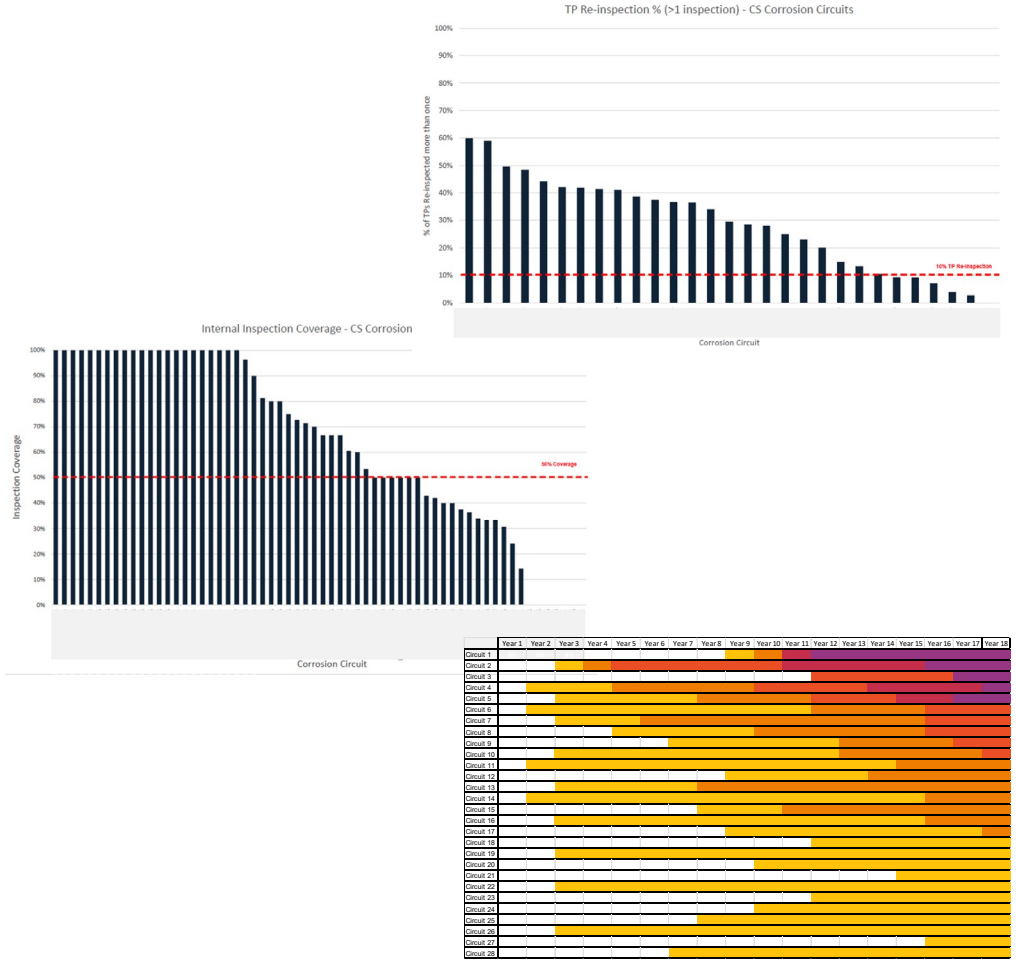
- Data analysis performed using Exact
- Determines a wide range of inspection metrics, e.g.
  - Number of test points inspected at circuit and line level
  - Proportion of test points with repeat inspections and number of repeat inspections
  - Distribution of inspection according to feature type (straight, bend, tee etc)
- Calculates corrosion rates and remaining life at the test point level
- Determines distributions of corrosion rates and remaining life at group level (e.g. corrosion circuit)
- Classifies test point data as “Good” or “Extreme”
- Extreme classification covers
  - Potential short term integrity threats
  - High levels of uncertainty related to input data
- Detailed review for each test point classified as extreme and actions and priority assigned
- Good data is used for group level analysis
- Distribution of remaining life used in deriving inspection interval recommendations

Data analysis (external corrosion)

- Analysis process currently uses a bespoke tool that will be incorporated in Exact
- Uses classification from external close visual inspection reports as a basis
- Estimates progression of wall loss over time depending on the most recent classification
- Wall loss and remaining life are used to identify
  - Window for fabric maintenance
  - Intervals for close visual inspection
- Quantitative basis for future inspection planning
- Allows de-coupling of intervals for inspection of internal and external corrosion → external intervals often longer

Insights and actions

- Analytics deliver value through the actions defined
  - Decisions driving changes in future plans
- The decisions and actions are derived from the additional insights provided by the analytics
- Optimisation projects rely on derivation and interpretation of a wide range of metrics.
- Interpretation is aided by graphics and visualisation.
  - Software facilitates generation of visual outputs
  - Interpretation remains reliant on engineering judgement



Changes in inspection strategy

Recommendations for specific actions are the primary output of the optimisation projects:

Inspection intervals	Test points	Gaps to be addressed	Re-circuitisation	Fabric maintenance
• Defined on a circuit level • Internal and external inspection intervals are decoupled	• Highlighting specific test points as near term integrity threats hence priority inspection • Test points to be included in routine inspection at next interval • Test points for review to address uncertainty based on input data	• E.g., where there has historically been insufficient inspection of a specific feature type, specific lines with no inspection history • Data reliability issues and updates to be made	• Recommendations to improve future planning and efficiency	• Requirements and windows for FM

Actions are reviewed and addressed by the IMRANDD Integrity Management team

Benefits to the operator

Optimised Strategy

- Recommendations better aligned to risk
- Actions to address near term integrity threats
- Improved efficiency in long term plans

Reduced offshore inspection effort

21% Average reduction per year to COP

£4million Savings from optimisation activity (up until COP)

Ongoing / future benefit

Data quality

- System data updated
- Databases populated with more reliable data
- Wider benefits, e.g. to robustness of RBI

Evergreen strategy

- Analysis as new data becomes available
- Strategy adapted to changing conditions

- Very good return on investment from the optimisation projects
- Additional optimisation scopes currently underway
- Staged integration as part of the routine activity of the Integrity Team

Acknowledgements

- Colleagues in IMRANDD's Data, R&D and Contract Integrity Teams
- Industry leaders who recognise the benefits of increased application of analysis for inspection evaluation and planning
- The audience today for an early start to listen to the presentations. Your time is appreciated!

For more information contact:

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