A TALES OF TWO PLATFORMS

- Welcome & Introduction
- The EI - Global Reach with Local Focus
- This Morning’s Running Schedule
- Thanks & Close
THE EI - GLOBAL REACH WITH LOCAL FOCUS

• **AHI Branch 2022 Events Programme**
  o Diverse technical program & visit schedule - see [www.energyinst.org/ei-near-me/uk/aberdeen](http://www.energyinst.org/ei-near-me/uk/aberdeen)

• **Membership Support**
  o Branch advisors available to assist for membership & development support - aberdeenmea@energyinst.org

• **Branch Partnership/Sponsorship Opportunities for 2022/23**
  o 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**
  o 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)**

• **EI Assist Program (Confidential Advice & Support Service)**
  o Supporting the EI community with free and confidential advice - [www.energyinst.org/membership-and-careers/ei-assist](http://www.energyinst.org/membership-and-careers/ei-assist)
RUNNING SCHEDULE

• A Tale of Two Platforms Presentation
  o Adam Lea-Bischinger

• Driving the Difference with Data
  o Mark Stone

• Panel Session
  o Chaired by Innes Auchterlonie

• Q&A / Close
A Tale of Two Platforms

Adam Lea-Bischinger - Integrity Team Lead
Imrandd – what’s in a name?

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

Integrity
Management
Research
AND
Development
“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
Integrity management contract structure

Integrity planning and inspection together

Separate integrity planning from enactment
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 varies – reservoir / well changes
- Plant modifications / upgrades
- Communication between departments
- Data sitting in spreadsheets
- Little spatial correlation
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
Migrating people and data

- Integrate existing team
- Migrated historical data
- Access to client's system
- Training of personnel
Approaching Integrity Management differently
Our approach – opportunities for improvement

1. Understand current condition and quick wins
2. Deeper dive into condition and data using analytics and engineering studies
3. Implement long-term optimised plan supported by additional tech and streamlined workflows
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**

<table>
<thead>
<tr>
<th>Started with a review of planned vs. actually hours in CMMS for circuits</th>
</tr>
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<tbody>
<tr>
<td>Hours in SAP used for annual planning</td>
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<th>Applied norms per work scope as per WSE</th>
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<tr>
<td>External visual inspection</td>
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</table>

**17,000+ hours removed from 2022 work plan**
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
### Coverage for Type-B Inspection Zone

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

<table>
<thead>
<tr>
<th>Factor</th>
<th>Result</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base Coverage</td>
<td>25%</td>
<td>Fixed value</td>
</tr>
<tr>
<td>Coverage Modifier</td>
<td>1</td>
<td>Medium confidence in degradation prediction</td>
</tr>
<tr>
<td>Consequence of Failure Modifier</td>
<td>1</td>
<td>High taken from WSE</td>
</tr>
<tr>
<td>Zone Area Modifier</td>
<td>1</td>
<td>Vessel surface area (A = 29.37 \text{ m}^2)</td>
</tr>
<tr>
<td>Accuracy Modifier (Type B)</td>
<td>1.15</td>
<td>Medium: 80% tolerance for wall thickness thinner than (\pm 0.4 \text{ mm})</td>
</tr>
<tr>
<td>Tolerance to Degradation Modifier</td>
<td>1</td>
<td>Medium: The known or predicted degradation consideration are such as to be observed expected to threaten the vessel's structural integrity</td>
</tr>
<tr>
<td>Spatial Homogeneity Modifier</td>
<td>1.25</td>
<td>Low (from inspection history an analysis)</td>
</tr>
<tr>
<td>Coverage Required</td>
<td>36%</td>
<td></td>
</tr>
</tbody>
</table>
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
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
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?
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
Optimising pipework inspection strategies for a global operator

Mark Stone – Operational Data Team Lead
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
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
Steps in each inspection optimisation project

Extraction → Data Cleansing → Analysis → Presentation and visualisation → Recommended Actions
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:

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

Actions are reviewed and addressed by the IMRANDD Integrity Management team
## Benefits to the operator

<table>
<thead>
<tr>
<th>Optimised Strategy</th>
<th>Reduced offshore inspection effort</th>
<th>Ongoing / future benefit</th>
</tr>
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<tbody>
<tr>
<td></td>
<td></td>
<td>Data quality</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Evergreen strategy</td>
</tr>
<tr>
<td>• Recommendations better aligned to risk</td>
<td>Average reduction per year to COP</td>
<td>• System data updated</td>
</tr>
<tr>
<td>• Actions to address near term integrity threats</td>
<td>Savings from optimisation activity (up until COP)</td>
<td>• Databases populated with more reliable data</td>
</tr>
<tr>
<td>• Improved efficiency in long term plans</td>
<td></td>
<td>• Wider benefits, e.g. to robustness of RBI</td>
</tr>
<tr>
<td>21%</td>
<td>£4million</td>
<td>• Analysis as new data becomes available</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Strategy adapted to changing conditions</td>
</tr>
</tbody>
</table>

- 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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