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Pipeline Integrity Moment

Internal Corrosion

*Achieving financial and operational improvements by relying on **quantitative internal corrosion hazard modelling** as the foundation of a **forward-looking performance-based corrosion management plan***

*Performance-Based Corrosion
Management Plan
(CMP)*



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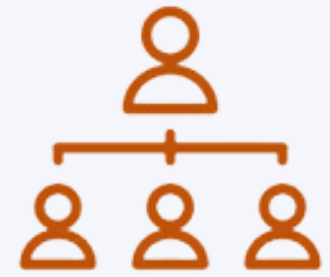
2010 - 2023

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Part A

Under-Performing Rule-Making 2000 - 2020

*A Period when Onerous Time-
Based Rules Failed to Deliver
Anticipated Improvements to
Pipeline Safety*



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*Under-Performing
Time-Based Rules*



Observations - Internal Corrosion (IC)

2000 - 2020

Compliance-focused integrity management strategies (2000 -2020) relied on the flawed premise that minimum pipeline safety standards within regulations were adequate to identify, assessing and mitigate internal corrosion risks



*Unintentionally
Encouraged
Risk-Blindness*



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Under-Performing Time-Based Rules



Observations - Internal Corrosion (IC)

2000 - 2020

- Compliance-focused integrity management relied upon time-based deployment of resources, placing field ops into a position of **reacting** to the detection of corrosion damage
 - repeated time-based inspection intervals were relied upon to detect damage and to measure defect growth rates
 - *no pipeline business sector demonstrated an improvement in pipeline failure incident rates by this strategy (2000-2020)*

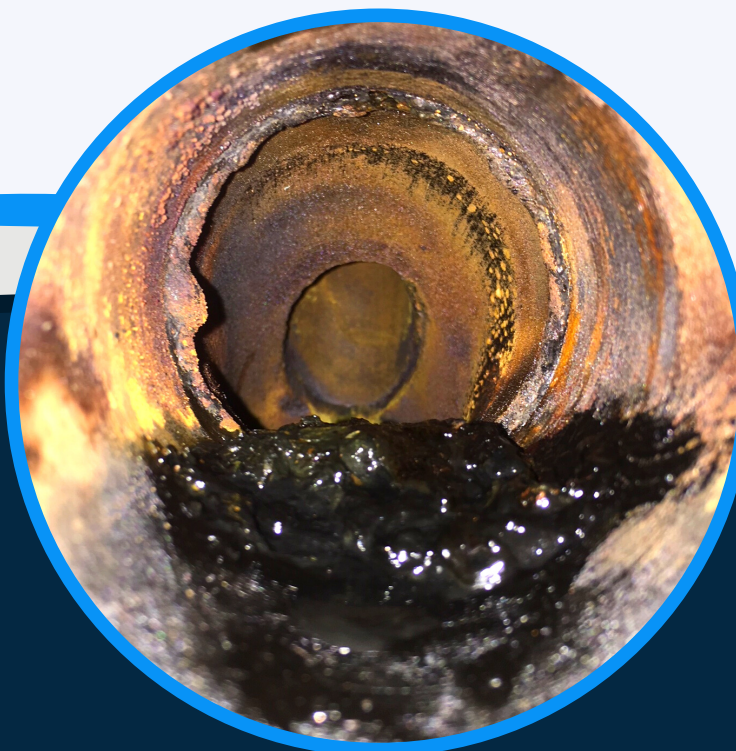




Observations - Internal Corrosion (IC)

2000 - 2020

- Compliance-focused integrity management (2000 - 2020) relied on standards fraught with risk-blindness
 - dominant integrity hazards were not addressed
 - *detrimental well start-up events within the well-field causing up-lift of fugitive corrosive fluids and debris*
 - *episodic ingress of non-conforming product and debris from upstream storage and processing*





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*Under-Performing
Time-Based Rules*



Observations - Internal Corrosion (IC) 2000 - 2020

Compliance-focused integrity management (2000 - 2020) contributed to misallocation of limited resources to low-risk structures and under-funding of appropriate hazard-optimized mitigation and inspection activities onto critical risk pipeline assets





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Part B

The Definition of Performance-Based Integrity Management





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Performance-Based Management



Observations - Internal Corrosion (IC) 2020 - Present

- Performance-based management positions the operator to risk-optimize all integrity activities
 - *a forward-looking strategy*
 - *field ops can predict and respond to ongoing changes to the risk exposure*
 - *inspections provide validation of assessment and mitigation effectiveness across all pipeline systems*



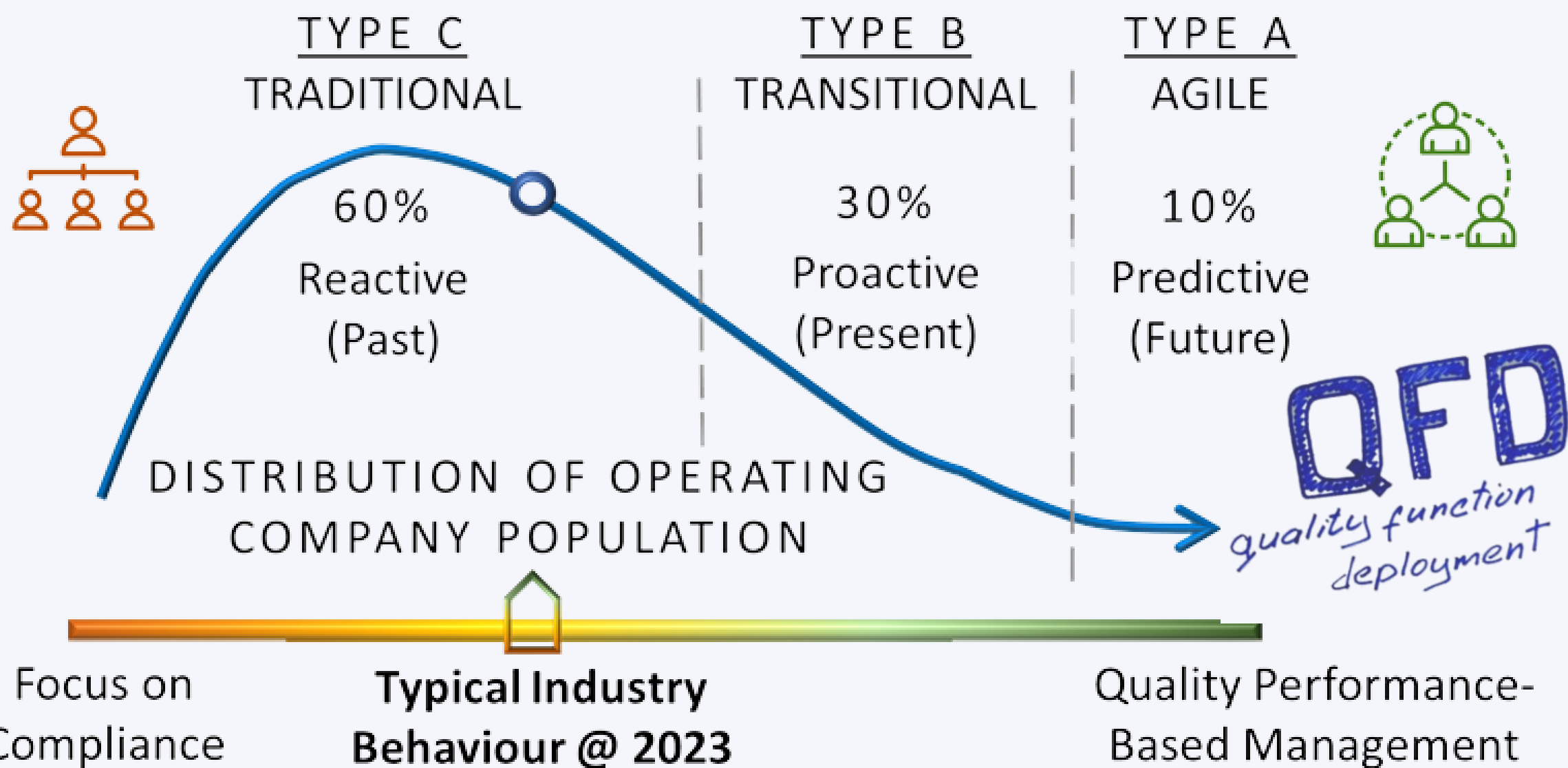


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Performance-Based Management



Observations - Internal Corrosion (IC) Status Quo & Benefits



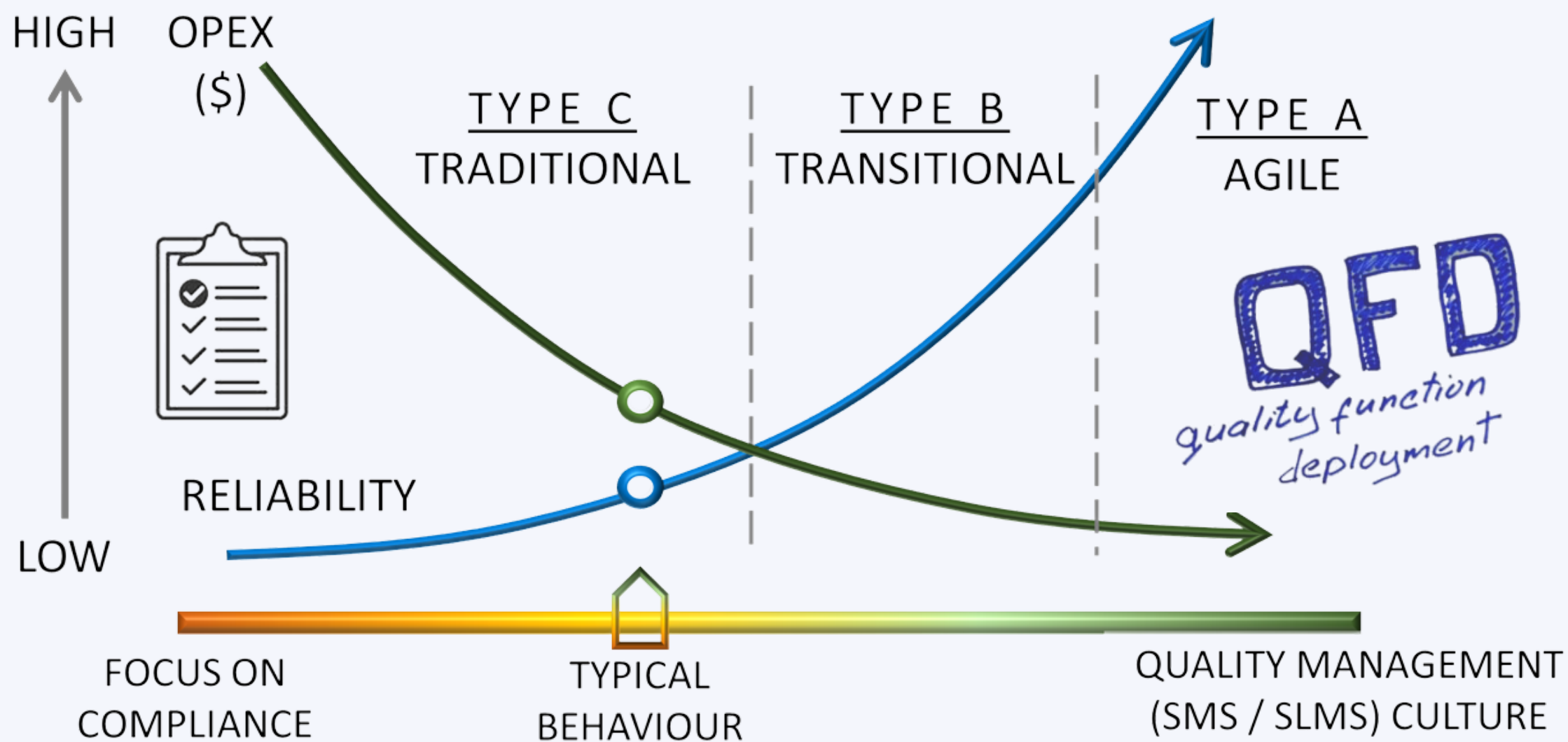


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Performance-Based
Management



Observations - Internal Corrosion (IC) Status Quo & Benefits





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Performance-Based Rule-Making



Observations - Internal Corrosion (IC) 2020 - Present

- The transformational shift to performance-based integrity management relies on robust characterization of the **over-life corrosion hazard profile** as the basis for hazard-optimized deployment of mitigation, monitoring and inspection
 - *corrosion management programs increasingly need to rely upon complex hazard models to identify and respond to hazards that vary significantly among pipeline systems*
 - *advanced hazard models address historical risk-blindness common to traditional standard methods*





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Part C

Achieving Performance-Based Integrity Management

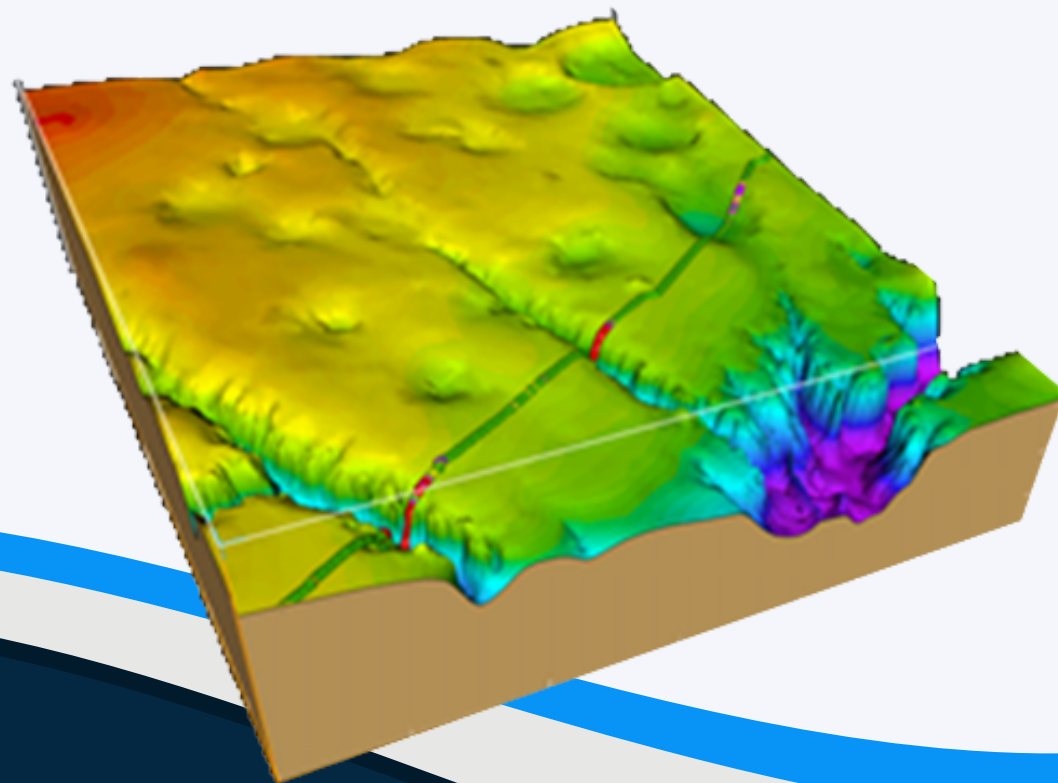
*Quantitative Corrosion Hazard
Modelling within a Performance-
Based Integrity Management
Program*



Quantitative Corrosion Hazard Profiling

Features & Benefits

- Quantitative corrosion hazard profiling defines the extent of internal corrosion damage along a pipeline with consideration of over-life operating conditions;
 - *steady-state operation / normal production fluids / upset conditions / ingress of fugitive debris / non-conforming product quality*





Quantitative Corrosion Hazard Profiling

Features & Benefits

- Provides a platform for capturing and considering input of field ops experience and operating conditions that could contribute to an elevated likelihood of corrosion damage and accelerated corrosion rates
 - *oxygen ingress / debris / intermittent operations / MeOH injection*
 - *pigging / upstream water separation / gas dehydration*





Quantitative Corrosion Hazard Profiling Features & Benefits

- Prioritize pipelines for in-line inspection and / or monitoring based upon potential severity of corrosion damage
 - *risk-based scheduling of in-line inspections and / or monitoring avoids deploying limited resources onto pristine non-corroded pipelines*

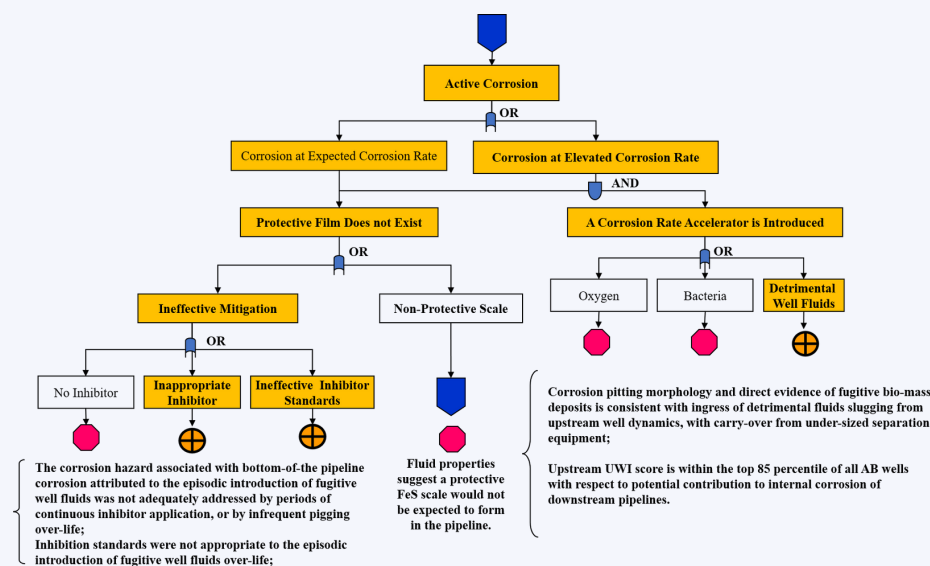




Quantitative Corrosion Hazard Profiling

Features & Benefits

- Understand the root-cause factors contributing to internal corrosion damage identified during in-line inspections and / or direct examination integrity digs
 - *implement effective mitigation based upon enhanced understanding of corrosion mechanism(s)*
 - *translate inspection results and mitigation strategies onto other pipeline structures sharing a strong sibling association with the inspected pipeline structure*

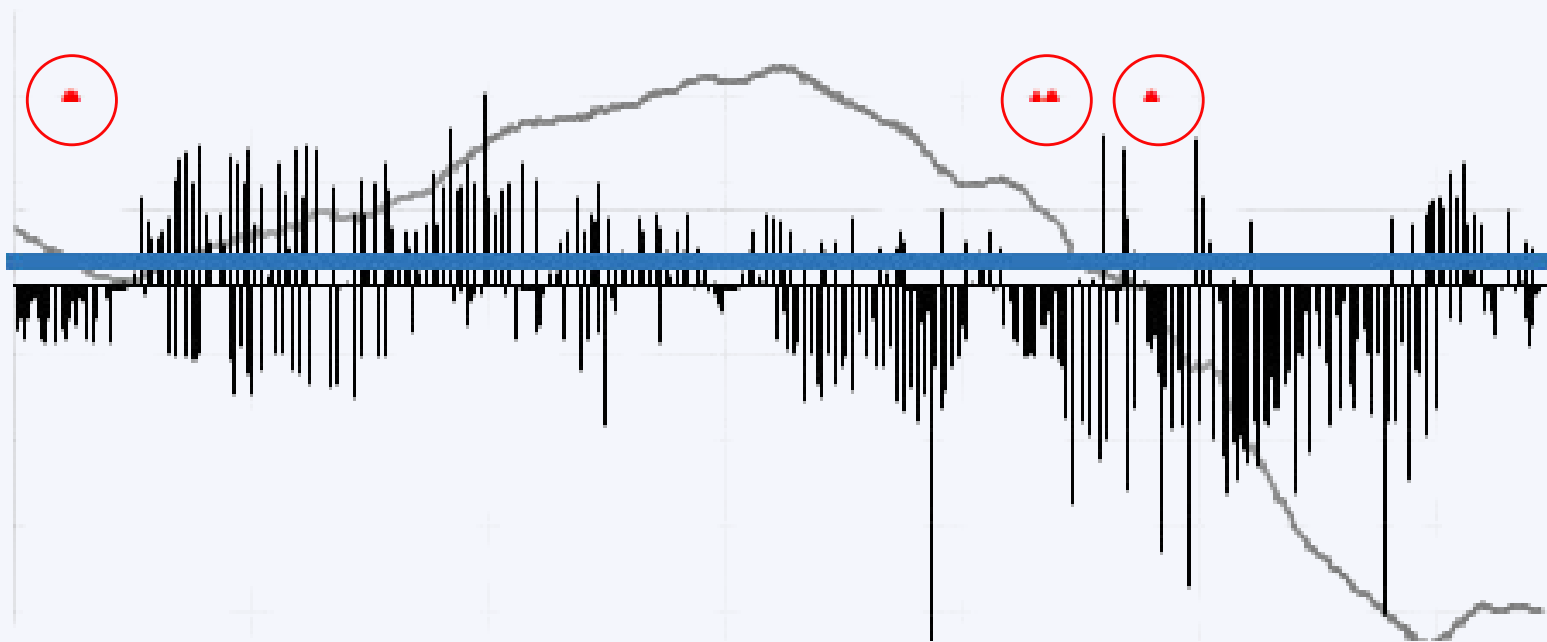




Quantitative Corrosion Hazard Profiling

Features & Benefits

- Pin-point the location(s) for corrosion monitoring stations as a measure of the effectiveness of applied mitigation controls at location(s) considered most probable to represent the maximum potential corrosion damage
 - *translate monitoring results and assessment of mitigation control measures onto other pipeline structures sharing a strong sibling association with the monitored structure*

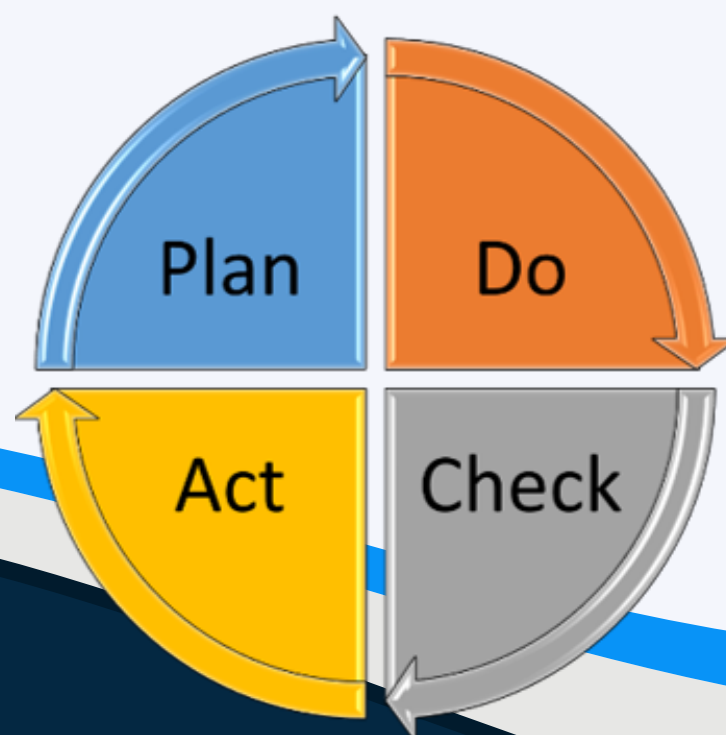




Quantitative Corrosion Hazard Profiling

Features & Benefits

- Validation of corrosion mitigation controls
 - *interpret successful inspection and monitoring results as affirmation of mitigation for specific hazard conditions*
 - *interpret unsuccessful monitoring results as a trigger for review and improvement of mitigation standards for specific hazard conditions*





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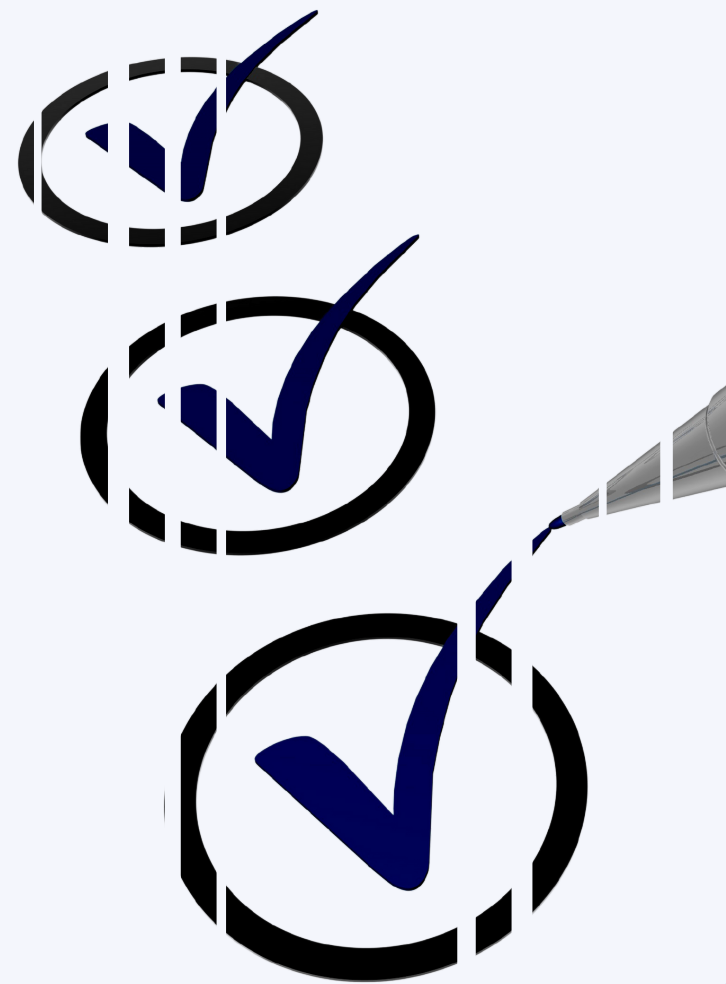
Pipeline Integrity Moment

Internal Corrosion

Up Next ...

- *A Self-Assessment Checklist*
 - *evaluating the transformation from a traditional compliance-focused program to a performance-based integrity management*

Performance-Based Corrosion Management Plan (CMP)





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We are dedicated to creating industry-leading integrity hazard models so field ops teams can risk-optimize the deployment of mitigation, monitoring and inspection schedules



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