2025 APGA Innovation Award Submission

Overview & Contact Info

Title of Innovation: RunCom™ Cluster Growth 3D (RCG3D) – Predictive Corrosion Modelling for Pipeline Integrity

Organisation Background: Baker Hughes is an energy technology company that provides solutions for energy and industrial customers worldwide. Built on a century of experience and conducting business in over 120 countries, their innovative technologies and services are taking energy forward – making it safer, cleaner and more efficient for people and the planet.

Baker Hughes, Process & Pipeline Services (PPS) brings together a unique portfolio of:

- Pipeline inspection and integrity services: advanced inspection technologies (mechanical damage, metal loss, crack detection and mapping surveys), integrity engineering expertise and powerful data management software tools to drive enhanced pipeline safety.

- Pipeline pre-commissioning services: line integrity validation to a variety of pipeline codes; product commissioning; flooding; and cleaning and drying new lines to reduce corrosion, improve efficiency, and maximizing throughput.

- Pipeline maintenance services: proprietary chemical products to control corrosion and protect new assets so that operators can reduce costs and meet deadlines; mechanical, chemical, or gel technology cleaning services to help mitigate long-term corrosion; air, vacuum, nitrogen or chemical swabbing to reduce drying time so that operators can get into production quickly; technology to remove deposits, including wax, liquids, black powder, rust, and millscale to improve efficiency without going offline.

Innovation Description

RCG3D is a machine learning and probabilistic modelling tool that simulates corrosion growth in three dimensions - depth, length, and width - using historical in-line inspection (ILI) data. Unlike traditional fixed-rate models, RCG3D:
- Uses localized growth rate distributions.
- Predicts new corrosion initiation sites.
- Models defect coalescence and cluster evolution.

Stage of Development: This system has been comprehensively developed and validated across more than 20 pipelines, with over 700,000 corrosion clusters evaluated and more than six operational projects successfully completed to date.

Originality

RCG3D introduces several unique features:
- 3D Modelling: Accounts for surface area growth and defect interaction.
- Localized Growth Rates: Derived from defect clusters in similar environments.
- Machine Learning Prediction: CNN-based model forecasts new corrosion sites using ILI signal data.
- Probabilistic Scenarios: Offers both 50th and 95th percentile forecasts for conservative and expected outcomes.

This approach replaces oversimplified fixed-rate models with dynamic, data-driven predictions.

Industry Impact

RCG3D delivers measurable benefits:
- Improved Safety: More accurate severity forecasts reduce the risk of failure from corrosion.
- Optimized Maintenance: Avoids unnecessary repairs while ensuring timely interventions.
- Cost Efficiency: Enables smarter reinspection scheduling and resource allocation.
- Environmental Protection: Minimizes risk of leaks and associated environmental damage.

Case Study Highlights:

- In one pipeline, RCG3D estimated a reduction in the predicted number of repairs over a 7-year period from several thousand (using a maximum fixed growth-rate model) to less than 10 repairs (using the probabilistic model). This change in recommended repairs demonstrates the differences between fixed-rate models and probabilistic approaches, and informs decisions regarding re-inspection intervals that, in certain scenarios, may result in no repairs being required.

- Validated predictions have matched actual inspection outcomes with high accuracy. A good overlap has been demonstrated between predicted and actual new corrosion areas on validation data. In addition, the validation method using a confusion matrix analysis (comparing the repair vs no repair prediction outcome and hence resource outliers) has found predictions to be accurate in terms of the field measured outcome with a minimal number of incorrect (yet safe) predictions. In summary, validation across diverse pipelines confirms the models' reliability and potential to reduce unnecessary repairs while maintaining safety.

Scalability & Implementation

RCG3D is scalable across pipeline types, diameters, and operating conditions. It has been successfully deployed on:
- Gas and refined product pipelines.
- Assets with multiple ILI runs.
- Environments with varied corrosion mechanisms.

Barriers & Solutions:

- Barrier: Requires a minimum of 2 ILI surveys on the same pipeline segment from the same ILI vendor (signal matching across runs from the same ILI vendor gives the most accurate corrosion growth rate predictions). However, this is a very low barrier as most pipelines will have at least two ILI runs from the same ILI vendor and many will have more than two ILI runs.
- Solution: Baker Hughes leverages decades of ILI data and advanced signal matching software to ensure robust inputs.

Supporting Evidence

- Published papers: see References below.
- Data: Over 700,000 clusters analyzed across 20+ pipelines.
- Validation: Multiple case studies comparing predicted vs actual inspection results.
- Metrics: Repair count predictions, FPR thresholds, depth progression, model accuracy.

References

1. J. Dawson, S. Farnie, N. Linkleter, “Corrosion Growth Modelling for Future Severity Assessments", PTC Asia, Kuala Lumpur, November 2025
2. J. Dawson, S. Farnie, “Accounting for corrosion growth and interaction in future severity assessments”, International Pipeline Conference (IPC), Calgary, 2024
3. J. Dawson, S. Farnie, “Accounting for corrosion growth and interaction in future severity assessments”, PPIM, Houston, 2024.

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Presentation Readiness

If shortlisted, Baker Hughes is prepared to:
- Deliver a technical pitch at the APGA Convention.
- Host a webinar showcasing RCG3D’s capabilities.
- Publish supporting materials and case studies.