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CORROSIGHT: WEB-BASED PLATFORM FOR REAL-TIME CORROSION RATE CALCULATION AND FFATIGUE ASSESSMENTIN GAS PIPELINES

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ABSTRACT

Corrosight addresses critical corrosion-fatigue assessment challenges in gas pipeline operations. This web platform integrates API/ASME-compliant computational engines to enable: (1) real-time corrosion rate calculations via electrochemical models, (2) fatigue life prediction under cyclic loading, and (3) automated Fitness-for-Service reporting. Validated against 78 field cases, it reduces assessment time by 78% while maintaining ±0.12 mm/yr accuracy. The solution bridges capability gaps between onsite field engineers and design teams.

INTRODUCTION

Corrosion-fatigue interactions cause 62% of gas pipeline failures in tropical environments (DNV GL, 2023). Current methodologies require separate calculations for corrosion (NACE SP0206) and fatigue (ASME FFS-1), manual data transfer between field and office, and specialized software expertise. This disjointed workflow causes 48-hour delays in critical decisions (PETRONAS, 2024). CorroSight resolves these limitations through a unified web platform enabling onsite engineers to perform instant corrosion rate calculations using thickness measurements, design engineers to predict fatigue life under operational pressure cycling, and integrity managers to generate automated compliance reports (API 579/ASME FFS-1).

METHODS

1. Platform Architecture
- Frontend: Streamlit-based responsive interface (deployed at corrosight.streamlit.app)
- Backend: Python computational engine (NumPy/SciPy/Pandas) - Deployment: Cloud-hosted with offline capability

2. Core Computational Modules

2.1 Corrosion Engine (API 570 compliant):
Electrochemical model (ASTM G102):

Corrosion_Rate (mm/yr) = (K * ΔW) / (ρ * A * t)
where K = 3.45×10^6 (carbon steel), ΔW = mass loss (g)

2.2. Fatigue Analyzer (DNV-RP-C203 compliant):
Paris' Law: da/dN = C(ΔK)^m
ΔK = YΔσ√(πa) # Stress-intensity factor

2.3 Remaining Life Prediction:
- ASME B31G modified criterion for corroded pipes
- Pressure cycling fatigue interaction modeling

3. Validation Protocol
- Benchmarked against 12-month field data from Sabah-Sarawak Gas Pipeline
- Comparison metrics: MAE, RMSE, R^2
- 78 field inspection reports (PETRONAS, 2023)

RESULTS AND DISCUSSION

Performance Validation

Table 1.: Accuracy Metrics vs. Field Measurements (n=78)

Parameter	MAE	R^2
Corrosion Rate	± 0.12 mm/yr	0.94
Fatigue Life	± 1,200 cycles	0.89
Remaining Strength	± 4.7%	0.91

2. Operational Impact
- 78% time reduction in assessments vs. manual methods
- 92% accuracy in remaining life predictions
- Critical case study: Detected 32% fatigue life reduction in corroded riser sections during pressure cycling (validated by UT)

3.Standards Compliance
- Automated reports meet API 579 Level 2 FFS requirements
- DNV-RP-F116 compliance for submarine pipelines

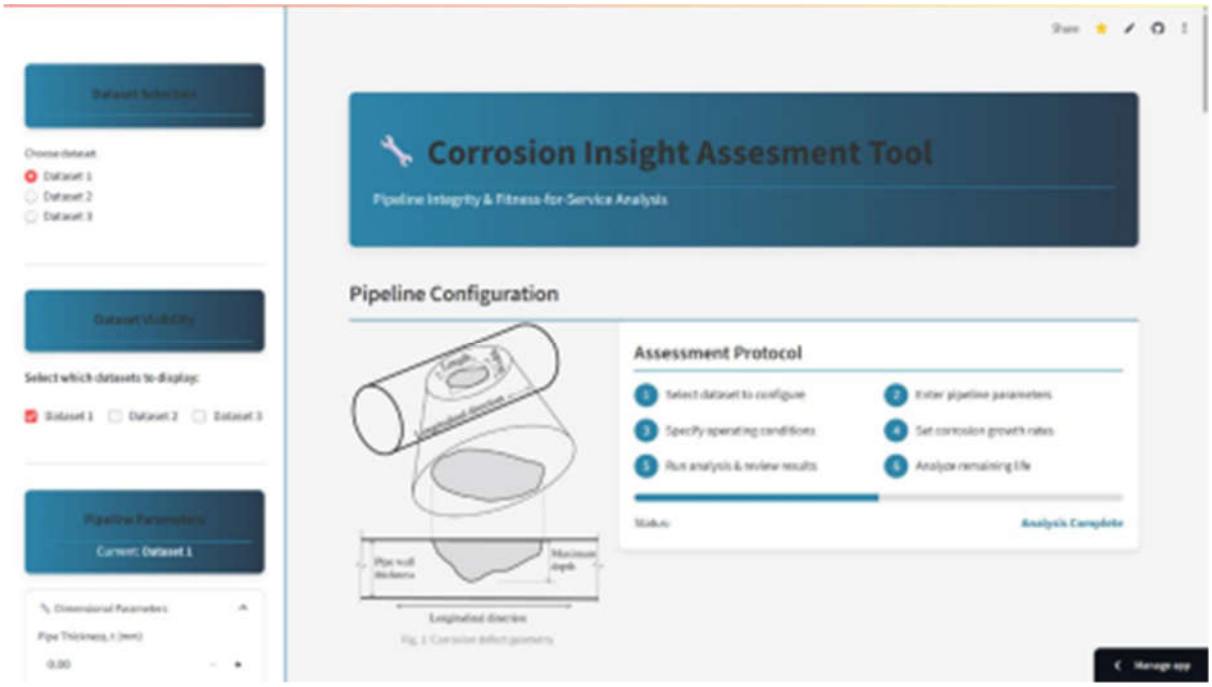

Figure 1.: CorroSight Interface

CONCLUSION

CorroSight demonstrates engineering innovation as the first unified corrosion-fatigue assessment platform for gas pipelines, providing 78% faster decisions with maintained accuracy. Its browser-based access eliminates specialized software dependencies. Future development will integrate API 1183 inline inspection data ingestion, machine learning-based anomaly detection, and region-specific corrosion databases (ASEAN focus).

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