


Case Study

Study Area:	AGR Unit Bypass Study – Material Adequacy Screening	
Job:	Material adequacy screening and corrosion assessment of existing piping and equipment under revised operating conditions following proposed AGR unit bypass.	
Date:	2024-2025	
Location:	UK North Sea Operator	
Project Background:	<p>The AGR system uses an amine-based process to remove CO₂ and H₂S from gas streams to meet export gas and crude oil specifications. Due to the predicted reduction in gas export, it was proposed to bypass the AGR system to reduce operational expenditure.</p> <p>Under the proposed bypass scenario, untreated gas containing higher concentrations of CO₂ and H₂S is routed to downstream processes and circulates throughout the facility, as the same gas is used for gas lift operations.</p> <p>A detailed screening study was therefore required to verify whether the existing materials of construction for piping and equipment were suitable for the increased acid gas concentrations expected following the AGR unit bypass.</p>	
Engineering Challenge:	<p>The key engineering challenges included:</p> <ul style="list-style-type: none"> • Significant increase in CO₂ and H₂S concentrations across multiple process systems post-AGR bypass • Potential reclassification of piping and equipment into more severe NACE regions • Risk of increased corrosion rates in carbon steel (CS) and low-temperature carbon steel (LTCS) systems • Verification of corrosion-resistant alloys (CRA) suitability under new sour service conditions as per ISO 15156-3 guidelines • Limited availability of recent corrosion integrity inspection data <p>The study required careful evaluation of both sour service compliance and long-term corrosion performance under revised steady-state conditions.</p>	

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<p>Scope of Work:</p>	<ul style="list-style-type: none"> • Modification of benchmarked HYSYS simulation to model AGR bypass scenario • Determination of new steady-state operating conditions • Extraction of piping materials, design data, and operating conditions from PFDs, P&IDs, line lists, and datasheets • Corrosion rate prediction for CS/LTCS piping using Norsok M-506 • Sour service qualification in accordance with ISO 15156-2 and ISO 15156-3 • NACE region reassessment for affected systems • Evaluation of corrosion inhibitor and gas dehydration mitigation effectiveness • Assessment of H₂S scavenger injection as an alternative operational strategy for fuel gas system
<p>Key Findings:</p>	<ul style="list-style-type: none"> • Most existing equipment and piping were found to be materially suitable under revised operating conditions, except few with unsuitable material flagged. • All CRA piping and equipment were compliant with ISO 15156-3 requirements. • Corrosion in CS/LTCS systems could generally be managed using existing mitigation strategies, including corrosion inhibitor injection and gas dehydration. • In gas streams downstream of dehydration units, the very low water dew point significantly reduced the likelihood of free water condensation and corrosion. • Certain piping and equipment were reclassified into more severe NACE Region 3 post-bypass due to increased H₂S concentration. • Some systems require material requalification due to NACE region changes.
<p>Engineering Recommendations:</p>	<ul style="list-style-type: none"> • Requalification of piping and equipment where NACE region classification changes occur. • Continued application and verification of corrosion inhibitor injection in crude oil systems downstream of booster pumps. • Monitoring of gas dehydration performance to prevent free water condensation in gas streams. • Controlled implementation of H₂S scavenger injection to maintain acceptable fuel gas quality. • Corrosion rate of TEG regeneration equipment and piping is sensitive to PH and TEG concentration and needs to be revalidated by the package vendor. • Periodic corrosion monitoring and inspection to validate predicted corrosion performance.
<p>Final Outcomes:</p>	<ul style="list-style-type: none"> • Demonstrated that the majority of existing piping and equipment are suitable for AGR bypass operation. • Identified systems requiring NACE requalification and additional verification. • Confirmed that corrosion risks can be managed using existing mitigation measures. • Provided technical basis to support decision-making regarding AGR bypass implementation. • Enabled potential reduction in operating cost while maintaining facility integrity and safety compliance.
<p>Key Lessons & Best Practices:</p>	<ul style="list-style-type: none"> • Early integration of process simulation with material integrity assessment is critical when modifying plant operating philosophy. • Changes in acid gas concentration can significantly impact NACE classification even when corrosion rates remain manageable. • Corrosion prediction tools such as Norsok M-506 provide valuable screening insight but must be supported by a monitoring strategy. • Verification of mitigation reliability (corrosion inhibitor availability, dehydration efficiency) is essential in sour service environments. • Operational changes intended for cost reduction must be thoroughly validated against material integrity and long-term asset life considerations. • Final decision on AGR system bypass is influenced by the findings and recommendations made under this study.