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| |  |  | | --- | --- | | **Control Number:** | 25ADIP-P-559-SPE | | **Title:** | Driving Net Zero Through Operational Excellence In Sulfur Recovery: Innovations In Acid Gas Processing, Energy Efficiency, And Reliability Optimization | | **Category:** | +8.11 Reliability, Availability, Maintainability, and Inescapability Challenges, Technologies, and Innovative Practices | | **Keyword1:** | formation of Sulfcrete | | **Keyword2:** | contra tracing | | **Keyword3:** | corrosion in the Sulfur recovery unit | | **Keyword4:** | in sulfur plants is a flow restriction due to high | | **Keyword5:** | Sulfur pit coil leak | | **Authors:** | S. UMARE, S. Soman, Hindustan Petroleum Corp. Ltd. | | **Abstract:** | **Objectives/Scope:** This paper aims to showcase operational excellence in Sulfur Recovery Units (SRUs) through innovative strategies to maximize acid gas and sour gas processing. It highlights key challenges, reliability issues, and engineering solutions adopted to enhance unit performance, energy efficiency, and environmental compliance while supporting Net Zero objectives. It highlights the strategies adopted to overcome key constraints and limitations impacting SRU performance. The paper discusses various optimization techniques implemented to enhance unit efficiency, reliability, and long-term operability **Methods, Procedures, Process:** The approach involves detailed case studies and analysis of operational issues encountered in SRUs, such as refractory damage, condenser tube plugging, steam tracing inadequacies, corrosion, and equipment failures. Innovative solutions like vector wall installations, contra trace steam tracing, and sulfur plant design modifications were implemented and evaluated. Systematic root cause analysis, field trials, and performance monitoring were conducted to validate each improvement. Comparative evaluation between legacy and modern SRU design practices was also carried out to identify actionable reliability upgrades **Results, Observations, Conclusions:** The paper presents successful implementation of several best practices and design enhancements that led to the sustainable operation of SRUs under high acid gas loading. Installation of vector walls in place of choker rings significantly improved the integrity and reliability of thermal reactors. The adoption of contra trace steam tracing resolved chronic tail gas line plugging issues. Sulfcrete formation in condensers was effectively tackled through innovative cleaning and monitoring strategies. Corrosion related reliability threats were mitigated via material upgrades and improved inspection practices. Comparison of old and new SRU designs revealed key reliability gaps, leading to strategic retrofits in older units. Additionally, addressing high-pressure drop issues highlighted the importance of optimizing equipment and pipeline configurations, particularly in sulfur pit coils and condensers, to prevent blockages and maintain flow. The proactive maintenance strategies implemented, such as real time monitoring and predictive analytics, enabled early detection of issues, minimizing downtime and improving operational efficiency. Case studies on equipment plugging due to coke, sulfur, and mist eliminator fouling demonstrated the effectiveness of design modifications and regular inspections. These interventions ensured continuous high-throughput operation, minimized environmental emissions, enhanced safety, and maintained compliance with regulatory standards. The learnings from past failures were instrumental in reinforcing operational integrity, ensuring long-term reliability, and supporting sustainability goals in SRU operations. **Novel/Additive Information:** This paper introduces unique engineering practices and real-world troubleshooting experiences in SRU operations, particularly focusing on innovations like vector walls and contra trace steam tracing. These insights contribute new knowledge to the petroleum industry, offering practical solutions to reliability and operability issues that hinder acid gas processing capacity and sulfur recovery performance | |

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| |  |  | | --- | --- | | **Control Number:** | 25ADIP-P-612-SPE | | **Title:** | Innovative Approaches To Accelerated Facility Commissioning: A Strategy Framework For Speedand Precision | | **Category:** | +8.11 Reliability, Availability, Maintainability, and Inescapability Challenges, Technologies, and Innovative Practices | | **Keyword1:** | Commissioning | | **Authors:** | M. Alsulmi, Saudi Aramco SAOO | | **Abstract:** | **Objectives/Scope:** Facility commissioning is a critical phase in the lifecycle of a new plant, requiring meticulous attention to detail to ensure smooth startup, efficient operations, and minimal downtime. Traditional commissioning approaches often result in delays, cost overruns, and compromised performance. To address these challenges, we developed an innovative strategy framework for accelerated facility commissioning, integrating best practices, cutting-edge tools, and collaborative teamwork. **Methods, Procedures, Process:** Our objective was to devise a structured approach to expedite the commissioning process whilemaintaining precision and quality. We applied this framework to the commissioning of a newly constructed facility, seeking to minimize startup time, maximize efficiency, and ensure reliable operations. We employed a multi-disciplinary team comprising experts from operations, maintenance, engineering, and vendors to collaborate on the development and implementation of the framework.Our methodology involved:1. Pre-commissioning preparation: thorough review of design documents, identification of potentialissues, and development of customized commissioning plans.2. Integrated commissioning: simultaneous execution of mechanical, electrical, instrumentation,and control system checks to minimize dependencies and overlaps.3. Phased start-up: staged introduction of individual systems, followed by gradual ramp-up to fullcapacity, ensuring controlled progression and early detection of anomalies. **Results, Observations, Conclusions:** Compared to conventional commissioning approaches, our innovative framework yielded remarkable gains; Startup duration reduction and First-year availability. This example demonstrates the efficacy of our accelerated facility commissioning framework in expediting the transition from construction tooperation. By embracing innovative techniques, collaborative teamwork, and disciplined execution, we significantly shortened the commissioning timeline without compromising performance or quality. **Novel/Additive Information:** Implementation details: appendices containing specific guidelines, templates, and checklists will beprovided upon request. | |

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| |  |  | | --- | --- | | **Control Number:** | 25ADIP-P-1467-SPE | | **Title:** | Evaluating Facility Readiness For Carbon Capture And Storage (ccs) Integration | | **Category:** | +8.11 Reliability, Availability, Maintainability, and Inescapability Challenges, Technologies, and Innovative Practices | | **Keyword1:** | Aging | | **Keyword2:** | Restoration | | **Keyword3:** | Generator | | **Keyword4:** | CCS | | **Keyword5:** | Performance | | **Authors:** | N. Laopornpichayanuwat, A. Nuengnamjai, PTTEP | | **Abstract:** | **Objectives/Scope:** • CCS project preparation: To prepare readiness for power generation system on existing offshore processing platform to support upcoming Carbon Capture and Storage (CCS) project. • Operational excellence: To demonstrate success case on aging turbo generator performance restoration as a maintenance engineer. • Collaboration: To emphasize an importance of multidiscipline collaboration to optimize unit downtime for offshore execution. **Methods, Procedures, Process:** The first CCS project for PTTEP is targeted to be launched in 2027. The project is considered to be one of the largest modifications ever on Arthit processing platform which has been in operation since 2008. As a maintenance engineer, existing facility readiness is crucial to fulfill new project implementation. Power generation system is one of a vital system which also plays an important role on this. In fact, one out of three units of turbo generator has been left derated for over a decade. Therefore, unit recovery plan has been setup to ensure seamless connectivity between OLD and NEW. **Results, Observations, Conclusions:** Turbo generator 3 (TG3) has been operated with an average of 25.74% capacity for several years without written evidence. A thorough investigation was setup among offshore crews and office discipline engineers in 2023 to solve the problem. The most indicative symptom which restricts TG3 capacity is cooling system, because winding temperature is slightly higher than other units when operating at the same load. The execution plan was then established in the same period of engine exchange in 2024 to avoid introducing operational risk due to multiple unit downtime. During execution, the cooling system was found to be performing below standard. The most severe as found is the incompletes of generator cooling fan blade installed which is believed to have an unconfirmed reason behind it. Eventually, the whole cooling system was restored as closely as possible to its original design specifications. Not only TG3 is restored back to its maximum capacity, but the unit is also ready to support additional load from upcoming CCS project. In addition, the TG3 has been tested at the highest achievable plant load after renewal and has been operated with an average of 36.94% capacity for more than a year without any problem. **Novel/Additive Information:** Proactive maintenance is crucial for facilitating new projects, especially CCS project, which are vital for the future of humanity. Obstacles must be eliminated to enable project success. Furthermore, aging equipment does not necessarily need to operate below its original design. Instead of accepting its current as-found condition, it is preferable to investigate and address the root causes of any issues. With proper maintenance and collaboration among all relevant parties, aging equipment can still perform like it did on day one. [[A graph showing a number of data  Description automatically generated with medium confidence](https://files.abstractsonline.com/CTRL/82/4/8D7/8B8/DCC/4A1/FAA/168/F5A/AED/AC5/F6/g1467_1.JPG)](https://files.abstractsonline.com/CTRL/82/4/8D7/8B8/DCC/4A1/FAA/168/F5A/AED/AC5/F6/g1467_1.JPG) | |

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| |  |  | | --- | --- | | **Control Number:** | 25ADIP-P-1471-SPE | | **Title:** | Evaluating Magnetic Bearings In Energy Applications | | **Category:** | +8.11 Reliability, Availability, Maintainability, and Inescapability Challenges, Technologies, and Innovative Practices | | **Keyword1:** | Magnetic | | **Keyword2:** | Bearing | | **Keyword3:** | Uptime | | **Keyword4:** | Efficiency | | **Keyword5:** | Reliability | | **Authors:** | J. Earl, Sapphire Technologies, Inc. | | **Abstract:** | **Objectives/Scope:** Magnetic bearings represent one of the most technically advanced subsystems in the compressors, pumps, and turbines which they spin. They are specified in the design of space systems, race cars, and semiconductor fabs but are also found throughout the energy sector. Sapphire Technologies, a subsidiary of Calnetix Technologies, is one of the few global manufacturers of magnetic bearings and has experience designing systems for this industry. To underscore the importance of magnetic bearings in the energy sector, this presentation will explore the history of bearing technologies, magnetic bearing supply chains, and how metrics like uptime are affected by bearing systems. **Methods, Procedures, Process:** Magnetic bearings create frictionless, non-contact operation in high-speed machinery by physically levitating (in a magnetic field) a rotating component. This presentation will identify and explain key magnetic bearing system design elements, including bias current selection, magnet polarity, position control, and diagnostic capability. It will also compare magnetic bearings with other bearing types and discuss how to select an appropriate bearing for different applications. **Results, Observations, Conclusions:** To illustrate how magnetic bearings affect operational economics, Sapphire Technologies will examine, as a case study, the magnetic bearing systems specified in its turboexpander-generators. Discussion will focus on the challenges and design considerations involved in implementing magnetic bearings in the high-pressure environments typical of natural gas service, including how the magnetic bearing design addresses axial and radial loads. **Novel/Additive Information:** The presentation will explain how magnetic bearings impact system efficiency and downtime and will examine how this addresses the requirements of energy infrastructure. | |

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| |  |  | | --- | --- | | **Control Number:** | 25ADIP-P-1590-SPE | | **Title:** | Minimizing Bias In Reliability Analysis Decision Making - A Comprehensive Approach | | **Category:** | +8.11 Reliability, Availability, Maintainability, and Inescapability Challenges, Technologies, and Innovative Practices | | **Keyword1:** | Reliability Analysis | | **Keyword2:** | Bias Control Methodology | | **Keyword3:** | Maintenance Optimization | | **Authors:** | S. Dhamayana, M. Al Rais, ADNOC Offshore | | **Abstract:** | **Objectives/Scope:** This research introduces a systematic approach to address a critical yet often overlooked challenge in reliability engineering: the presence of statistical biases that compromise maintenance strategy effectiveness. By examining how Simpson's Paradox and Accuracy Paradox specifically manifest in reliability data analysis, the framework provides reliability professionals with practical methods to identify and counteract these misleading statistical phenomena. **Methods, Procedures, Process:** Through detailed case studies from operational oil and gas facilities, the research demonstrates how conventional analysis methods can inadvertently promote suboptimal maintenance scheduling when statistical biases remain uncontrolled. The findings reveal that seemingly rational decisions based on aggregated data may lead to inadequate maintenance for critical components, potentially compromising system integrity and safety.The methodology implements three key elements to overcome these challenges: stratified analysis techniques that prevent misleading data aggregation; context-controlled comparison protocols that ensure meaningful benchmarking; and balanced performance metrics that avoid the pitfalls of oversimplified evaluation criteria. This comprehensive approach ensures reliability decisions remain robust against statistical distortions. **Results, Observations, Conclusions:** The practical impact of the framework is significant—when applied to actual industrial instrumentation data, bias-controlled analysis recommended maintenance intervals substantially different from those derived through conventional methods. Most notably, critical components were identified as requiring up to 75% more frequent maintenance than previously indicated, representing a substantial shift in resource allocation and risk management. **Novel/Additive Information:** This validated framework equips reliability engineers and maintenance planners with enhanced analytical tools to optimize maintenance strategies and inventory management while avoiding the hidden pitfalls of common statistical biases, ultimately improving operational reliability and resource efficiency in industrial environments. | |

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| |  |  | | --- | --- | | **Control Number:** | 25ADIP-P-1666-SPE | | **Title:** | Mitigation Of Gas Turbine Bearing Failures Through Air Intake Filter Housing Drain Line Reconfiguration | | **Category:** | +8.11 Reliability, Availability, Maintainability, and Inescapability Challenges, Technologies, and Innovative Practices | | **Keyword1:** | Aeroderivative Gas Turbines | | **Keyword2:** | Reliability | | **Keyword3:** | Air Filtration | | **Keyword4:** | Bearings | | **Keyword5:** | Offshore | | **Authors:** | K. Youssef, S. Almemari, ADNOC Offshore | | **Abstract:** | **Objectives/Scope:** The objective of this paper is to present the technical and operational rationale behind the reconfiguration of the Air Inlet Filter Housing (AIFH) drain lines on five Siemens SGT-A65 gas turbines at the SARB Plant, ZIRKU Island. This improvement initiative aims to enhance system integrity and mitigate bearing failures caused by contamination ingress. **Methods, Procedures, Process:** Contaminants and moisture bypassing the second-stage filtration due to the previous AIFH drain configuration reached the engine inlet and contributed directly to the corrosion of gas turbine bearings. This contamination path led to multiple bearing failures, each costing approximately USD 2 million in replacement and associated downtime. With five engines impacted, the total cost of bearing replacements reached **USD 10 million**. As part of a proactive system upgrade, it was identified that the existing AIFH drain configuration could be optimized by isolating drainage paths from the rain hoods, moisture knock-out vanes, and second-stage filter areas. The improvement involved installing individual check valves for each drain path to prevent backflow and cross-contamination. The new configuration aligns with best practices in air intake design to improve filtration efficiency and reliability. Engineering evaluations were completed, and implementation activities have commenced at site. **Results, Observations, Conclusions:** The earlier configuration allowed contaminants and moisture to bypass the second-stage filters, accelerating the saturation and degradation of the third-stage filters. This contributed to bearing corrosion and multiple failures. The reconfiguration is expected to prevent such failures across all five gas turbines, resulting in projected savings exceeding USD 10 million in repair costs. Early results post-implementation show a marked reduction in sludge accumulation and improved filter performance, confirming the effectiveness of the new drain design. **Novel/Additive Information:** This paper presents a unique operational case study demonstrating how targeted modifications to air filtration system drainage can substantially improve gas turbine reliability. The insights gained offer valuable lessons for similar offshore applications aiming to reduce contamination-related failures and extend equipment lifecycle performance. | |

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| |  |  | | --- | --- | | **Control Number:** | 25ADIP-P-1878-SPE | | **Title:** | Root Cause Analysis & Successful Revival Of Gas Turbine After Unusual Failure Of Turbine Buckets | | **Category:** | +8.11 Reliability, Availability, Maintainability, and Inescapability Challenges, Technologies, and Innovative Practices | | **Keyword1:** | Innovative Approach | | **Keyword2:** | Root Cause Analysis | | **Keyword3:** | Plant Sustainable Operation | | **Keyword4:** | Design Improvement & Failure Mitigation | | **Keyword5:** | OEM Endorsement | | **Authors:** | M.A. Butt, Pak Arab Fertilizer Pvt Ltd (Fatima Group) | | **Abstract:** | **Objectives/Scope:** This paper focuses on an unusual turbine buckets failure observed during the Hot Gas Path Inspection (HGPI) of Gas Turbine (GE 10/1) in Major Turn Around. The scope includes the root cause analysis (RCA) & the successful revival strategy that avoided extensive downtime, alongside a successful insurance claim following the identification of design flaws in fasteners of Transition Piece. **Methods, Procedures, Process:** During the HGPI of Gas Turbine, turbine buckets failures led to an extended overhaul. OEM (Baker Hughes) recommended to replace rotor. Unfortunately spare rotor was not available at site rather at OEM workshop for refurbishment & would take 5-6 months to receive. To mitigate downtime, an innovative buckets dressing method was employed using a balancing chart approach. In which buckets mapping performed, followed by iterative dressing to remove cracks and restore balance. Additionally, a root cause analysis (RCA) identified a missing bolt from the transition piece, which had lodged in the first-stage nozzle, damaging turbine blades. Further investigation revealed inadequate fastener design of transition piece, which was also endorsed by OEM. **Results, Observations, Conclusions:** The turbine blade dressing process successfully removed cracks, and re-mapping confirmed that the blades met operational standards. After the procedure, start-up vibrations and other operational parameters were normal, and the turbine operated without issues for the next six months until the arrival of the new rotor. The RCA findings revealed that the missing bolt from the transition piece had caused significant damage by getting stuck inside the first-stage nozzle. This led to the identification of a design flaw in the locking plate, which failed to secure the bolt, allowing it to loosen. The OEM confirmed the design inadequacy through a technical bulletin, recommending an upgraded fastener design. The implementation of this design improvement ensured long-term turbine reliability. The successful mitigation of downtime, innovative approach to blade restoration, and collaboration with OEM played key roles in restoring turbine functionality. Furthermore, the RCA was crucial in securing a successful insurance claim worth USD 880,000, demonstrating the importance of thorough failure analysis and preventive design modifications. **Novel/Additive Information:** This paper contributes new insights into gas turbine failure analysis by presenting a case of turbine buckets damage caused by a flawed transition piece bolt design. The innovative approach of buckets dressing to mitigate downtime (~ 6 months) offers a novel solution in turbine maintenance. Additionally, the paper highlights the importance of OEM collaboration in validating RCA findings and implementing design upgrades, offering valuable lessons for reliability engineering and maintenance in the petroleum industry. | |

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| |  |  | | --- | --- | | **Control Number:** | 25ADIP-P-2026-SPE | | **Title:** | Enhancing Emergency Shutdown Valve Reliability | | **Category:** | +8.11 Reliability, Availability, Maintainability, and Inescapability Challenges, Technologies, and Innovative Practices | | **Keyword1:** | Reliability | | **Keyword2:** | Maintenance | | **Keyword3:** | Partial Stroke Testing (PST) | | **Keyword4:** | Emergency shutdown (ESD) valves | | **Authors:** | K. Alshammari, A.H. Al-Deraa, A.M. Busaad, Saudi Aramco Gas Operations | | **Abstract:** | **Objectives/Scope:** In an effort to pilot the latest technology and advancement in the instrumentation field, the locally actuated partial stroke testing (LAPST) technology was carefully chosen, installed and tested. The objective of this initiative is to improve the reliability of emergency shutdown (ESD) valves equipped with single-acting actuators through the use of LAPST technology as a positioner alternative. **Methods, Procedures, Process:** To accomplish this objective, a comprehensive methodology was devised, involving the installation and commissioning of the LAPST device on selected ESD valves with single-acting actuators. Thorough commissioning tests were conducted to ensure proper functioning, followed by configuration and calibration of the device to perform partial stroke testing within a predefined range. Furthermore, standard operating procedures were created for routine testing, maintenance, and troubleshooting of the LAPST device, ensuring that operators were adequately trained and prepared to utilize the technology effectively. **Results, Observations, Conclusions:** The implementation of LAPST technology yielded notable results, including successful execution of partial stroke tests without interruption to the controlled process, demonstrating the efficiency of LAPST in maintaining process continuity. Moreover, electronic failures and related safety concerns were eliminated, resulting in improved overall reliability of ESD valves. Maintenance requirements for ESD valves decreased significantly, leading to cost savings and increased plant production. Based on these findings, it is concluded that LAPST technology represents a viable and effective solution for partial stroke testing of ESD valves, surpassing traditional positioners in terms of reliability, safety, and maintainability. **Novel/Additive Information:** The introduction of LAPST technology provides a novel solution to the existing challenges associated with positioners, offering a reliable and safe means of performing PST on ESD valves. The mechanical design of LAPST eliminates the risk of electronic failure, and its bypass and manual override capability ensures added safety and flexibility. This innovation has the potential to enhance the overall reliability and efficiency of ESD valve systems, contributing to improved plant safety and production. | |

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| |  |  | | --- | --- | | **Control Number:** | 25ADIP-P-2077-SPE | | **Title:** | Resilient Foundation Solutions For Surface Equipment In High-stress Oil Recovery Operations | | **Category:** | +8.11 Reliability, Availability, Maintainability, and Inescapability Challenges, Technologies, and Innovative Practices | | **Keyword1:** | Epoxy Grouts | | **Keyword2:** | IOR/EOR Operations | | **Keyword3:** | Surface Equipment Reliability | | **Keyword4:** | Foundation Integrity | | **Keyword5:** | Vibration Control | | **Authors:** | S. Browne, Alphatec Engineering | | **Abstract:** | **Objectives/Scope:** Surface equipment supporting Improved and Enhanced Oil Recovery (IOR/EOR) operations is often exposed to extreme operating conditions, including high temperatures, aggressive chemical environments, and continuous mechanical stresses. These factors contribute to the deterioration of equipment foundations, leading to misalignment, vibration, frequent maintenance, and unplanned downtime. This paper addresses how epoxy-based grouting systems can be applied as a resilient and reliable solution to enhance the long-term performance and maintainability of such foundations under high-stress field conditions. **Methods, Procedures, Process:** This study outlines Alphatec Engineering’s approach to implementing epoxy grout systems in IOR/EOR surface facilities. It compares conventional cementitious grouts with epoxy formulations in terms of compressive strength, bonding characteristics, shrinkage behaviour, and resistance to chemical and thermal degradation. Procedures include surface preparation, controlled mixing, grout placement, and curing techniques that ensure long-term adhesion and load transfer. Various case studies from high-temperature, high-vibration facilities are used to illustrate performance improvements and integration into existing maintenance strategies, without requiring significant structural modifications. **Results, Observations, Conclusions:** Observed outcomes from implemented epoxy grout solutions include significant reductions in foundation-related equipment failures, improved alignment retention, and lower vibration levels. Maintenance data from surface facilities indicate extended inspection intervals and reduced intervention rates, contributing to improved mean time between failures (MTBF) and higher equipment availability. The epoxy materials demonstrated strong resistance to oil ingress, chemical exposure, and thermal cycling, outperforming traditional grout systems in terms of both durability and maintainability. These results confirm that resilient foundation systems are a viable, cost-effective approach to addressing RAMI challenges in high-stress oil recovery environments. By enhancing structural integrity and reducing degradation pathways, epoxy grout systems support reliable and continuous operations across critical surface equipment. **Novel/Additive Information:** This paper presents a practical, materials-based solution to longstanding RAMI challenges in oil recovery surface operations. It consolidates field-proven strategies for integrating advanced epoxy grouts into asset management practices, offering measurable gains in maintainability, uptime, and equipment resilience without the need for extensive retrofit or redesign. | |

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| |  |  | | --- | --- | | **Control Number:** | 25ADIP-P-2187-SPE | | **Title:** | Waste Reduction And Higher Return On Investment | | **Category:** | +8.11 Reliability, Availability, Maintainability, and Inescapability Challenges, Technologies, and Innovative Practices | | **Keyword1:** | Battery regeneration | | **Authors:** | F. Alhosani, ADNOC Onshore | | **Abstract:** | **Objectives/Scope:** Enable battery regeneration to restore Lead Acid Batteries to their original performance and operational standards. Lower expenses are related to acquiring new battery banks by focusing on regenerating and reconditioning existing ones. Reduce environmental impact by minimizing waste generation and carbon emissions through sustainable practices. Broaden battery regeneration initiatives to include high-capacity batteries, boost throughput, and establish a centralized facility dedicated for battery regeneration to restore Lead Acid Batteries original performance and enhance efficiency. **Methods, Procedures, Process:** Apply high-powered electrical pulses to break down the crystalline layer of amorphous lead sulphate, transforming it back into sulphuric acid while restoring and reconstituting battery plates. Utilize specialized devices designed for battery regeneration, ensuring an optimal restoration process that typically spans 24-48 hours. Evaluate cell voltage and internal resistance to identify and select batteries suitable for regeneration, focusing on reconditioning approximately 40-50% of weaker batteries. Acquire advanced, higher-capacity regeneration kits to streamline the process, reduce restoration time, and enhance operational capabilities. **Results, Observations, Conclusions:** The successful regeneration of battery banks from ADNOC Onshore BAB and Gas has resulted in significant cost savings. Operational reliability of these regenerated batteries was proven during the pilot project for the ADNOC Onshore BAB asset, with the batteries consistently meeting all acceptable performance parameters. Looking ahead to 2025, plans are in place to regenerate 25 more battery banks, which are anticipated to deliver savings of US$400,000-450,000 yearly. **Novel/Additive Information:** Plans are underway to transform the Bab facility into a centralized hub dedicated to battery regeneration, supported by specialized teams managing batteries from multiple assets. The focus lies on in-house regeneration of solar battery banks that have been in service for more than three years, aligning with goals of sustainability and cost efficiency. Additionally, the initiative envisions significantly shortening regeneration process times and boosting annual regeneration capacity through the adoption of advanced technological solutions such as high-powered electrical pulse units and specialized testers, which will significantly shorten regeneration process times and boost annual regeneration capacity. | |

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| |  |  | | --- | --- | | **Control Number:** | 25ADIP-P-2216-SPE | | **Title:** | Integrated Threats And Opportunity Management | | **Category:** | +8.11 Reliability, Availability, Maintainability, and Inescapability Challenges, Technologies, and Innovative Practices | | **Keyword1:** | Database interrelation | | **Keyword2:** | Database Bridges | | **Keyword3:** | Resolution Process | | **Keyword4:** | Issue identification | | **Authors:** | I.A. Ugryumov, ADNOC Gas | | **Abstract:** | **Objectives/Scope:** The objective of this topic is to showcase how systematic integration of the ITOM database addresses the gaps in reliability management processes. It aims to enhance production issue tracking, streamline mitigation actions, and improve decision-making frameworks while aligning with industry challenges and advancements in threat/opportunity management. **Methods, Procedures, Process:** The study evaluates existing reliability business processes, identifying inefficiencies in threat tracking and prioritization. An integrated ITOM framework is proposed to address these gaps, utilizing performance monitoring tools, standardized methodologies, and structured problem-solving approaches. Data-driven simulations and case studies validate the effectiveness of this framework. The process emphasizes disciplined delivery, fostering learning, collaboration, and accountability for site-specific discipline teams to optimize reliability workflows. **Results, Observations, Conclusions:** The integration of ITOM has delivered substantial improvements in Asset operations:   * Asset performance monitoring and production efficiency have been significantly enhanced, resulting in measurable financial gains. * Structured processes and clear ownership facilitated the identification of significant "Value at Risk" per annum over six months of business activity, with teams prioritizing top mitigation actions effectively. * Task prioritization mechanisms and collaborative efforts have already achieved significant production loss avoidance, addressing critical reliability threats and enabling focus on long-term challenges.   Quantitative and qualitative analyses reveal accelerated response times for reliability threats and strengthened alignment between organizational objectives and mitigation strategies. This study demonstrates the scalability of ITOM frameworks in solving complex challenges, preserving legacy knowledge, and driving impactful transformation within the downstream industry **Novel/Additive Information:** This process introduces innovative methodologies for integrating ITOM into reliability management, presenting new insights into structured threat mitigation processes and performance monitoring. By addressing current knowledge gaps, it provides valuable additions to the state of knowledge in the energy sector, fostering advancements in production reliability [[A diagram of a company's management  Description automatically generated](https://files.abstractsonline.com/CTRL/E7/D/E89/5AB/676/4DC/0AA/C83/F7D/D19/82A/B1/g2216_1.jpg)](https://files.abstractsonline.com/CTRL/E7/D/E89/5AB/676/4DC/0AA/C83/F7D/D19/82A/B1/g2216_1.jpg) | |

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| |  |  | | --- | --- | | **Control Number:** | 25ADIP-P-2305-SPE | | **Title:** | Direct Retrofit And Hard Bus Retrofitting Solution For Existing Aeg Bab Service Yard Substation | | **Category:** | +8.11 Reliability, Availability, Maintainability, and Inescapability Challenges, Technologies, and Innovative Practices | | **Keyword1:** | SUBSTATION RETROFITTING | | **Authors:** | A.S. Ahmed, ADNOC Onshore | | **Abstract:** | **Objectives/Scope:** Implementation of Direct Retrofit and Hard Bus Retrofitting Solutions for the existing AEG system at the Service yard substation, along with the replacement of 415V switchgears at Main Substation, and Chiller Yard Motor control center MCC **Methods, Procedures, Process:** The complete replacement of the substation through EPC project pre-awarding was estimated to cost 2.4 million USD under P-11660. This option required an extended implementation period and a availability of a new plot area for establishing the new substation. In contrast, the retrofitting phase was completed using in-house material procurement, costing around $309,000 USD, and existing OEM ABB service contract number 4700007394 for implementation. The service cost was approximately $107,000 USD, bringing the total project cost for material and installation services to approximately $416,000 USD. **Results, Observations, Conclusions:** The original plan was to replace the switchgears at the service yard substation to enhance system operability. However, after conducting a feasibility study, it was decided to proceed with a retrofitting solution. The decision was made because retrofitting has a shorter implementation plan and offers a 30% cost saving compared to an EPC project. As a result, the substation's power system’s reliability has significantly increased, and the electrical protection scheme has been upgraded to ensure safe operation. **Novel/Additive Information:** For cases that require substation replacement, retrofitting the substation and switchgear can be a cost-effective and time-efficient solution, while also ensuring improved performance and reliability. | |

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| |  |  | | --- | --- | | **Control Number:** | 25ADIP-P-2450-SPE | | **Title:** | Mpp Motor Vfd Foc Sensorless Operation To Manage Undervoltage Interruptions | | **Category:** | +8.11 Reliability, Availability, Maintainability, and Inescapability Challenges, Technologies, and Innovative Practices | | **Keyword1:** | VFD | | **Keyword2:** | Voltage dip | | **Authors:** | S. Abdul Aziz, Al Dhafra Petroleum | | **Abstract:** | **Objectives/Scope:** The aim of the paper is to demonstrate how Al Dhafra MPP VFD DC bus voltage can withstand the voltage dips and prevent tripping while operating in Field Oriented Control sensorless scalar control mode configuration. By addressing the power system voltage dips, we are not only safeguarding our equipment but also ensuring smoother and more reliable operations. **Methods, Procedures, Process:** A conventional VFD is able to withstand the voltage dip in closed loop configuration with the feedback from the encoder. Our research seeks to explore the possibilities and benefits of achieving similar resilience without relying on encoder feedback. Thanks to this innovative algorithm with the invaluable support of NIDEC Conversion, our MPP VFDs can now withstand voltage dips even when operating in open loop control mode(scalar). This improvement is a substantial step forward in ensuring the reliability and stability of our systems. The new algorithm significantly enhances the performance of our MPP VFDs. **Results, Observations, Conclusions:** Enhancements and improvements we've made to the Sensorless Field-Oriented Control (FOC) operation of the MPP Variable Frequency Drive are designed to ensure that it can sustain power system voltage dips, which will significantly improve our operational availability. This is a major step forward in our continuous efforts to reduce production downtime and enhance overall efficiency. This improvement will undoubtedly have a positive impact on our production processes, minimizing interruptions and maximizing productivity. **Novel/Additive Information:** NA | |

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| |  |  | | --- | --- | | **Control Number:** | 25ADIP-P-2456-SPE | | **Title:** | Revolutionizing DCS Management: An RPA Solution For Automated Asset Tracking And Optimization | | **Category:** | +8.11 Reliability, Availability, Maintainability, and Inescapability Challenges, Technologies, and Innovative Practices | | **Keyword1:** | Asset Management | | **Keyword2:** | I/O Spare Channels | | **Keyword3:** | Automated Asset Inventories | | **Authors:** | F. Al Kalbani, A. Abri, Petroleum Development Oman (PDO); N. Al Hamimi, PDO; I. Alabri, ARA Petroleum Exploration & Production | | **Abstract:** | **Objectives/Scope:** An innovative RPA tool has been developed to automate key processes in managing DCS systems. The tool eliminates inefficiencies and manual handling of DCS resources including controllers and I/O channels. This is achieved via automating the collection of asset inventory, mapping the DCS resources in Realtime to live dashboards, and allowing online reservation of resources for future projects. This solution enhances operational efficiency, reduces manual intervention, and ensures seamless asset management, ultimately optimizing system performance and reducing operational costs. **Methods, Procedures, Process:** The RPA tool executes four distinct steps in order to produce useful information of DCS resources. The initial step is data collection by embedding scripts within OT domain that aggregate controller and I/O cards data. The second step is data transfer via OT/IT interface allowing unidirectional data routing to the RPA repository. The third step is utilization of advanced algorithm for data analysis and production of reports. The last step is data conversion to useful information in the form dashboards in MS power BI. **Results, Observations, Conclusions:** The Robotic Process Automation (RPA) tool has been successfully implemented across remote facilities utilizing conventional Distributed Control Systems (DCS), transforming how data is collected and analyzed. By eliminating the need for routine site visits and reducing human intervention, the tool has streamlined operations—delivering a measurable manpower savings of 0.05 Full-Time Equivalent (FTE) per site. Beyond automation, the RPA tool significantly enhances asset management by providing real-time insights into controller loading. This visibility enables smarter optimization of I/O allocation, ensuring that system capacity is used efficiently and effectively. Moreover, the tool has elevated strategic planning and resource allocation for upcoming projects. This is made possible through a robust reservation system, seamlessly integrated with Microsoft Power BI. The integration not only centralizes data but also enables intuitive dashboards and dynamic reporting, empowering stakeholders to make informed, data-driven decisions. In summary, the RPA tool is more than just a process automation solution—it’s a powerful enabler of operational efficiency, intelligent resource management, and forward-looking project planning. Its deployment marks a key step toward digital transformation in remote facility operations. **Novel/Additive Information:** This RPA tool introduces a novel integration of OT and IT by automating data aggregation, eliminating manual handling, and enabling real-time, cross-domain insights. Its unique design enhances data accuracy, streamlines resource allocation, and empowers automation teams to make faster, data-driven decisions. With annual savings of approximately **$10,000 per site**, and ROI typically achieved within **12 months** across **80+ sites**, it transforms automation into a strategic, high-impact function delivering sustained financial and operational value. | |

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| |  |  | | --- | --- | | **Control Number:** | 25ADIP-P-2597-SPE | | **Title:** | Enhancing Esp System Reliability: Insights From Difa Inspection And Root Cause Analysis | | **Category:** | +8.11 Reliability, Availability, Maintainability, and Inescapability Challenges, Technologies, and Innovative Practices | | **Keyword1:** | Electrical Submersible Pump (ESP) | | **Keyword2:** | Dismantle Inspection and Failure Analysis (DIFA) | | **Keyword3:** | Root Cause Analysis | | **Keyword4:** | Operational Failures | | **Keyword5:** | Corrective Actions | | **Authors:** | A.M. LADMIA, Abu Dhabi National Oil Company; S.J. Bin Naqeh, ADNOC Onshore | | **Abstract:** | **Objectives/Scope:** The primary objective of this presentation is to share the findings from the recent Dismantle Inspection and Failure Analysis (DIFA) conducted on the Electrical Submersible Pump (ESP) system post workover and pull out of hole. The inspection aimed to identify the root causes of the recent failures and recommend corrective actions to enhance system reliability. By adopting these recommended actions, the reliability and lifespan of the ESP system will be significantly improved, leading to a reduction in downtime and operational expenses **Methods, Procedures, Process:** The inspection was carried out at the provider Facilities in Jabal Ali, Dubai. The inspection involved a thorough examination of the ESP system, focusing on electrical, mechanical, and operational failures. Key components such as the wellhead penetrator, power cables, mechanical seals, and gas-handling equipment were scrutinized. **Results, Observations, Conclusions:** The DIFA inspection revealed several critical issues contributing to the ESP system’s failure. Electrical failures included considerable deterioration of the wellhead penetrator and mechanical damage to the power cables. Mechanical failures involved gaps in the mechanical seals, leading to fluid ingress and debris accumulation. Operational failures were identified, such as rotation during workover fishing and the presence of scale and asphaltenes in the gas-handling equipment. **Novel/Additive Information:** This presentation will provide valuable insights into the causes of ESP system failures and the recommended corrective actions. By implementing these actions, the reliability and longevity of the ESP system can be enhanced, reducing downtime and operational costs. | |

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| |  |  | | --- | --- | | **Control Number:** | 25ADIP-P-2657-SPE | | **Title:** | How To Ensure Power Supply Availability For Uninterrupted Production During Electrical Disturbances By Comprehensive Testing Of Auto Transfer System Of Switchgear | | **Category:** | +8.11 Reliability, Availability, Maintainability, and Inescapability Challenges, Technologies, and Innovative Practices | | **Keyword1:** | Power Supply Reliability | | **Keyword2:** | Auto Transfer Scheme | | **Keyword3:** | Electrical | | **Keyword4:** | Switchgear | | **Keyword5:** | Power outage | | **Authors:** | G. Murugesan, M. Manohar, Borouge | | **Abstract:** | **Objectives/Scope:** The objective is to provide guideline for comprehensive testing of Auto Transfer System (ATS) of the switchgear to validate the redundant power system availability during electrical power supply disturbances to assets within the configured time for uninterrupted production. This includes timing co-ordination between different operating voltage levels such as 33kV, 11kV, 6.6kV, 3.3kV & 415V and the connected assets of Normally open Bustie configuration of Redundant power system switchgears. **Methods, Procedures, Process:** The method entails comprehensive testing of Auto Transfer System Logic during the project pre-commissioning and the plant turnaround shutdown. The process involves simulating various electrical power supply disturbance scenarios at both upstream and immediate downstream voltage levels to validate proper timing coordination and operation of the auto transfer scheme. This method is specifically applicable to normally open bus tie configurations of the redundant power system switchgear and does not include any scenarios involving manual transfer. **Results, Observations, Conclusions:** The Auto Transfer System should operate according to logic with proper time co-ordination between the voltage levels. For all simulated electrical power system disturbances, the auto transfer activates at the next voltage level only within the set time and ensures the continuity of power supply to the downstream asset for uninterrupted production. The automatic transfer system disconnects the incoming power supply which is causing electrical disturbances and transfer to another healthy incoming power supply of redundant power supply system within the configured time. This ensures that all connected assets receive power supply in time to ensure uninterrupted production. By comprehensive testing of Auto Transfer System during the project pre-commissioning and the plant turnaround shutdown as detailed in this procedure, will implant 100% confidence of Auto transfer system performance on demand. **Novel/Additive Information:** This paper presents novel information on the importance of comprehensive testing of the ATS to validate the redundant power system availability during electrical power supply disturbances to assets within set time for uninterrupted production. This will ensure 100% confidence of ATS performance on demand. | |

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| |  |  | | --- | --- | | **Control Number:** | 25ADIP-P-2679-SPE | | **Title:** | Automated Obsolescence Management (AOM) Solution | | **Category:** | +8.11 Reliability, Availability, Maintainability, and Inescapability Challenges, Technologies, and Innovative Practices | | **Keyword1:** | Asset Obsolescence Management (AOM) | | **Keyword2:** | SAP Plant Maintenance | | **Keyword3:** | Reliability | | **Authors:** | S. Abdul Wahab, Saudi Aramco | | **Abstract:** | **Objectives/Scope:** Saudi Aramco's vast asset base makes managing obsolescence challenging. Rising obsolescence incidence impacts cost, supportability, and product lifecycle. To mitigate this, the organization must proactively manage obsolescence using latest digital technology, ensuring a structured approach to minimize risks and optimize asset performance. **Methods, Procedures, Process:** In line with Saudi Aramco engineering procedures and best practice, a digital solution been developed and deployed in SAP comprising of below 3 key processes, • Establish evaluation criteria - The applicable criteria for evaluating specific Model(s) and Equipment shall be established as a baseline configuration along with Obsolescence risk matrix. • Evaluation Process- Once the evaluation criteria are configured in the system, Model(s) and Equipment evaluation can be performed. The system shall provide the final score, based on which recommendations shall be planned. • Manage Obsolescence - Based on recommendations as the outcome of the evaluation process, required planning and mitigation actions shall be taken. **Results, Observations, Conclusions:** Proactive Obsolescence Management: A Game-Changer for Strategic Readiness • With the introduction of cutting-edge Automated Obsolescence Management (AOM) solutions, businesses can now leverage leading indicators to forecast and adjust their strategies proactively. • Anticipate and mitigate the impact of obsolescence, rather than reacting to asset degradation, through a systematic and proactive approach. • By harnessing the power of automated alerts and seamless integration with business partner collaboration platforms, companies can access critical information and take proactive measures to mitigate the risks associated with asset obsolescence. This innovative approach enabled organizations to stay ahead of the curve, ensuring optimal asset performance, minimizing downtime, and maximizing overall business resilience **Novel/Additive Information:** The AOM solution represents a significant paradigm shift in obsolescence management, empowering businesses to transition from a reactive to a proactive stance. By embracing this forward-thinking approach, organizations can unlock new levels of strategic readiness, agility, and competitiveness, ultimately driving long-term success and sustainability. | |

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| |  |  | | --- | --- | | **Control Number:** | 25ADIP-P-2703-SPE | | **Title:** | Reliability-based Design And Assessment Of Corrosion For Natural Gas And LVP Liquid Hydrocarbon Pipelines | | **Category:** | +8.11 Reliability, Availability, Maintainability, and Inescapability Challenges, Technologies, and Innovative Practices | | **Keyword1:** | pipelines integrity | | **Keyword2:** | corrosion | | **Keyword3:** | probability of failure | | **Keyword4:** | risk-based design | | **Keyword5:** | reliability analysis | | **Authors:** | A. Farag, Hingeneering Consulting Inc | | **Abstract:** | **Objectives/Scope:** Corrosion is a major threat to pipeline integrity, and traditional deterministic methods often fail to capture the uncertainty in key factors like maximum annual operating pressure, outside diameter, wall thickness, yield strength, and corrosion growth rate. A probabilistic approach offers a more accurate estimate of failure likelihood. The Canadian Standards Association (CSA) Z662 supports this method, providing a risk-based design framework for both natural gas and low vapour pressure (LVP) liquid hydrocarbon pipelines. **Methods, Procedures, Process:** This study implements Annex O of the 2023 CSA-Z662 equations and standards into Python to calculate the probability of failure due to corrosion limit states for various pipeline configurations. The analysis includes NPS 8", 16", and 26" pipes with wall thicknesses of 0.25", 0.375", 0.5", and 0.675". Using inline inspection (ILI) data, the model accounts for corrosion defect length, depth, and growth rate. Corrosion depths from 30% to 80% of wall thickness were assessed, enabling a robust reliability-based evaluation for natural gas (NG) and Low Vapour Pressure (LVP) liquid hydrocarbon pipelines. **Results, Observations, Conclusions:** The reliability analysis shows that NG pipelines are generally more critical than LVP liquid pipelines when exposed to corrosion. For NG service, Grade 483 (X70) pipes with NPS 26 and wall thicknesses of 15.1 mm and 12.7 mm are safe up to 40% wall loss. Grade 414 (X60) pipes with NPS 16 and wall thicknesses of 12.7 mm and 9.5 mm are safe up to 40% and 30% corrosion, respectively. Grade 359 (X52) pipes with NPS 8 and wall thicknesses of 9.5 mm and 6.4 mm remain safe up to 30% corrosion. In comparison, the same grades and dimensions in LVP service exhibit higher tolerance to corrosion. Grade 483 (X70) pipes with NPS 26 and wall thicknesses of 15.1 mm and 12.7 mm are safe up to 50% corrosion. Grade 414 (X60) pipes with NPS 16 can tolerate up to 50% and 40% corrosion, while Grade 359 (X52) pipes with NPS 8 are adequate up to 40% wall loss. These results emphasize the higher criticality of NG pipelines compared to LVP pipelines, necessitating stricter corrosion limits and stricter maintenance practices to maintain long-term safety and operational integrity of NG pipelines under gas service conditions. **Novel/Additive Information:** With stricter environmental regulations and safety standards, pipeline operators must proactively ensure public safety and protect the environment from corrosion. To meet evolving demands, operators should adopt probabilistic methods, moving beyond traditional deterministic approaches. These advanced methods predict corrosion-related failure probabilities more accurately by accounting for uncertainties and variability in degradation. Embracing probabilistic analysis allows operators to optimize maintenance strategies, make better-informed decisions, and strengthen their commitment to regulatory compliance and environmental responsibility. | |

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| |  |  | | --- | --- | | **Control Number:** | 25ADIP-P-2716-SPE | | **Title:** | Comparative Analysis Of Gas Chromatography And Tunable Filter Spectroscopy For Gas Composition Measurement. A Case Study In The Amal Steam Project. | | **Category:** | +8.11 Reliability, Availability, Maintainability, and Inescapability Challenges, Technologies, and Innovative Practices | | **Keyword1:** | Optical GC | | **Authors:** | I.S. Al Hajri, Petroleum Development Oman | | **Abstract:** | **Objectives/Scope:** This paper compares conventional Gas Chromatography (GC) and Tunable Filter Spectroscopy (TFS) for gas composition measurement in the oil and gas industry. It introduces the principles and capabilities of both technologies, presents a case study from the Amal Steam Project, highlights challenges encountered with TFS, proposes solutions and discusses limitations, and provides recommendations for suitable TFS applications. **Methods, Procedures, Process:** The study outlines the fundamental principles of conventional Gas Chromatography and Tunable Filter Spectroscopy. Their capabilities are compared based on separation method, analysis time, complexity, maintenance, resolution, versatility, and cost. A detailed case study from the Amal Steam Project is presented, describing analyzer requirements, challenges faced with standard TFS recipes due to gas composition variability, proposed solutions such as customized recipes, and inherent limitations of TFS compared to GC for this application. Recommendations for appropriate TFS applications are then derived. **Results, Observations, Conclusions:** Conventional GC excels in detailed analysis and high-resolution separation, including the ability to distinguish isomers in complex mixtures. TFS, by contrast, offers fast, near real-time responses for key properties such as heating value. The Amal case study revealed challenges with TFS due to process gas compositions potentially exceeding the scope of standard recipes, and limitations in isomer resolution that impact heating value accuracy. Customized recipes may provide a solution for specific gas compositions; however, TFS remains limited in handling complex or non-standard mixtures compared to GC. TFS is recommended for applications requiring rapid response where detailed isomer separation is not critical and gas composition remains within the recipe scope. Conventional GC is preferred for comprehensive analysis of complex or variable gas streams. **Novel/Additive Information:** This paper provides practical guidance for engineers selecting gas analysis technologies by detailing real-world challenges encountered with TFS in a specific project, discussing potential solutions such as customized recipes, and offering clear recommendations on when to apply TFS versus conventional GC based on application requirements and compositional variability. This information supports engineers in making informed technology choices for field implementation. | |

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| |  |  | | --- | --- | | **Control Number:** | 25ADIP-P-2961-SPE | | **Title:** | Ensuring Reliability: The Role Of Check Valves In High-pressure Environments | | **Category:** | +8.11 Reliability, Availability, Maintainability, and Inescapability Challenges, Technologies, and Innovative Practices | | **Keyword1:** | Reliability | | **Keyword2:** | water injection | | **Keyword3:** | production | | **Keyword4:** | root cause | | **Keyword5:** | maintenance | | **Authors:** | D. Pinto Sepulveda, Baker Hughes | | **Abstract:** | **Objectives/Scope:** This paper aims to analyze the reliability issues in water injection systems operated by Ecopetrol’s Southern Regional Vice Presidency (VRS), focusing on the adverse effects of reverse flow in horizontal pumping systems. The objectives include identifying root causes, evaluating valve performance, and implementing corrective actions to improve system integrity. **Methods, Procedures, Process:** To identify the root cause of failures in the horizontal pumping systems, a logical fault tree methodology was applied. This structured approach helped determine that the predominant issue was the inappropriate selection of check valves as well as additional contributing factors such as unstable discharge manifolds, lack of water treatment infrastructure, suspension of improvement projects, and low execution of preventive maintenance. Based on these findings, The activities implemented in the action plan included technical improvements like the installation of suitable check valves, high-pressure flexible joints, enhanced pipe supports, and financial risk evaluations tied to deferred maintenance. **Results, Observations, Conclusions:** The implementation of the corrective action plan significantly improved the reliability and performance of the horizontal pumping systems in Ecopetrol’s Southern Regional Vice Presidency (VRS). By replacing check valves with appropriately selected alternatives and supporting system with components such as flexible joints and pipe supports, the adverse effects of reverse flow were mitigated. Key damage previously observed—such as mechanical seal failures, motor bearing impacts, thrust chamber seal breaches, impeller and shaft damage, and rupture of suction pipes—were notably reduced. In addition, the evaluation and partial implementation of production water treatment systems helped aim chemical-related deterioration. Furthermore, efforts to resume predictive maintenance projects led to more structured maintenance of equipment. Quantitative results showed a 60% increase in equipment reliability, a 40% reduction in annual maintenance OPEX, and a 12% reduction in deferred production losses. These outcomes not only confirmed the root cause analysis but also demonstrated the effectiveness of a multidisciplinary approach to operational problem-solving. The conclusions prove the need for a correct valve selection and general system diagnostics in high-pressure injection operations. **Novel/Additive Information:** This paper provides a novel contribution by linking mechanical failures in high-pressure injection systems to incorrect check valve selection, supported by a multidisciplinary analysis. Beyond its technical findings, the experience gained offers transferable insights that can help identify and prevent similar issues in water injection systems globally. Sharing this approach can support operational teams in improving reliability, optimizing maintenance practices, and reducing operational costs across the petroleum industry. | |

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| |  |  | | --- | --- | | **Control Number:** | 25ADIP-P-3027-SPE | | **Title:** | Estimation De La Pfd d’Un SystèMe f&G En Conditions réElles De Fonctionnement à l’Aide Du Logiciel Mtbf Calculator | | **Category:** | +8.11 Reliability, Availability, Maintainability, and Inescapability Challenges, Technologies, and Innovative Practices | | **Keyword1:** | Reliability | | **Keyword2:** | Availability | | **Keyword3:** | Safety | | **Keyword4:** | Failure prediction | | **Keyword5:** | MTBF | | **Authors:** | C. Slimani, Université de quebec en Outaouais | | **Abstract:** | **Objectives/Scope:** The objective of this study is to improve the accuracy of estimating the Probability of Failure on Demand (PFD) for Fire & Gas (F&G) safety systems by incorporating real-world operating conditions into the failure rate predictions. This approach aims to go beyond generic failure data and reflect the specific environmental and operational constraints of an actual oil production well system. **Methods, Procedures, Process:** A case study was conducted on a surface-controlled subsurface safety valve (SCSSV) from a well at the Ourhoud oil field. Two estimation approaches were compared: one using generic reference data, and the other using adjusted failure rates derived from real-life operational parameters, processed through the MTBF Calculator software. The prediction models account for temperature, pressure, environmental factors, and maintenance conditions. **Results, Observations, Conclusions:** Results demonstrate a significant difference in PFD values when real operating conditions are considered. Even for a single component, the adjusted PFD values indicate the potential for underestimation of risk if reference data alone is used. This validates the necessity of adapting risk assessments to field conditions. The study concludes that such tailored evaluations lead to more reliable safety performance judgments and can inform better decision-making in industrial safety. **Novel/Additive Information:** This work emphasizes the practical application of reliability prediction software in adjusting failure rates to field-specific conditions, an approach not commonly implemented in routine industrial safety assessments. It adds value by showing that even a focused adjustment on one component reveals critical discrepancies in system reliability metrics, advocating for broader application of this methodology. | |

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| |  |  | | --- | --- | | **Control Number:** | 25ADIP-P-3110-SPE | | **Title:** | Extending Gas Chromatograph Calibration Gas Shelf Life: Driving A Cost-efficient Step Change In Petronas Carigali | | **Category:** | +8.11 Reliability, Availability, Maintainability, and Inescapability Challenges, Technologies, and Innovative Practices | | **Keyword1:** | gas chromatograph | | **Keyword2:** | calibration gas | | **Keyword3:** | shelf life | | **Keyword4:** | gas chromatograph validation | | **Keyword5:** | calibration gas cost optimization | | **Authors:** | N. Shaidatul Shima Mohamad Daud, A. Sipin, D. Datu Shahrun, S. Mat Samoin, PETRONAS Carigali Sdn Bhd | | **Abstract:** | **Objectives/Scope:** This paper addresses the viability of using calibration gas beyond its designated shelf life for Gas Chromatograph validation in fiscal and allocation metering systems, where current practices are limited by rigid shelf-life constraints. It examines whether expired calibration gas poses risk to measurement accuracy. By evaluating gas composition stability under controlled conditions, the objective is to determine whether shelf life can be extended to optimize cost without compromising performance or regulatory compliance in PETRONAS Carigali. **Methods, Procedures, Process:** The evaluation followed the repeatability and reproducibility criteria outlined in ASTM D1945 (2019), the standard test method for natural gas analysis by gas chromatography. Testing was conducted under controlled conditions using calibration gases of varying shelf life, brands, and cylinder pressures. These included GC validation and calibration using both valid and beyond-shelf-life (BSL) gases, cross-verification across different brands, and performance evaluation at reduced cylinder pressure. GC outputs were validated against certified reference standards to assess whether BSL calibration gas impacts measurement integrity, supporting its extended use in custody and allocation metering applications. **Results, Observations, Conclusions:** The validation confirmed that the Gas Chromatograph (GC) consistently met the repeatability and reproducibility limits specified in ASTM D1945 across all test scenarios. Results indicated that the GC maintained analytical accuracy when using both valid and beyond-shelf-life (BSL) calibration gases, including during cross-verification across different gas brands. Gas composition remained stable even after 96 months beyond the manufacturer’s stated shelf life. Furthermore, cylinder pressures below the manufacturer’s minimum recommended limit did not impact GC performance, provided the pressure remained above ambient. These outcomes validate the integrity and stability of extended-shelf-life calibration gas under operational conditions, reinforcing its suitability for both GC validation and calibration in custody and allocation metering systems. The findings support a shift toward condition-based usage, challenging conventional shelf-life restrictions. This enables the organization to reduce waste, maximize calibration gas utilization, and implement a measurable cost-efficiency step change without compromising measurement integrity or regulatory compliance. The new strategy was reviewed and acknowledged by Malaysia Petroleum Management (MPM), the host authority, and is positioned for broader implementation across metering systems within PETRONAS Carigali. **Novel/Additive Information:** This novel strategy enables the use of calibration gas beyond its manufacturer-defined shelf life for Gas Chromatograph (GC) validation—an area rarely addressed in existing practices. It challenges conventional shelf-life constraints by demonstrating that GC analytical accuracy is maintained without compromising measurement integrity or regulatory compliance. The strategy supports a shift toward a condition-based approach, enabling cost-efficient and scalable implementations, while setting a new benchmark for metering practices in the industry. | |

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| |  |  | | --- | --- | | **Control Number:** | 25ADIP-P-3111-SPE | | **Title:** | Enhancing Business Practices With Microsoft Power Bi | | **Category:** | +8.11 Reliability, Availability, Maintainability, and Inescapability Challenges, Technologies, and Innovative Practices | | **Keyword1:** | Enhancing | | **Keyword2:** | Business Practices | | **Keyword3:** | Power BI | | **Keyword4:** | Maintenance Efficiency | | **Keyword5:** | Improve Decision Making | | **Authors:** | B. Ahmed, ADNOC Offshore | | **Abstract:** | **Objectives/Scope:** This paper aims to enhance business practices at a large oil and gas company by addressing current challenges in data analytics and reporting. The objectives include improving data visualization and reporting efficiency, enhancing decision-making capabilities through real-time insights, reducing dependency on IT teams by automating data processes, and implementing a comprehensive data analysis and tracking Reports and Dashboards. Additionally, it focuses on ensuring data accuracy and quality in ERP systems with millions of records. The document provides detailed insights into how Microsoft Power BI can transform raw data into meaningful information, ultimately optimizing business processes and performance. **Methods, Procedures, Process:** The business enhancement process begins with the analysis of data from CMMS and validating its availability in Data Marts. It is ensured that all relevant key data fields and relationships are available in Power BI data marts.After initial data analysis, a brainstorming discussion has been conducted with all relevant teams, such as Maintenance & Operation teams and Asset Integrity & Operation Excellence team members, to refine the objectives and content of the report and dashboard. Then Development of Reports and Dashboards starts, UAT is performed to validate the Report functionality and data. Then proposed reports and dashboards are validated by team leads and managers, and after their endorsement, they were published to BI Service in order to access by users. A quick awareness session is conducted to explain the features and key outputs. **Results, Observations, Conclusions:** We face challenges in integrating and analyzing ERP data, particularly from their CMMS system. Implementing Power BI has led to: • ERP Data Integration - Seamlessly connected with SAP (CMMS) modules to consolidate data. • Improved Reporting - Real-time analytics provide insights into maintenance and operations, with dynamic reports and drill-down capabilities. • Cost Reduction - Enhanced equipment reliability reduces failure and maintenance costs. Increased workforce utilization saves manhours. • Enhanced Decision-Making - Custom dashboards enable faster, data-driven decisions. • Reduced Dependency - Self-service analytics lessen reliance on IT teams. • Leverage Automation - Scheduled data refreshes minimize manual processing. • Mobile Accessibility - Access interactive reports via mobile and tablet. This demonstrates how Power BI optimizes ERP systems, streamlining operations and enhancing business efficiency. **Novel/Additive Information:** This paper illustrates the significant impact of Microsoft Power BI in addressing complex operational and maintenance challenges within the Oil and Gas industry. The implementation of a Power BI dashboard and reports has proven to be transformative, enhancing visibility, streamlining report generation, and empowering decision-makers to take proactive measures. By leveraging dynamic dashboards, offshore operations have been able to reduce their backlog, achieve KPIs target and improve overall maintenance efficiency. | |

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| |  |  | | --- | --- | | **Control Number:** | 25ADIP-P-3131-SPE | | **Title:** | New Approach For Pm Reengineering In An Oil And Gas Company | | **Category:** | +8.11 Reliability, Availability, Maintainability, and Inescapability Challenges, Technologies, and Innovative Practices | | **Keyword1:** | Reengineering | | **Keyword2:** | Preventive Maintenance | | **Keyword3:** | Optimization | | **Keyword4:** | Maintenance Strategy | | **Keyword5:** | Job Plan | | **Authors:** | J. REYNALDO YUS, S. KAR, R. RAVICHANDRAN, T. SANTHANAMUTHU, M. ALMHEIRI, K. MUNAINDI, ADNOC Offshore | | **Abstract:** | **Objectives/Scope:** Revision and optimization of maintenance plans for a large oil and gas company, integrating various sites with different maintenance strategies. Standardize maintenance strategies across the company using best practices in the company and benchmarking with IOCs strategies. **Methods, Procedures, Process:** Reviewed job plans, execution times, and resource requirements, ensuring alignment with system-wide maintenance strategies. Equipment grouping and instrumentation/electrical unification improved efficiency. The proposed optimizations were validated by site managers before CMMS updates, ensuring criticality-based prioritization. Rejected proposals were justified with operational insights. This structured review achieved significant resource savings and process streamlining. **Results, Observations, Conclusions:** The analysis highlighted the need to update the hierarchy and criticality of the equipment, preparing maintenance strategies for each type of equipment. Many plans were found unnecessary due to duplication or condition monitoring. Many pieces of equipment were identified without maintenance plans or deactivated by mistake, some due to the recent migration of the CMMS. Detected that many maintenance plans did not have job plans or were inadequate. It was recommended to standardize maintenance plans for common equipment across various sites, such as fire water pumps, diesel engines, generators, or lifeboats. Periodic reviews should be conducted every five years to avoid numerous issues due to long intervals between reviews. The next phase, once gaps needing improvement in the maintenance plans are identified, is to carry out a holistic review that includes all maintenance plans, not just those with high frequency. **Novel/Additive Information:** The review involved a multidisciplinary examination of preventive maintenance plans across sites. Improvements were made in one quarter for some sites. Many observations at the first site were repeated at following sites, making further reviews repetitive. This optimization ensures appropriate maintenance strategies and clarity on labor required. Reliable information will enable AI tools for maintenance improvement. The benefit will be improved reliability and availability of equipment, optimizing maintenance costs. This standardization will also facilitate future studies on reliability, availability, and maintainability of new projects and operating facilities. | |

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| |  |  | | --- | --- | | **Control Number:** | 25ADIP-P-3134-SPE | | **Title:** | Modeling Imperfect Repair For Realistic Ram Analysis Of Operating Facilities | | **Category:** | +8.11 Reliability, Availability, Maintainability, and Inescapability Challenges, Technologies, and Innovative Practices | | **Keyword1:** | Imperfect Repair | | **Keyword2:** | RAM Analysis | | **Authors:** | S. KAR, ADNOC Offshore | | **Abstract:** | **Objectives/Scope:** This paper analyzes the prevalent approach of conducting RAM (Reliability, Availability, Maintainability) analysis of operating facilities and explains why non-representative modeling of rotating equipment is one the major reasons for unrealistic performance forecasts (generally far rosier than reality). The paper also identifies the correction factors needed to overcome this and proposes a novel methodology to embed these factors into the calculation process. **Methods, Procedures, Process:** A pragmatic methodology of modeling imperfect repair has been proposed that integrates all the correction factors seamlessly. This methodology encompasses three elements - 1. Introduction of age-dependent failure rates for applicable failure modes, 2. Incorporation of Restoration Factors to capture the degree of imperfect repair and 3. Selection of representative virtual age model to capture the nature of imperfect repair. As a result, the actual behavior of rotating equipment under real life operating conditions gets correctly captured in the model leading to a far more accurate and realistic RAM analysis. **Results, Observations, Conclusions:** Extensive life cycle simulations were conducted using the proposed methodology. Initially, standalone machines were considered. Later, small systems comprising the most extensively encountered machinery configurations were analyzed. The observations were consistent - even for marginal wear and tear and high restoration efficiency, there was low to modest decrease in “Mean Availability” accompanied by drastic increase in “Expected number of Failures” and “Downtime”. “Mean Time to First Failure (MTTFF)” also nosedived signifying that the likelihood of a system failure occurring in its design lifetime rapidly shifted from improbable to possible.Later, multiple systems with different operating configurations were combined using their functional relationship in a real complex operating facility. The same negative trends repeated themselves for individual systems and at an overall level produced a much worse cumulative effect. All these outcomes corroborate actual site experience.As a conclusion, it can be stated that this paper has successfully put forward a pragmatic approach to introducing correction factors into RAM models. The paper has also illustrated by means of facts and figures how these correction factors have enabled the RAM analysis to deliver a far more accurate and realistic prediction of operating facility performance over its design life. **Novel/Additive Information:** The novelty of the illustrated methodology lies in its simple and pragmatic approach of modeling imperfect repair which, despite being an undisputed reality in Oil & Gas operating facilities, is not incorporated in the RAM models due to inadvertent oversight. By embracing this methodology RAM analysis delivers a far more accurate and realistic performance forecast which makes all the strategic decisions, typically associated with RAM analysis, far more efficacious and value-adding. | |

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| |  |  | | --- | --- | | **Control Number:** | 25ADIP-P-3146-SPE | | **Title:** | An Innovative Approach Of Analyzing Repairable System Failures For Reliability Improvement | | **Category:** | +8.11 Reliability, Availability, Maintainability, and Inescapability Challenges, Technologies, and Innovative Practices | | **Keyword1:** | Repairable Systems | | **Keyword2:** | Failure Analysis | | **Keyword3:** | Recurrent Event Data Analysis | | **Authors:** | S. KAR, ADNOC Offshore | | **Abstract:** | **Objectives/Scope:** This paper illustrates why traditional practice of “Life Data Analysis (LDA)” proves to be inconclusive or misleading while analyzing repairable system failures in Oil & Gas industries. This paper also elaborates an innovative approach of analysis and shows how this innovative approach provides a better insight into failure occurrence and prevention/mitigation thus paving the way for reliability improvement. **Methods, Procedures, Process:** This innovative approach is called “Recurrent Event Data Analysis (RDA)”. This approach, contrary to LDA, appreciates the two fundamental realities about repairable system failures and incorporates them into the calculation process. These realities are - 1. Failures are not “independent and identically distributed” and 2. Restorations/Repairs do not follow a “perfect renewal process”. This paper first explores two RDA methods - Nonparametric method (Mean Cumulative Function [MCF]) and Parametric method (General Renewal Process [GRP]). It then applies both on a real-life example to illustrate their superior merit as a decision-making tool. **Results, Observations, Conclusions:** Failure data (260 failures covering 9 failure modes, recorded over a duration of 12 years) for a population of 21 identical (same service condition at different sites) repairable equipment was selected at random for analysis. Initially the traditional LDA approach was followed. At first the deterministic LDA method and then the most popular stochastic LDA method, i.e. 2-point Weibull analysis was used. However, none of these methods could provide any definitive failure or repair characteristics based on which an effective failure management policy could be formulated. As a next step, the nonparametric RDA method (MCF) was used - the group MCF pointed towards a stable to slightly improving population. The parametric RDA method (GRP) was used thereafter - the beta parameter value was found to be around one for all scenarios - this corroborated the finding from MCF method. The GRP method also estimated a repair effectiveness factor much less than one which implied imperfect repair. Thus, while the traditional LDA methods provided little actionable insight, RDA provided a holistic understanding of the sample population and concluded that focus should be on improving repair efficacy. Additionally, RDA provided the stochastic capability to estimate conditional reliability and expected number of failures. **Novel/Additive Information:** The novelty of the illustrated approach lies in the fact that unlike LDA, RDA is not constrained by unrealistic assumptions and that’s why it is more representative of the intrinsic physics of failure prevalent in repairable systems. This bestows RDA with the potential to complement and even outcompete LDA as a tool for reliability improvement - the same has been demonstrated in this paper by means of facts and figures. | |

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| |  |  | | --- | --- | | **Control Number:** | 25ADIP-P-3149-SPE | | **Title:** | Improved Well Delivery Time In Unconventional Play By Applying Integrated Engineering Workflow, Onshore Abu Dhabi, Uae | | **Category:** | +8.11 Reliability, Availability, Maintainability, and Inescapability Challenges, Technologies, and Innovative Practices | | **Keyword1:** | Integrated Drilling | | **Keyword2:** | Rotary steerable system (RSS) | | **Keyword3:** | Managed Pressure Drilling (MPD) | | **Keyword4:** | mud coolers | | **Keyword5:** | high temperature | | **Authors:** | M. Amin, ADNOC Onshore | | **Abstract:** | **Objectives/Scope:** Developing HPHT mature gas carbonate field that requires several challenges to be overcome.This paper aims to present a unique workflow and integrated engineering approach to reduce the well time addressing the above challenges by utilizing advanced robust Rotary steerable system (RSS) with matched system along with Managed Pressure Drilling (MPD) and high Temperature rated fluid Loss water-based (HT WBM) system with dual coolers. **Methods, Procedures, Process:** Long run duration more than 20 days downhole along with high mud weight and solids environment up to 16 ppg and 30% respectively were addressed by advanced robust RSS with enhanced seal design along with optimal customized bit designed to balance performance and stability that matched the drive system. MPD was utilized to maintain bottom hole pressure as low as possible, aiming to reach a near balance state with formation pressure to reduce losses and sticking risk while promptly identify influxes and minimize gas flow that includes corrosive H2S up to 4% and CO2 of 110000 ppm which historically led to unstable mud system, acidized mud , sticking ,damage to downhole equipments, HSE risks and standpipe pressure fluctuation that contributes to bad detection and slow rate of penetration (ROP) for data gathering. HT WBM system was used along with a superior lubricant to maintain low torque along with stable downhole pressures and proper hole cleaning. Dual mud coolers utilized to control the downhole temperature below 302-degree F downhole. **Results, Observations, Conclusions:** This was the first time in the unconventional field to drill the 8 ½’’ curve and lateral phase shoe to shoe in a single run with total footage of 6,545 ft compared to similar offset wells that was drilled in minimum two drilling runs with same footage. The phase was drilled in 23 days with 23.4 ft/hr average ROP and 347 circulating hours saved 8.5 days compared to plan. MPD enabled drilling with a lower density compared to offset wells and ensured the well was under control by promptly identifying influxes with a volume less than 0.5 bbl and applied dynamic well control without stopping the drilling operations; gas cut mud and SPP fluctuation were controlled and did not affect the overall performance. Friction factors were maintained between 0.2-0.3 having the superior lubricant in place and mud PH was continuously monitored and maintained within 9.5-10 reflecting stable mud system alongside the Garett Gas Train tests (GGT). Downhole temperature did not exceed 260-degree F while utilizing dual mud coolers **Novel/Additive Information:** **The consistency of applying the above integrated engineering showed improvement well after well building the learning curve and proved to be efficient strategy to meet well objective as well as reduce well time and cost efficiently.** | |

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| |  |  | | --- | --- | | **Control Number:** | 25ADIP-P-3150-SPE | | **Title:** | Quantum Leap In Reliability Performance Monitoring Using Real-time System Data | | **Category:** | +8.11 Reliability, Availability, Maintainability, and Inescapability Challenges, Technologies, and Innovative Practices | | **Keyword1:** | Reliability Performance Monitoring | | **Keyword2:** | Real-Time Systems Data | | **Keyword3:** | Intelligent Dashboard | | **Keyword4:** | Bad Actor | | **Authors:** | S. KAR, J. Reynaldo Yus, R. RAVICHANDRAN, S. Ettireddi, S. Ulaganathan, A. Alshehhi, ADNOC Offshore | | **Abstract:** | **Objectives/Scope:** This paper illustrates how the indelible time signatures, captured in real-time system, in the form of ‘run status feedback’ from equipment have been utilized to enhance real-time reliability performance monitoring & Bad Actor identification. This paper also outlines the design specifications to automate this process by integrating multiple platforms e.g. WMS (Work Management System), SAP PM Module etc. by applying the principle of concurrent time signatures of unique Tags. **Methods, Procedures, Process:** Equipment, while not under operation, can assume three states - stand-by, under planned maintenance and under unplanned maintenance. Traditionally, these states are demarcated using SAP PM Module data. However, SAP data input, being manual, often fails to capture these states, reasons and time stamps correctly. This leads to erroneous calculation of reliability performance. This paper adopts an alternate approach - it considers the binary time signatures in real-time system as sacrosanct and re-classifies the non-running hours into the above-mentioned three states through a stringent validation process. This eliminates the errors resulting out of incorrect time accounting. **Results, Observations, Conclusions:** One of the operating sites was selected at random as a pilot for implementing the above approach. Initially, run status feedback from all major rotating equipment of that site was configured in real-time system followed by periodic validation of the captured data. Later, a data loading platform was developed at the back end to re-classify the non-running hours into the three possible states along with reasons. Emphasis was given on rigorous validation of maintenance interventions using multiple sources. Subsequently two intelligent dashboards were developed. The first one captured the primary reliability indices i.e. Reliability, Operational Availability and Utilization Factor. The second one was developed as an interactive deep-dive platform for reliability analysis with data collation features at multiple levels e.g. individual equipment, equipment family, failure modes, maintainable items etc. A jack-knife diagram was also introduced to automatically identify Bad Actors on a combined criteria of recurrence (chronic scale) and downtime (acute scale). After successful implementation of the pilot, unrestricted access was given to all reliability engineers. The same approach was extended to two more sites. As reliability performance monitoring became more accurate it enabled the organization to derive actionable insights from these dashboards and implement them for reliability enhancement. **Novel/Additive Information:** The novelty of the illustrated method lies in its ingenious approach of using time signatures from real-time systems as reference, thereby eliminating human error and ushering us into an era of automatic Bad Actor identification. Further integration with SAP, WMS and manual reporting with an AI enabler is already underway to make the end-to-end process completely automatic, thus paving the way for accelerated reliability improvement. | |

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| |  |  | | --- | --- | | **Control Number:** | 25ADIP-P-3181-SPE | | **Title:** | Maintenance Criticality Assessment | | **Category:** | +8.11 Reliability, Availability, Maintainability, and Inescapability Challenges, Technologies, and Innovative Practices | | **Keyword1:** | Risk based approach | | **Keyword2:** | Maintenance Criticality | | **Keyword3:** | Criticality Assessment | | **Keyword4:** | sustainable operations | | **Keyword5:** | Maintenance Strategy | | **Authors:** | M.T. Anto, ADNOC Onshore | | **Abstract:** | **Objectives/Scope:** Implementing Risk based approach to the maintenance strategy. Criticality assessment was carried out for all static equipment’s in ADNOC Onshore. The methodology is based on evaluating the risk created in case an equipment fails, or its functionality is impaired. The level of risk is divided into four categories: High Medium, Low and Non-critical. Objective is given below.   * To select the Preventive Maintenance activities and the frequency (inspection, testing, maintenance) - Highest critical equipment receiving highest attention. The lowest critical equipment operates using a Run to Failure strategy. * Equipment most critical to the business will take priority over activities of less critical plant and equipment. * Critical spares holding. * Develop support strategies and contracts that will mitigate the risk of equipment outage.   Risk based approach for the Maintenance strategy will result in substantial cost optimization and enhanced process safety. **Methods, Procedures, Process:** Six elements were considered for performing the Risk Assessment. 1. Safety (Based on HSEIA and Bow tie) 2. Production Loss (Based on Operating Philosophy & Operating Manual) 3. Environment (Based on ENVID Report) 4. Repair Element (Based on contract SOW related to repairs) 5. Redundancy (Based on design philosophy and operating Manual) 6. Failure rate (Based on inspection report, SAP corrective work orders etc.). Scores are assigned for each element during the workshop. Final score is the logarithmic product of each individual element score. Criticality is assigned to each equipment based on the final score and as per the procedure. **Results, Observations, Conclusions:** A multidisciplinary team consisting of Operations, HSE, Inspection, Corrosion and Maintenance performed the assessment. Below are the outcome. • Criticality ranking was assigned to all static equipment’s across all fields. • Based on the implementation of the Risk based approach, the criticality ranking dropped by approximately 60% of the equipment’s, opening the window for substantial cost optimization. • Criticality ranking increased for 10% of the equipment due to impact on production loss and environmental impact mostly. More focus will be given to those equipment’s from the process safety perspective. Homogeneity analysis was also conducted where the assessment results from each field were compared. Risk Ranking assigned for similar equipment (equipment type, service operating conditions etc.) were verified. Wherever deviations were observed, deep dive analysis was performed, and necessary modifications were made. **Novel/Additive Information:** Risk based approach for the Maintenance strategy will result in substantial cost optimization and enhanced process safety. However, the key to the successful implementation lies in the internal procedure which depicts the criteria for selecting values for the six risk elements. Moreover procedure has to be aligned with the 6X6 Risk Matrix of the specific company, HSEIA studies, Operating Philosophy & Operating Manual, ENVID Report and historical data [[A diagram of a company  Description automatically generated](https://files.abstractsonline.com/CTRL/00/A/C98/8C2/0BF/420/A8B/DC4/A68/A2A/A91/0D/g3181_1.png)](https://files.abstractsonline.com/CTRL/00/A/C98/8C2/0BF/420/A8B/DC4/A68/A2A/A91/0D/g3181_1.png) | |

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| |  |  | | --- | --- | | **Control Number:** | 25ADIP-P-3206-SPE | | **Title:** | Enhancement Of Asset Availability | | **Category:** | +8.11 Reliability, Availability, Maintainability, and Inescapability Challenges, Technologies, and Innovative Practices | | **Keyword1:** | Increased asset availability | | **Keyword2:** | Hybrid estimation methodology | | **Keyword3:** | Bottom-up estimation technique | | **Keyword4:** | Lead technique | | **Keyword5:** | TECOP & SWOT analysis | | **Authors:** | F. Al Marzooqi, V. Boni, F. Alebri, H.H. BRAHMBHATT, v. Krishna Mahanti, ADNOC Onshore | | **Abstract:** | **Objectives/Scope:** To achieve enhanced asset availability by optimizing the Total Shutdown duration from 15 days to 11 days of Asab CDS which acts as a processing HUB of 5 satellite fields while ensuring 100% HSE, Asset Integrity and Quality. **Methods, Procedures, Process:** Concept Phase: Defined the scope by identifying necessary activities and resources. Used a hybrid estimation methodology combining Analogous and 3-point Beta Distribution (PERT) to estimate the duration. Additionally, we employed a “Decomposition Technique” to prevent scope creep in terms of time, cost and resources and referred to lessons learned to enhance accuracy. Detailed Planning Phase: We further reduce the duration by bottom-up estimation technique at a granular level for all work packs on each WBS. We identified critical path activities, potential bottlenecks, and risks. To track and control these activities, we broke down critical jobs into smaller tasks and set milestones at significant project points. We utilized the "lead technique" to sequence and compress jobs further and mitigated potential risks by leveraging TECOP & SWOT analysis. Execution Phase: Based on job schedule we assigned the right job to the right resource and capability to accelerate the job both qualitatively and quantitatively. The shutdown duration for tie-ins was minimized by introducing an isolation valve between upstream and downstream of the process, this significantly reduced the number of tie-ins. Remaining activities could continue after start-up, as the RFC was scheduled at a later stage. **Results, Observations, Conclusions:** By applying the methods and techniques, we increased asset availability from 96% to 99% by reducing the shutdown duration by 4 days. We completed critical activities such as 54 tie-ins, over 3250 isolations, 56 valves refurbishment, off-stream activities, dead-leg repairs, and major maintenance of rotary equipment. Success was achieved through clearly defining the objectives, and constant follow-up of pre-shutdown tasks. Close supervision, continuous progress monitoring, and real-time data analysis enabled us to promptly address potential delays and prevent job slippage. To avoid delays and safety hazards caused by fog, we implemented a 12-hour shift schedule with shift changeover at 12 noon. Our team successfully achieved the goal despite the involvement of various internal stakeholders such as HUB Maintenance, Asset Maintenance, Operations Support, Project teams, and external stakeholders like ADNOC Gas and Al Dhafra Petroleum in this major shutdown. In 2024, ADNOC Onshore SE Asset, particularly ASAB field, successfully overcame technical challenges and outperformed industry benchmarks, where typically 50% of turnarounds face delays of 20% or more, and over 75% exceed budget by 10%. **Novel/Additive Information:** Following the reorganization and formation of HUB TAR team, vigilant monitoring from the concept phase to closeout led to significant success. Moreover, the Operation Manager's leadership provided clear guidance and resolved critical issues, contributing to the shutdown's success. | |

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| |  |  | | --- | --- | | **Control Number:** | 25ADIP-P-3208-SPE | | **Title:** | Syngas Compressor High Vibration Diagnosis And Resolution | | **Category:** | +8.11 Reliability, Availability, Maintainability, and Inescapability Challenges, Technologies, and Innovative Practices | | **Keyword1:** | Vibration | | **Keyword2:** | instability | | **Keyword3:** | sub-synchronous | | **Keyword4:** | syngras | | **Keyword5:** | compressor | | **Authors:** | K. Vangari, M.S. Shalabi, Baker Hughes | | **Abstract:** | **Objectives/Scope:** This case study is focused on accurately identifying the root cause of the gradual vibration rise and intermittent vibration excursions leading to potential unavailability of a compressor train.The subject machine train is a Synthesis gas compressor at Oman India Fertilizers Company (OMIFCO) based in Oman. The machine train consists of a LP and HP compressors driven by a Steam turbine in a single shaft configuration. This is a high critical compressor delivering 215,800 kg/hr of syngas at a rated speed of 9370 rpm, suction and discharge conditions are 30.4 bar(g), 40°C and 200 bar(g), 40°C respectively. **Methods, Procedures, Process:** The machine was in continuous operation since last start up in April-2022 following a major overhaul. LP Compressor NDE bearing vibration trend plots showed rising trend since late 2022, mainly due to synchronous 1X vibration gradual increase resulted from suspected rubbing.LP Compressor bearings vibration trend plots also showed multiple intermittent vibration excursion events and the amplitude during one of vibration excursion events crossed OEM Alarm limit at NDE bearing with symptoms of potential flow turbulence. LP Compressor DE vibration trends also showed similar symptoms with less amplitudes. **Results, Observations, Conclusions:** Based on the vibration data diagnosis it was concluded that change in rotor dynamic stiffness condition caused the change/increase in 1X amplitudes whereas the flow turbulence at particular operating conditions was driven by suspected changes in seals clearances. Thus, the decision was taken to shut down the machine train to inspect LP compressor rotor internals and inspect the compressor seals condition (interstage, center labyrinth, dry gas, and balance drum seals) and clearances for signs of deterioration. The inspection revealed significant damage to the balance drum seal. **Novel/Additive Information:** The vibration diagnosis was able to accurately identify the source of the vibration anomaly which greatly helped the customer in plan the maintenance activities accordingly thus reduced the shutdown duration. [[A screenshot of a computer  Description automatically generated](https://files.abstractsonline.com/CTRL/E9/3/41D/061/99A/4D4/A96/4DD/AF2/236/36D/05/g3208_1.jpg)](https://files.abstractsonline.com/CTRL/E9/3/41D/061/99A/4D4/A96/4DD/AF2/236/36D/05/g3208_1.jpg) [[A screenshot of a computer screen  Description automatically generated](https://files.abstractsonline.com/CTRL/E9/3/41D/061/99A/4D4/A96/4DD/AF2/236/36D/05/g3208_2.jpg)](https://files.abstractsonline.com/CTRL/E9/3/41D/061/99A/4D4/A96/4DD/AF2/236/36D/05/g3208_2.jpg) [[A close-up of a metal ring  Description automatically generated](https://files.abstractsonline.com/CTRL/E9/3/41D/061/99A/4D4/A96/4DD/AF2/236/36D/05/g3208_3.jpg)](https://files.abstractsonline.com/CTRL/E9/3/41D/061/99A/4D4/A96/4DD/AF2/236/36D/05/g3208_3.jpg) | |

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| |  |  | | --- | --- | | **Control Number:** | 25ADIP-P-3246-SPE | | **Title:** | Asset Life Cycle Management | | **Category:** | +8.11 Reliability, Availability, Maintainability, and Inescapability Challenges, Technologies, and Innovative Practices | | **Keyword1:** | Asset Life Cycle | | **Keyword2:** | Asset upgradation | | **Keyword3:** | Asset Life Extension | | **Keyword4:** | Maintain and Operate | | **Keyword5:** | Obsolescence Management | | **Authors:** | M. Pandian, Pipeline Infrastructure Ltd | | **Abstract:** | **Objectives/Scope:** Pipeline Infrastructure Ltd (PIL) owns and operates a 1375 km, 48-inch natural gas pipeline from Kakinada to Bharuch in India, Commissioned in April 2009 with a design life of 30 years. Asset life cycle cost is crucial for managing assets. PIL developed a comprehensive asset management philosophy to manage our gas transmission network and its assets. This asset life cycle management plan integrates maintenance strategy, asset condition and future business needs. This approach outlines our plans for managing and investing in PIL network assets over the next 20 years. **Methods, Procedures, Process:** Our approach to asset life cycle management philosophy includes: **Develop**: Investments in new assets to meet pipeline network demand **Operate**: Real-time monitoring. Control, response to events, and planning safe asset decommissioning**Maintain:**Ensure assets function safely and reliably from commissioning through to their replacement or disposal. **Replacement/ Upgrade**: Replace old assets with modern equivalents or extend their useful life and functionality. **Results, Observations, Conclusions:** **Key findings:**1.Identified New business opportunities 2.Developed Comprehensive maintenance plan/ strategies for critical and semi-critical equipment. 3. Evaluated the condition, performance and risk associated with our assets 4. Created a framework for deferred-maintenance, asset replacement and renewal decision analysis and outline additional considerations beyond the quantitative analysis. 5. Developed 20 years forecasting budget plan asset life cycle cost **Conclusion** Asset management enables an organization to examine the need for, and performance of, assets and asset systems at different levels. Additionally, it enables the application of analytical approaches towards managing an asset over the different stages of its life cycle (which can start with the conception of the need for the asset, through to its disposal, and includes the managing of any potential post disposal liabilities). We conduct a thorough evaluation of the condition, performance, and risks associated with our assets. This assessment allows us to plan for asset replacement and upgrades. In some instances, it may be more efficient to extend an asset's lifespan beyond its anticipated duration through renewal efforts. **Novel/Additive Information:** Asset life cycle management typically includes design, install, operation & maintenance, and decommissioning. Our approach places a greater emphasis on asset upgrades and obsolescence management, which are often less prioritized by the industry but are essential for maintaining asset availability and reliability. [[A diagram of a company's process  Description automatically generated](https://files.abstractsonline.com/CTRL/F6/4/A7C/6B9/A50/4DC/284/970/FAA/AF6/7EE/0E/g3246_1.png)](https://files.abstractsonline.com/CTRL/F6/4/A7C/6B9/A50/4DC/284/970/FAA/AF6/7EE/0E/g3246_1.png) | |

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| |  |  | | --- | --- | | **Control Number:** | 25ADIP-P-3302-SPE | | **Title:** | Level Measurement Practical Challenges | | **Category:** | +8.11 Reliability, Availability, Maintainability, and Inescapability Challenges, Technologies, and Innovative Practices | | **Keyword1:** | level measurement | | **Keyword2:** | level transmitter | | **Keyword3:** | level challenges | | **Keyword4:** | troubleshooting | | **Authors:** | I. Al Jabri, PDO | | **Abstract:** | **Objectives/Scope:** This paper aims to highlight the key issues and challenges associated with level measurement systems in the oil & gas industry. It seeks to identify areas where level transmitter vendors need to innovate and enhance their solutions to meet operational demands and improve client satisfaction. **Methods, Procedures, Process:** The paper presents a comprehensive overview of the various challenges encountered during the installation and operation of different types of level transmitters in oil & gas applications. It begins with the selection of appropriate level measurement technologies based on the characteristics of process fluids and continues through the installation, commissioning, and operational phases. The discussion includes troubleshooting methodologies used to identify root causes of performance issues, followed by recommendations and solutions to address these challenges. These insights are documented as part of a learning process. **Results, Observations, Conclusions:** Through the analysis of multiple case studies, the paper identifies critical focus areas that require attention from engineering teams. These findings are intended to serve as valuable lessons and are shared with level measurement equipment manufacturers as feedback from end users. The goal is to encourage research and development efforts aimed at improving product reliability and performance. Additionally, the paper proposes a set of guidelines or checklist items that can assist engineering teams in selecting and designing effective level measurement systems. **Novel/Additive Information:** This paper introduces a practical and often overlooked topic to a broad audience involved in upstream operations within the oil & gas industry. By presenting real-world challenges, it fosters knowledge sharing and encourages the exchange of best practices among industry professionals. It also provides a platform for exploring how different facilities address similar issues, ultimately contributing to the advancement of level measurement technologies. | |

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| |  |  | | --- | --- | | **Control Number:** | 25ADIP-P-3403-SPE | | **Title:** | Ensuring Asset Integrity Via Non-destructive Testing Of Mechanical Properties In Aging Infrastructure | | **Category:** | +8.11 Reliability, Availability, Maintainability, and Inescapability Challenges, Technologies, and Innovative Practices | | **Keyword1:** | non destructive mechanical testing | | **Keyword2:** | reliability integrity | | **Keyword3:** | pipelines | | **Keyword4:** | fracture toughness | | **Keyword5:** | economic incentive | | **Authors:** | D. Raghu, Kaleidoscope Energy LLC; K. Esaklul, Oxy Oil & Gas Corp; M. Haggag, ABI Integrity Services LLC | | **Abstract:** | **Objectives/Scope:** Aging infrastructure across oil, gas, and energy sectors presents critical challenges due to undocumented mechanical properties. This paper focuses on non-destructive testing (NDT) of key mechanical attributes—especially fracture toughness—to safely extend asset life, reduce downtime, and repurpose pipelines for evolving energy needs. The techno-economic value lies in minimizing capital outlay (savings up to 90% vs. rebuilds), enabling safe operability, and supporting energy transition goals such as CO₂ and hydrogen transport using statistically reliable, field-deployable NDT data. **Methods, Procedures, Process:** This study highlights the Stress-Strain Microprobe (SSM) technique, employing Automated Ball Indentation (ABI) for in-situ mechanical property assessment. ABI provides tensile strength, yield strength, and fracture toughness by correlating load-displacement curves with validated master curves. Results are calibrated using J-integral data from destructive tests, ensuring robust accuracy. The system is fully portable, automated, and suited for both field and lab use. Statistical modeling—including confidence intervals and probability of exceedance—supports the use of ABI-derived values for rerating, redesign, or repurposing infrastructure. This method reduces operational complexity and enhances compliance, safety, and asset utilization without requiring costly shutdowns. **Results, Observations, Conclusions:** The validation of ABI-based non-destructive testing confirms good correlation with destructive testing results for tensile, yield, and fracture toughness. Emphasis is placed on conservative data interpretation, allowing operators to derive mechanical properties with high confidence and minimal risk. Through probabilistic analyses, particularly exceedance probability modeling, ABI-derived values can be applied for rerating pipelines, redesigning pressure vessels, and certifying well tubulars. Case studies illustrate practical use cases such as safely increasing allowable design stress, rerating aging gas lines, and repurposing existing pipelines for CO₂ and hydrogen transport. These examples demonstrate how the technique supports real-world engineering decisions while reducing risk exposure and uncertainty. The methodology not only improves asset integrity management but also optimizes capital efficiency. Instead of full infrastructure replacement, which is capital-intensive and time-consuming, ABI-based evaluations allow for targeted interventions. This facilitates better asset stewardship and supports energy transition objectives with minimal disruption. Capital savings from using this technique can range from 75-90%, delivering a clear return on investment while maintaining regulatory and operational compliance. In conclusion, ABI-supported NDT serves as a proven, scalable solution for extending the safe, functional lifespan of energy infrastructure. **Novel/Additive Information:** While ABI has existed for over two decades, its innovative edge lies in its modern application—integrating data analytics, statistical rigor, and field automation for decision-grade integrity assessments. This paper showcases how portable ABI systems, when combined with machine learning and probabilistic modeling, redefine infrastructure management. The result is a paradigm shift: enabling safe, cost-effective repurposing of aging assets, aligning with net-zero infrastructure goals, and ensuring technical reliability with significantly reduced capital intensity. | |

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| |  |  | | --- | --- | | **Control Number:** | 25ADIP-P-3433-SPE | | **Title:** | Pragmatic Approach For Ex Equipment Management In Oil And Gas Sector | | **Category:** | +8.11 Reliability, Availability, Maintainability, and Inescapability Challenges, Technologies, and Innovative Practices | | **Keyword1:** | Ex Equipment | | **Keyword2:** | Hazardous areas | | **Keyword3:** | RBI | | **Keyword4:** | SAP | | **Keyword5:** | Ex Registration | | **Authors:** | T. SANTHANAMUTHU, R. RAVICHANDRAN, K. MUNAINDI, A. Baobaid, ADNOC OFFSHORE | | **Abstract:** | **Objectives/Scope:** This paper introduces a comprehensive Ex Equipment management strategy, designed to uphold safety standards while integrating As Low as Reasonably Practicable (ALARP) principles. The strategy establishes a balanced, effective, and targeted approach, ensuring compliance with regulatory requirements and optimizing maintenance efforts. It provides a consistent approach for registration in CMMS, inspection, and maintenance strategies right from projects to operating phase. It tackles Ex equipment in hazardous areas and in non-hazardous areas. **Methods, Procedures, Process:** The strategy defines a unified process to address Ex Equipment at both project and operation phases across Hazardous (HAC) and non-hazardous environments. It sets defined procedures for SAP registration, inspection, maintenance, performance review, and personnel training requirements. These procedures cover the three inspection levels: visual, closed and detailed and all types of installation. It offers guidance to determine the most suitable inspection strategy based on factors such as facility life cycle stage, asset register size and maturity of inspection data, which sets a route map for moving from simple periodic inspection to risk-based approach. **Results, Observations, Conclusions:** The developed strategy provided a unified framework for consolidated registration, inspection, maintenance execution, and defects management for new and existing installations. This resulted in significant improvements in the safety and reliability of Ex equipment. The clearly defined frequency for all inspection levels and the random sampling reinspection approach set a streamlined inspection process that resulted in inspection efficiency, resources optimization and improved defect identification. The standardization of SAP-based registration through defining minimum data requirements for equipment register established an improved data completeness that helps to maintain accurate records for timely maintenance activities and verification of installed safety-critical elements. Furthermore, the strategy is reinforced by an audit and review procedure that demonstrates its effectiveness and ensures that personnel competence is adequate. This review procedure helps to identify recurring issues and trends, enabling continuous improvement in equipment management practices. It also highlights gaps in the workforce's knowledge and skills, allowing for targeted training programs that enhance overall competency. **Novel/Additive Information:** This strategy provides a pragmatic and comprehensive approach ensuring the safety and integrity of Ex equipment through systematic management system, risk-based inspection (RBI), and maintenance strategies with optimum cost. This approach is tailored to mitigate risks considering the generic practices followed in oil and gas industries. | |

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| |  |  | | --- | --- | | **Control Number:** | 25ADIP-P-3436-SPE | | **Title:** | Deployment Of Sodium Nickel Chloride Batteries For Offshore Vital Loads: A High-reliability, Low-maintenance Alternative To Conventional Vrla And Ni-cd Systems | | **Category:** | +8.11 Reliability, Availability, Maintainability, and Inescapability Challenges, Technologies, and Innovative Practices | | **Keyword1:** | Uninterruptible Power Supply | | **Keyword2:** | Battery Energy Storage | | **Keyword3:** | Battery Monitoring System | | **Authors:** | M. MEGAT KHAS, Petronas Carigali Sdn Bhd | | **Abstract:** | **Objectives/Scope:** This paper aims to present PETRONAS Carigali’s experience in deploying sodium nickel chloride (Na-NiCl₂) batteries as a replacement for traditional Valve-Regulated Lead-Acid (VRLA) and Nickel-Cadmium (Ni-Cd) batteries in offshore applications. The focus is on addressing the limitations of conventional technologies under high ambient temperatures and improving reliability, safety, and maintenance outcomes for critical offshore loads. **Methods, Procedures, Process:** A pilot deployment of Na-NiCl₂ batteries was conducted from June 2014 to June 2019, followed by full implementation in February 2020 across selected offshore platforms. Comparative evaluations were carried out against existing VRLA and Ni-Cd systems, focusing on installation footprint, thermal management requirements, failure modes, and lifecycle cost. Battery performance was monitored via an integrated Battery Management System (BMS), which enabled real-time health diagnostics, remote monitoring, and automated discharge testing. Operational data and maintenance records were collected and analyzed to assess long-term performance and reliability under offshore environmental conditions. **Results, Observations, Conclusions:** Na-NiCl₂ batteries demonstrated significantly better thermal tolerance and reduced maintenance needs compared to legacy systems. Field results showed a 25-30% reduction in footprint versus Ni-Cd batteries for equivalent capacity. The modular design—with available blocks at 24VDC, 48VDC, 120VDC, and 220VDC—simplified system integration and minimized interconnection losses. Unlike VRLA and Ni-Cd batteries, Na-NiCl₂ units do not emit hazardous gases, eliminating the need for explosion-proof battery rooms and cooling systems. This resulted in lower energy use and contributed to corporate GHG emission reduction goals. The BMS enabled enhanced reliability through continuous condition monitoring and reduced manual inspection frequency, improving safety by minimizing technician exposure. However, limitations were observed in remote solar applications requiring autonomy beyond 24 hours, where traditional OPzV VRLA systems remain more economical due to their discharge characteristics. **Novel/Additive Information:** This paper contributes new insights into the practical application of Na-NiCl₂ battery technology in offshore oil and gas operations. It offers real-world implementation data, performance comparisons with legacy systems, and lessons learned that can guide other operators in evaluating advanced energy storage systems tailored to harsh offshore environments. | |

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| |  |  | | --- | --- | | **Control Number:** | 25ADIP-P-3439-SPE | | **Title:** | Innovative In-house Ai Tool Deployment For Materials Inventory Management (VED Analysis) | | **Category:** | +8.11 Reliability, Availability, Maintainability, and Inescapability Challenges, Technologies, and Innovative Practices | | **Keyword1:** | VED Analysis | | **Keyword2:** | AI Enabled | | **Keyword3:** | Inventory management | | **Keyword4:** | Maintenance Excellence | | **Keyword5:** | Innovative practices | | **Authors:** | S. RAJAMANI, H. Al Mansoori, A. Al Ali, S. Koshy, M. Almessabi, S. Kochhar, M.S. Al Marzooqi, ADNOC Offshore | | **Abstract:** | **Objectives/Scope:** The objective is to highlight our Operation/Maintenance excellence division initiative to embrace AI technology to develop a solution tool in-house to reclassify the spares criticality (VED Analysis) in line with the ADNOC Group Inventory Management Procedure. The Item Criticality Analysis employs a Quantitative Method based on the relative assessment of Equipment Severity and Spares Consumption. The traditional manual process is time-consuming, requiring bulk data handling from SAP reports, calculations and analysis in Excel sheets. **Methods, Procedures, Process:** Initiated Business case approval process for development of a new tool for assessing Spares criticality that utilizes AI, incorporating advanced algorithms and large language models for user interactions. We organized the data based on SAP historical material usage and equipment severity through clustering technique. The model is specifically trained for the Offshore industry using different advanced algorithms. Once the data is prepared, anomaly detection is used to spot unusual behavior and handle different scenarios. Predictions are based on material consumption history and associated equipment criticality. Interactive dashboards and a Q&A chatbot support self-learning of the solution. **Results, Observations, Conclusions:** VED Analysis provides business owners and inventory managers with a clear understanding of which items require immediate attention and prioritization. By categorizing inventory items into V (Vital), E (Essential), and D (Desirable), businesses can allocate resources efficiently and ensure a smooth supply chain flow. The new AI technology solution approach process which has positive impact on 1. Improved business process 2. Reducing manual errors 3. Save manhours, reduce costs. 4. Effective spare parts management strategy towards maintenance and operational excellence. 5. Support timely maintenance activities- Improving the plant equipment reliability and availability. 6. Provide Historical Analysis and Trends. Through Spares criticality (VED) Analysis, the company shall ensure that it always maintains an adequate stock level, minimizing the risk of stockouts and ensuring uninterrupted production. VED Analysis helps to identify the critical items that demand close monitoring and swift action. Inventory managers can plan critical spare parts stock replenishment to support the maintenance activities (PM/PDM/CM). **Novel/Additive Information:** The most significant milestone is the complete process is inhouse company development with effective collaboration among Operation Excellence/ Digital oil Field and Offshore Digital Department. This innovative solution significantly enhances process efficiency by over 50% and improves data accuracy and quality by minimizing human errors during manual data processing. This novel approach will facilitate substantial cost savings over the next five years, optimize spares management, reduce operational costs, and enhance asset reliability. | |

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| |  |  | | --- | --- | | **Control Number:** | 25ADIP-P-3476-SPE | | **Title:** | Improve Reliability By Resolving The Intermittent Flow Fluctuations In The Acid Gas Flow To The Reaction Furnace While Controller Is In Auto Mode Leading To Fluctuation In The Thermal Reaction Temperature Of Reaction Furnace In The Sulphur Recovery Units 52/53/54 Fic 122. | | **Category:** | +8.11 Reliability, Availability, Maintainability, and Inescapability Challenges, Technologies, and Innovative Practices | | **Keyword1:** | Acid Gas Flow | | **Keyword2:** | Flow Fluctuation | | **Keyword3:** | Control Valve Design | | **Keyword4:** | Sulphur Recovery | | **Keyword5:** | Reliability | | **Authors:** | S. Patel, AG | | **Abstract:** | **Objectives/Scope:** Improve Reliability by resolving the intermittent flow fluctuations in the Acid Gas Flow to the Reaction Furnace when in auto mode in the Sulphur Recovery Units 52/53/54FIC122. **Methods, Procedures, Process:** **Data Collection**: Gather operating parameters of the Reaction Furnace, Control Valve datasheet, control valve servicing history, and corrective maintenance records. **Analysis**: Analyse collected process data and review control valve design. **Solution**: Address concerns identified during data analysis through OEM discussions and identify control valve design requirements. **Procurement & Commissioning**: Procure and commission the new control valve through CAPEX budget. **Performance Evaluation**: Monitor valve performance for three months and produce a report. **Results, Observations, Conclusions:** **Observations**: Acid Gas Control Valve is not designed to meet process requirements. **Conclusions**: Acid Gas fluctuations were caused by the scotch yoke piston actuator coupled with a keyed shaft, which has inherent hysteresis, and the shaft bearing not designed for operating temperatures of 400°C. **Solution**: Design deficiencies were addressed by using a crank & slider mechanism actuator coupled to a splined shaft butterfly valve body and upgrading the shaft bearing to R30006 Cobalt Alloy Bearings. **Result**: The new control valve is working in Automatic mode and meeting process requirements. **Novel/Additive Information:** The old Acid Gas Flow Control Valve had a scotch yoke piston actuator coupled to a keyed shaft with inherent hysteresis. The new actuator uses a crank & slider mechanism, and the valve body has a splined shaft for fine valve position control. The thrust bearings are designed to withstand higher temperatures during upsets in the Reaction Furnace. | |

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| |  |  | | --- | --- | | **Control Number:** | 25ADIP-P-3531-SPE | | **Title:** | Seal Gas System Optimization In Flare Gas Recovery Compressors: Eliminating The Booster Compressor Through System Re-evaluation | | **Category:** | +8.11 Reliability, Availability, Maintainability, and Inescapability Challenges, Technologies, and Innovative Practices | | **Keyword1:** | Seal system reliability | | **Keyword2:** | seal gas booster | | **Keyword3:** | seal system availability | | **Keyword4:** | Flare Gas Recovery | | **Authors:** | N. KANDULA, S.K. Singh, H. Singh, NMDC Energy; F. Kamal, National Petroleum Construction Company | | **Abstract:** | **Objectives/Scope:** The seal system in a Flare Gas Recovery Compressor (FGRC) prevents process gas leakage by maintaining a higher-pressure barrier using an external inert gas—typically nitrogen. In some cases, a booster compressor is used to meet seal gas pressure requirements, especially during start-up or pressurized shutdown conditions when nitrogen supply conditions do not meet seal pressure requirements across all operating modes. The case study presented in this paper explores how an instrumented system that simplifies system design, cuts costs, and improves maintainability can also replace the need for a booster compressor. **Methods, Procedures, Process:** A comprehensive evaluation of seal gas system pressure requirements was conducted, covering normal operation, start-up, and settle-out conditions. The pressure drop calculations were performed accounting for pressure losses across the filter and other elements of the system. Technical discussions with the compressor OEM and seal system vendor were held to understand minimum pressure requirements. Alternative options such as nitrogen receivers and automated depressurization logic were modeled. Reliability under trip and low-pressure conditions was examined to validate uninterrupted seal gas supply without booster compressor dependency. **Results, Observations, Conclusions:** The analysis confirmed that the existing nitrogen supply pressure with new instrumentation is sufficient to maintain the required pressure margin between buffer and seal gas in all operating scenarios. No process gas leakage or seal integrity concerns were identified, even under pressurized condition. The risk of simultaneous failure of independent elements deemed extremely low. Vendor validation supported the findings, allowing the system to be operated without a booster compressor. The outcome enables simplified design, improved maintainability, and cost savings while maintaining system performance and operational safety. **Novel/Additive Information:** NMDC Energy recently executing an Onshore Gas Processing EPC project having FGRC units to recover the vent gases. FGRC seal system initial design followed standard approach i.e. with seal gas booster compressor. However, an Efficient Control System Design was proposed during the execution stage which eliminated requirement of seal gas booster compressor. The paper aims to share the case study, providing benefits to all stakeholders in Oil & Gas industry. | |

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| |  |  | | --- | --- | | **Control Number:** | 25ADIP-P-3573-SPE | | **Title:** | Inspection, Repair And Integrity Management Of External Cracks On Buried Onshore Pipelines Assessed By AI Integrated Customized Tools And Softwares | | **Category:** | +8.11 Reliability, Availability, Maintainability, and Inescapability Challenges, Technologies, and Innovative Practices | | **Keyword1:** | Buried Pipeline | | **Keyword2:** | Cracks | | **Keyword3:** | In line Inspection, ILI | | **Keyword4:** | Fitness for service, FFS | | **Keyword5:** | In-service repairs | | **Authors:** | S. Patil, ADNOC Onshore | | **Abstract:** | **Objectives/Scope:** Pipeline network at Company consists of various segments transporting Crude Oil since 1960’s where few have surpassed double the design life. During routine coating maintenance works, unanticipated external crack anomalies were observed. Crack detection ILI technique was adopted for subsequent ILI campaigns. This paper aims to highlight such identifications, assessments through AI integrated soft-wares and their maintenance which prolong the replacements. Failures can lead to significant environmental, reputational or immediate financial losses up to USD 5million. **Methods, Procedures, Process:** Significant deterioration was found in the Coal Tar Enamel (CTE) tape coatings through periodic CP-DCVG surveys and other dig-site verifications which also revealed crack anomalies. Accordingly, novel and customized intelligent pigging surveys with Ultrasonic Crack detection technology coupled with multiple techniques to include axial cracks, circumferential cracks and corrosion metal loss detection were adopted. Four nos. of the old pipeline segments were observed with multiple crack anomalies. These were analyzed through AI integrated soft wares. Considering significantly high numbers of cracks an Engineering Critical Assessment (ECA) was conducted using proprietary third-party software to identify maximum tolerable sizes. These were further assessed for defect interactions as per BS 7910 (API 579) guidelines and finally classified in four categories. Based on the criticality of each category, a maintenance program was determined prioritizing the most critical anomalies for repairs which indicated initiation of carbonate/bi-carbonate stress corrosion cracking.In view of the dynamic scenario with continuous operation of Main Oil Lines, a subsequent ILI campaign was also initiated to assess the growth and morphology of crack anomalies. Further assessments were carried out to determine crack growth rates. Accordingly, a proactive maintenance and repair plan was charted out considering the predicted model. **Results, Observations, Conclusions:** Based on the results and maintenance practices adopted for the crack anomalies observed in the above case, routine inspection and maintenance programs should be upgraded with the latest available technologies to prolong the service life of ageing pipelines in an effective manner. It can therefore be concluded that:a. Continue with prioritized verification, repair and maintenance activities including upgradation of coating system for the anomaly locations with new-age liquid epoxy coatings.b. Enhancement to existing inspection and maintenance programs should be implemented (Eg: In this case, standard MFL-ILI was substituted by a combination of UTCD ILI with multiple detection capabilities).c. For unpredictable anomalies, subsequent inspection programs with similar and comparable techniques should be deployed to enable future predictions of growth rates.d. Periodic engineering critical assessments for ageing assets should be continued. **Novel/Additive Information:** With the application of sound engineering and fundamental principles, a sustainable maintenance program is achievable even in the most challenging cases. | |

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| |  |  | | --- | --- | | **Control Number:** | 25ADIP-P-3594-SPE | | **Title:** | Enhancing Reliability And Availability Of Liquid Ring Compressors Through Manufacturing And Design Improvements | | **Category:** | +8.11 Reliability, Availability, Maintainability, and Inescapability Challenges, Technologies, and Innovative Practices | | **Keyword1:** | Reliability | | **Keyword2:** | Availability | | **Keyword3:** | Maintainability | | **Keyword4:** | Flare reduction | | **Keyword5:** | Innovative Practices | | **Authors:** | M. Alharmoodi, A. Al Dahmani, A. Sreedevi Babu, R. Sahadevan, ADNOC Onshore | | **Abstract:** | **Objectives/Scope:** Flare Gas Vapor recovery compressors(VRC) are key to operating fields in complying to HSE related Flaring KPIs. The asset had a history of failures observed from 1 year in service of their Liquid ring VRC. This paper shares the lessons learned and enhancements related to the problems faced in these compressors, which had significant impact on equipment availability and reliability related to: • Component manufacturing related quality control process deficiencies • Component design deficiencies • Bearing failures **Methods, Procedures, Process:** The paper is based on field experience of asset Facility. The methodology followed to resolve the problems that surfaced, over a period of 7 years ,were as below: • Review team formed including enduser , Engineering and Equipment manufacturer. • Review to identify the probable causes for the repeated impeller failure at blade area and jointly decide on the rectification and enhancements to avoid future failure • Review effectiveness of the impeller manufacturing quality control process • Review Suitability of impeller blade profile design • Holistic Operability Review of process design of VRC by Engineering team • Review Suitability of bearing frame assembly **Results, Observations, Conclusions:** Engineering and manufacturing process quality, enhancements were identified and agreed upon by the team.The same were implemented in manufacturing of impeller and bearing frame and incorporated in the repair of the compressor. The enhancements have proven to enable overcoming the failure causes and improve the reliability and availability of the unit which is currently in operation for more than two years. The observation and conclusion which were the outcome of the process were: • Impeller blade profile was found to be inadequate for the process conditions by the equipment manufacturer and was upgraded with material increase in the thinner part of the blade during casting process. • The review of failure analysis reports identified that the impeller crack initiation and failure was probably result of a material problem, due to deficient casting cooling/heat treatment of the impellers, leading to high residual stress level. Engineering team proposed quality control enhancement measures including shot pinning which were implemented during manufacturing ,resulting in higher impeller reliability and no further cracking in blade area observed. • Holistic Operability Review concluded that there are no design deficiencies related to process in the system • Bearing frame was upgraded with higher capacity bearings which in turn eliminated the bearing failures. **Novel/Additive Information:** The lessons learned provides guidelines, which should be considered in the design/manufacturing of similar compressors. Consideration of these lessons learned in future projects, will enhance availability and reliability and hence maximize the profitability. Same can be cascaded to other similar units across operations facing similar reliability issues. | |

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| |  |  | | --- | --- | | **Control Number:** | 25ADIP-P-3652-SPE | | **Title:** | Lube Oil Dilution In Hydrocarbon Turboexpanders, Impact On Machine Reliability And Mitigation Strategies | | **Category:** | +8.11 Reliability, Availability, Maintainability, and Inescapability Challenges, Technologies, and Innovative Practices | | **Keyword1:** | Turboexpander | | **Keyword2:** | lube oil dilution | | **Keyword3:** | oil contamination | | **Keyword4:** | bearing wear | | **Keyword5:** | seal gas condensate | | **Authors:** | A. Kumar, ADNOC Technical Academy | | **Abstract:** | **Objectives/Scope:** Turboexpanders are critical rotating equipment that are widely used in natural gas processing, cryogenic gas separation, and energy recovery systems. These machines operate at high rotational speed, under extreme conditions of high pressure and low temperature. A persistent reliability challenge in these machines is lube oil dilution, a phenomenon where heavier process gases and condensates ingress into the lubrication system. This contamination leads to a reduction in oil viscosity, deterioration of lubrication performance, and subsequent risks to the mechanical integrity of critical components, particularly bearings. These consequences not only compromise turboexpander operation but also increase maintenance costs due to catastrophic failures and reduces overall system reliability. **Methods, Procedures, Process:** This paper covers a comprehensive analysis of the mechanisms behind lube oil dilution in turboexpanders, its operational impact, diagnostic techniques, and modern strategies for mitigation, with a focus on real-world case studies that includes improvement in operating procedures, field modification and enhancements in seal system design. This paper also emphasizes on predictive and proactive maintenance strategies including routine oil analysis, bearing temperature, vibration monitoring, and lube oil reservoir level monitoring as essential tools for early detection of oil contamination. Role of advanced Magnetic bearing turboexpanders has also been addressed that eliminate this oil dilution issue. **Results, Observations, Conclusions:** An integrated strategy, combining enhanced seal system design, effective pressure control, oil monitoring and purification, and predictive maintenance, can effectively mitigate lube oil dilution in turboexpanders. **Novel/Additive Information:** Cases studies and operational best practices shared in this paper will be beneficial for turboexpander operators to improve reliability, enhance operational efficiency and prolong equipment service life. | |

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| |  |  | | --- | --- | | **Control Number:** | 25ADIP-P-3687-SPE | | **Title:** | Innovative Way To Mitigate Business Uncertainty Of Value Creation - Conversion Of Dc Driven Motor To Ac Driven Motor | | **Category:** | +8.11 Reliability, Availability, Maintainability, and Inescapability Challenges, Technologies, and Innovative Practices | | **Keyword1:** | 24V DC Motor | | **Keyword2:** | Can Do Mindset | | **Keyword3:** | Cost avoidance | | **Keyword4:** | operation performance | | **Keyword5:** | Business Value | | **Authors:** | M.K. Mandal, S. Chanda, V. Kumar, R. Perumal, K. Gupta, S. Pande, ADNOC Offshore | | **Abstract:** | **Objectives/Scope:** Integrity of subsea line assured by injecting corrosion inhibitor. The existing Chemical Injection (CI) Skid packages were designed with 24V DC Motor and since commissioning, premature failures (non-repairable) have occurred in multiple WHTs for the CI Skid motor. Being Ex-DC Motor, in situ maintenance/repair work was not feasible. Potential outage of WHTs leading to threat to business continuity i.e. loss revenue generation. As a Pilot CI Skid DC Motor was replaced with AC Motor thereby overcoming the risk of frequent failures of asset as well as eliminated the need to replace the complete skid (Pump & Motor) thereby reducing future OPEX. **Methods, Procedures, Process:** Type of motor changed to improve performance efficiency. Following steps followed a) Study to conclude cost effective solution & identified use of AC motor is very effective b) Approached different OEM for supply of AC motor that can be accommodated in the same footprint c) Compatibility with the existing I&C System /LCP assured, compliances with company standard ensured. Vendor support ensured ( maintenance/spare parts) d) Trial conducted at vendor facilities with new motor and confirmed no adverse impact on performance of pump e) Same implemented at WHT **Results, Observations, Conclusions:** Existing CI pump with new AC Motor performance found satisfactory. The results indicate that driver change from the DC to AC Motor doesn’t have impact on the performance of the pump. This innovative action improved Company business in the following ways a) ***Cost avoidance***: Team mitigated business uncertainty by replacing only motor instead of total skid for 33 WHTs (Pump/motor) ~ US$5.0 Million b) ***Resources Depletion*:** If complete skids (Pump & Motor) replacement be considered there would be potential engagement of Barge for at least 15 days. c) ***Sustainable oil production***: Outage of WHTs due to failure of CI Systems leading loss of production and consequently oil production loss ~ US$41.25 per year ( 33 WHTs once per year & 5 days outage @ rate of 5 MBD ) **Novel/Additive Information:** This activity demonstrated “*Can Do Mindset*” and innovative in nature & in line with company’s expectation of value maximization. a) Customized solution of utilizing the AC Motor to retrofit the existing CI Skid pump. Avoid cost towards pump replacement. b) Elimination of Operational bottle neck due to frequent failures of DC Motor so CI Skid c) Lesser maintenance campaigns as AC Motors requires very low maintenance (unlike DC Motors for brush replacements) d) Implementation strategy to avoid production loss. This is unique solution one kind of within ADNOC [[A blue machine with pipes  Description automatically generated](https://files.abstractsonline.com/CTRL/B3/7/361/425/DDE/42F/DB2/E1D/477/7B7/57C/8F/g3687_1.png)](https://files.abstractsonline.com/CTRL/B3/7/361/425/DDE/42F/DB2/E1D/477/7B7/57C/8F/g3687_1.png) | |

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| |  |  | | --- | --- | | **Control Number:** | 25ADIP-P-3697-SPE | | **Title:** | Transforming Critical Materials Management In The Energy Sector Through A Blockchain-enabled VMI Marketplace | | **Category:** | +8.11 Reliability, Availability, Maintainability, and Inescapability Challenges, Technologies, and Innovative Practices | | **Keyword1:** | Critical Materials Management | | **Keyword2:** | Blockchain | | **Keyword3:** | VMI | | **Keyword4:** | Marketplace | | **Authors:** | A. Khoory, Gerab National Enterprises | | **Abstract:** | **Objectives/Scope:** This paper presents an innovative model that integrates Vendor Managed Inventory (VMI), Blockchain, and curated B2B Marketplace technologies to reshape how energy companies manage critical materials. By combining these technologies, energy organizations can enhance supply chain transparency, resilience, and operational efficiency. The model is being developed by **Gerab National Enterprises**, a global supplier of piping solutions to over 60 countries. The model proposes a scalable digital platform that reduces downtime, optimizes inventory, strengthens ESG compliance, and speeds up procurement in complex industrial environments. **Methods, Procedures, Process:** **Methods, Procedures, Process:** The model creates a digital ecosystem based on the following components: ● **Vendor-Managed Inventory (VMI):** Pre-qualified vendors oversee critical stock levels under VMI agreements to ensure continuity. ● **Real-Time Data Integration:** Inventory is continuously monitored and synced with ERP systems for up-to-date visibility. ● **Blockchain Smart Contracts:** Contracts automate replenishment, delivery confirmation, and payments. A system that removes manual processes and reduces potential disputes. ● **Curated B2B Marketplace Interface:** Energy companies can source from multiple pre-vetted vendors while maintaining quality control. ● **Immutable Transaction Records:** Each step, from product origin to payment, is recorded on the blockchain to ensure full traceability. **Advanced Analytics and ESG Reporting:** The platform provides insights on supplier performance, inventory turnover, and ESG indicators. Supporting continuous improvement and compliance. **Results, Observations, Conclusions:** This blockchain-enabled VMI marketplace can deliver measurable benefits: ● Real-time visibility helps prevent shortages of critical spares and reduces downtime. ● Smart contracts speed up procurement by automatically triggering replenishment and payments, leading to faster and dispute-free transactions. ● Blockchain records manufacturing certifications and product movement to ensure authenticity. ● The marketplace encourages vendor competition and provides sourcing flexibility without compromising standards. The platform is scalable. It starts with high-criticality items and is designed to expand into other product categories, service contracts. Early pilot studies show a 30 to 40 percent reduction in inventory carrying costs and a 25 percent improvement in lead times. Transparent material tracking also improves ESG compliance. The model supports digital transformation and improves supply chain resilience, which aligns with the energy sector’s priorities of operational excellence and sustainability. It can also be adapted to other industries where supply assurance, speed, and transparency are essential. **Novel/Additive Information:** This paper introduces a unique combination of VMI, Blockchain, and Marketplace technologies. Unlike traditional VMI systems or procurement platforms, the integrated model delivers a fully autonomous and transparent digital supply chain. It establishes a new standard for industrial performance and supports the future of energy operations. | |

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| |  |  | | --- | --- | | **Control Number:** | 25ADIP-P-3721-SPE | | **Title:** | Research On Asset Replacement Plan Approach And Results Between 2023 To 2025 | | **Category:** | +8.11 Reliability, Availability, Maintainability, and Inescapability Challenges, Technologies, and Innovative Practices | | **Keyword1:** | Asset Replacement Plan ARP | | **Keyword2:** | Lead Responsible Devision | | **Keyword3:** | ARP master sheet | | **Keyword4:** | ARP Business Process Outline | | **Keyword5:** | Reliability and Integrity | | **Authors:** | A.M. Alhefeiti, M. Alhammadi, ADNOC Offshore | | **Abstract:** | **Objectives/Scope:** • Objectives: To identify the strategy implemented in ADNOC OFFSHORE (AOF) to develop the two years Asset Replacement Plan (ARP) 2023 & 2024 and the way forward on producing 2025 ARP Plan. • Scope: Elevating efforts among all stakeholders to reach the proper approach in developing AOF ARP in 2025. **Methods, Procedures, Process:** • Methods: It is built on condition-based assessments, long term condition plans, fitness for service assessment and obsolescence which focused on eight categories, rotating, instruments & control, electrical, subsea pipelines, static, lifting, telecom and structures. • Procedures: Starting with SAP asset register database, then pinpointing critical assets and assessing conditions based on these assets to advise the Remanent life (RL). • Process: In 2023, considering ARP from different 4 Business Units (BUs), and accordingly unify the ARP Master sheet from different 4 inputs. Furthermore, agreed with BUs on 2023 Business Process Outline (BPO) including ARP Workflow & RACI chart for 2024 ARP onward. **Results, Observations, Conclusions:** • Results: The final report which is issued in 2023 and related to each BUs exercise was the first step up to reach a proper ARP report in 2024. The 2023 Master list including more than 20 thousand Items while it has been reduced to around 11Thousand items in 2024. • Observations: As more we go with ARP exercise, as it is getting better accuracy. As we implemented many lessons learned in 2024 ARP which was not implemented in 2023 such as removing assets with estimation cost less than 50 K $ and shortlisting the items to include only capex replacement but are going furthermore for this year ARP exercise for more lesson learns to be implemented. First, all agreed data on the ARP Master sheet to be filled properly including risk level and cost estimation. Second, Thump rule package estimation cost equation should be utilized for long term ARP list only (more than 11 years). Finally, precise focus is required on the 5-year ARP plan and streamline the way forward of inclusion in AOF Business Plan. • Conclusions: Looking into the approaches and lessons learned during 2023 & 2024 ARP exercise allowing us to prepare much precise AOF ARP in 2025. **Novel/Additive Information:** • Novel/Additive Information: Adding to the previous explanation, we are going to prepare a full day workshop with all stakeholders to update the 2023 BPO and include all concerns which we went through for two years to provide a proper workflow and RACI chart which to be followed accordingly. In addition, using technology privilege on different areas in 2025 like ARP Dashboard, ARP Chatbot, and ARP process platform. | |

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| |  |  | | --- | --- | | **Control Number:** | 25ADIP-P-3725-SPE | | **Title:** | Outage Optimization Of Gas Processing Platform By Installation Of Double Block And Bleed Arrangement | | **Category:** | +8.11 Reliability, Availability, Maintainability, and Inescapability Challenges, Technologies, and Innovative Practices | | **Keyword1:** | Inspection Bottlenecks | | **Keyword2:** | Mitigation Strategies | | **Keyword3:** | Maintenance Efficiency | | **Keyword4:** | Minimize Plant Shutdowns | | **Keyword5:** | Improved Reliability | | **Authors:** | L. Yarlagadda, V. Kumar, M. Debbache, ADNOC Offshore | | **Abstract:** | **Objectives/Scope:** The objectives and scope of this project are centered around addressing the bottlenecks related to plant shutdowns for periodic inspections and endorsements, with the ultimate goal of reducing unplanned plant outages in the future. The hydrocarbon gas from Suction Drum feeds three identical parallel Compression Trains (100MMSCFD) through Recycle Coolers T-104A/B (normally one in operation. The two Recycle Coolers and the Suction Drum are common to all three compression trains. The Recycle Gas Coolers operate together at 50% of total capacity. However each cooler is designed to handle the total flow. hence the segregation of Recycle Gas Coolers needs to be carried out to increase reliability and avoid Unplanned Plant shutdowns. **Methods, Procedures, Process:** The implementation involved several key steps. First, a engineering study was conducted to identify bottlenecks in the plant's shutdown process for inspections. After reviewing various options, a techno-commercial recommendation was made to install double block and bleed arrangement at four locations on the inlet and outlet of the Recycle Gas Coolers for positive isolation. The project scope included procuring and installation of required valves and piping & ensuring that there were no process impact on cooler arrangement. To implement required modification, 7 days plant shutdown was estimated. To avoid any impact on FSOPR mandate, modifications were executed as part of Major Overhaul. **Results, Observations, Conclusions:** Double block and bleed arrangement at four locations were installed for T-104A/B, and the piping was rerouted during the 2025 maintenance shutdown. The addition of double isolation valves enhanced safety and allow for inspection and maintenance of coolers with any business interruption. This implementation improves system reliability and helps prevent future outages. Around USD 18 Millions/ year saving is estimated. **Novel/Additive Information:**  Segregation of recycle gas coolers utilizing unused design capacity improved system reliability, enhanced safety, and reduced future outages during maintenance activities. | |

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| |  |  | | --- | --- | | **Control Number:** | 25ADIP-P-3749-SPE | | **Title:** | Off Design / Off Spec Operation Of Turbo Compressors - Challenges And Mitigation | | **Category:** | +8.11 Reliability, Availability, Maintainability, and Inescapability Challenges, Technologies, and Innovative Practices | | **Keyword1:** | Compressor | | **Keyword2:** | Off design | | **Keyword3:** | Contaminants | | **Authors:** | M. BHATTACHARYA, Petrofac LLC | | **Abstract:** | **Objectives/Scope:** Despite selecting a critical turbo compressor for a designated service and operating window, there have been instances where compressors were operated in off design / off spec conditions. Such situation leads to delay in commissioning and outage of such critical machines . The objective of this paper is to generate awareness and exercise adequate mitigation action during the design and commissioning phase. **Methods, Procedures, Process:** The paper is divided into two parts, each addressing separate approaches: • Off design operating conditions - these include scenarios such as lower gas pressure or molecular weight during commissioning. or operating at choke flow due to malfunctioning recycle valves. • Off spec operating conditions - these refer to the presence of black dust, foulants, chlorides, or wet gas containing CO2. This paper outlines appropriate design considerations to ensure operational reliability under these undesired operating conditions. The paper includes real case studies with incident learnings **Results, Observations, Conclusions:** For off design conditions, such as reduced suction pressure or lower molecular weight, the paper explores reconfiguring the compressor operating map, adjusting vibration parameters, and applying necessary overrides to enable compressor start-up. It recommends configuring the safe operating map to detect low-frequency vibrations, which are early indicators of stall or surge. In cases where the gas contains black dust or has higher moisture content than specified, the paper suggests incorporating labyrinth seals in the rotor design and apply protective coatings to mitigate fouling. For wet gas compression, it outlines how to assess the design for droplet impingement risks and optimize the use of corrosion resistant alloy impellers, especially when dealing with chlorides or aqueous CO2. An extensive operational integrity study of the gas seal system, considering all potential failure modes, has been advised to ensure a robust design. Additionally, start-up requirements, including isolation and depressurization under settle-out pressure conditions, should be factored into the seal system design. **Novel/Additive Information:** Insights gained from operating compressors under such conditions provide valuable knowledge for machinery engineers and operators. This paper offers practical design considerations and recommendations that support objectives of operational excellence which protects the interest of contractor and end user . | |

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| |  |  | | --- | --- | | **Control Number:** | 25ADIP-P-3815-SPE | | **Title:** | Enhancing Reliability In Crude Oil Pipelines Leak Detection: A Case For Integrating Artificial Intelligence With Traditional Leak Detection Systems | | **Category:** | +8.11 Reliability, Availability, Maintainability, and Inescapability Challenges, Technologies, and Innovative Practices | | **Keyword1:** | TRADITIONAL LEAK DETECTION | | **Keyword2:** | ARTIFICIAL INTELLIGENCE | | **Keyword3:** | INTEGRATED LEAK DETECTION SYSTEMS | | **Keyword4:** | RELIABILITY | | **Keyword5:** | SIMULATION AND MODELLING | | **Authors:** | T.T. SHAAPERA, ADNOC Onshore | | **Abstract:** | **Objectives/Scope:** Crude oil transportation through long-distance pipelines has its fundamental risk of undetected leaks leading to production disruption and environmental pollution. While traditional leak detection systems (TLDS) are generally adopted, they have limitations in sensitivity, human error, and leak detection delays in difficult terrains. This paper through reliability modelling and simulation of both TLDS and integration of Artificial intelligence and TLDS (AI-TLDS); puts forward holistic proofs supporting the high reliability of integrated AI-TLDS for energy pipelines. **Methods, Procedures, Process:** The methodology for the study is the reliability modelling of both TLDS and the integrated AI-TLDS, using the continuous-time Markov chain and the monte Carlo simulations (MCS). The MCS is performed using over 10,000 leak scenarios to detect variability in detection times and false alarms on a 48inch oil pipeline with a length of 250km and flow rate of 1 million barrels of oil per day. The continuous time Markov chain was used to validate the results of the MCS providing steady state probabilities and mean time to detection for reach of the scenarios under study. **Results, Observations, Conclusions:** The study demonstrates that integrating AI with traditional leak detection systems significantly enhances reliability and performance compared to conventional methods. The extensive simulations with over 100,000 Monte Carlo iterations accounted for unpredictable variability in leak sizes and environmental noise, ensuring vigorous analysis. To further validate the findings, continuous-time Markov analysis was applied. Each simulation modeled system performs across a five-year span, tracking both time to failure and the duration between leak occurrence and accurate detection. Results revealed that AI-enhanced systems (AI-TLDS) achieved a 20.5% longer meantime to failure, lasting 4.6 years compared to 3.8 years for traditional leak detection systems (LDS), thereby improving system reliability. Additionally, AI-TLDS exhibited a 31% faster detection rate, identifying leaks in 9.1 minutes versus 13.2 minutes for conventional LDS. The false positive rate (FPR) also dropped significantly—52% lower, with AI-TLDS recording 3.9% FPR compared to 8.1%, reducing unnecessary interventions. Other results include 35% improved small leak detection, with AI achieving 88% success versus 65%. In Sensitivity to maintenance, AI performance is optimized with six-month retraining intervals (resulting in a 4.6-year meantime to failure) but still outperforming traditional LDS even with less frequent retraining. The results are discussed in the paper. **Novel/Additive Information:** The study is among the first to apply continuous-time Markov chains and Monte Carlo simulations to compare the reliability of traditional LDS versus AI-integrated LDS specifically for pipeline leak detection. This dual modeling approach is new to the oil sector, where reliability studies often use simpler methods like fault tree analysis or empirical data. Many operators face barriers to AI adoption; therefore, the hybrid approach leverages AI for leak detection while retaining the conventional LDS. | |

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| |  |  | | --- | --- | | **Control Number:** | 25ADIP-P-3907-SPE | | **Title:** | Fiber Glass Sacrificial String For Efficient Set Of Flash Cement Recipe In Drilling Operations: A Case Study On Mitigating Critical Losses In Abu Dhabi Oil Company | | **Category:** | +8.11 Reliability, Availability, Maintainability, and Inescapability Challenges, Technologies, and Innovative Practices | | **Keyword1:** | flash cement recipe | | **Keyword2:** | fiber glass | | **Keyword3:** | sacrificial string | | **Keyword4:** | cure losses | | **Keyword5:** | critical losses | | **Authors:** | A. Amorocho, Abu Dhabi National Oil Company | | **Abstract:** | **Objectives/Scope:** The objective of this paper is to present the effectiveness of using fiber glass sacrificial string beneath steel string to set flash set cement recipes to cure critical losses in the Damman, UER, and Simsima formations while drilling surface casing (17 1/2in or 12 1/4in) in Abu Dhabi Oil company. The application aims to reduce Non-Productive Time (NPT) and enhance drilling performance by reducing the rig cost. **Methods, Procedures, Process:** The methodology involves introducing a fiberglass tubing assembly as a sacrificial string during cementing operations. The tubular assembly will circulate work fluid or cement to the desired position, closer to the problematic zones, to cure critical losses effectively. This method allows the use of flash set cement recipes, which accelerate cement thickening time and reduce the risk of stuck pipes. The process includes running the drill pipe (DP) with the sacrificial string, spotting the cement plug in the critical loss zone, and retrieving the string to the surface. **Results, Observations, Conclusions:** From case studies and practical implementations, the use of fiber glass sacrificial string has shown significant improvements in managing critical losses. Technology has enabled the utilization of flash cement set products and reduced the time required for setting these advanced cement plugs, with each plug taking around 24 to 48 hours compared to the longer durations with traditional methods that require several trips. The approach presents a reduction in NPT by more than 3 days and a cost saving of over USD 150,000 in average for the aquifer section by reducing the rig time and the curing losses materials. There are added benefits for the subsequent efficiency and integrity of the casing running and cementing as the effectiveness of the curing treatment by the placement in front of the aquifer, has facilitated efficient cement bond in these areas with severe losses, improving the quality and longevity of casing cement, and reducing corrosion and other well integrity issues. Additionally, the fiberglass string can be easily drilled out if stuck, without the complexity associated with steel pipes. The adoption of this technology has also led to a decrease in the number of required cement plugs, further optimizing operational costs and safety. **Novel/Additive Information:** This paper presents innovative insights into mitigating critical drilling losses using fiberglass sacrificial string technology used along with aggressive curing losses recipes. The novel approach offers a fast, cost-effective solution adaptable to various drilling environments, adding significant value to the current state of knowledge in the petroleum industry. By sharing practical experiences and results, the paper aims to benefit industry professionals seeking to enhance well integrity and operational efficiency. | |

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| |  |  | | --- | --- | | **Control Number:** | 25ADIP-P-3972-SPE | | **Title:** | Optimizing Equipment Uptime: A Data-driven Approach To Mean Time To Repair And Downtime Reduction | | **Category:** | +8.11 Reliability, Availability, Maintainability, and Inescapability Challenges, Technologies, and Innovative Practices | | **Keyword1:** | Data-Driven | | **Keyword2:** | Optimization | | **Keyword3:** | Maintenance | | **Keyword4:** | MTTR | | **Keyword5:** | Reliability | | **Authors:** | R. Al Balushi, Petroleum Development Oman | | **Abstract:** | **Objectives/Scope:** This work critically examines the challenges in defining and collecting equipment downtime data, particularly Mean Time to Repair (MTTR), within industrial operations. It aims to highlight inconsistencies in MTTR interpretation and proposes a data-driven approach for optimizing MTTR, exemplified by gas well choke valves, to minimize production losses and enhance operational efficiency. The study underscores the importance of standardized data practices for reliable performance assessment. **Methods, Procedures, Process:** The methodology integrates a critical review of existing literature and standards, such as ISO 14224, to analyze inconsistencies in maintenance data collection, particularly for terms like MTTR. This is complemented by a data-driven approach applied to a specific case study of gas well choke valves. This involves collecting and analyzing historical failure and repair data, performing root cause analysis to identify factors contributing to prolonged repair times, and developing a tailored optimization framework. This framework includes proactive maintenance strategies, streamlined repair processes, and improved documentation access to enhance reliability. **Results, Observations, Conclusions:** In the Last 3 years the Gas unscheduled deferment data contributed by Chock valve failure increased to 20 MMCSM due to delay in MTTR. Looking into history, on average 45 days are taken starting from Chock valve failure, logistics, dismantling, placing material order, repair and Installation. This complexity, overprocessing and delay in repairing of chock valve leads to major delay in MTTR which consequently delays the start-up of wells and increase in unscheduled deferment. As per root cause analysis conducted, the initiator of the delay occurred due to the absence of critical valve documents and the manual conventional way of providing datasheets and General arrangement drawings GAD. A survey was conducted for more than 600 wells chock valves to identify their serial number and have database to map common valves manufacturer with the right datasheet and GAD. The automated tool will be used to map different valve types with their respective datasheets and GADs. This tool will significantly reduce the period of ordering destructed parts of chock valve from original Equipment manufacturer OEM. Additionally, the intervention and time by operation team to provide missing documents will be eliminated. **Novel/Additive Information:** This research provides a novel synthesis by linking the critical examination of downtime terminology (as per ISO 14224) with a practical, data-driven optimization framework for gas wells. It uniquely highlights the direct impact of standardized documentation and data accessibility on reducing repair times and production losses, The estimated potential saving is approximately 6.9 MMCSM of unscheduled gas deferment annually if it is deployed in all PDO gas facilities. | |