

STRUCTURAL RISK-BASED INSPECTION (RBI)

for

OFFSHORE ASSET LIFE EXTENSION STUDY (ALES)

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PREFACE

The field of offshore structural integrity has undergone substantial evolution over recent decades, driven by the need for more advanced, reliable, and cost-effective approaches to risk assessment, inspection, and maintenance. This book presents a comprehensive and practical framework that integrates modern engineering principles with established reliability models, offering a systematic methodology for managing offshore structural assets throughout their lifecycle.

Beginning with an in-depth introduction to the Structural Integrity Management System (SIMS), the book outlines a structured methodology for fixed offshore jacket structures that encompasses baseline data analysis, trend evaluation, and prioritisation techniques for identifying critical structural vulnerabilities. The core of this work expands on the Risk-Based Inspection (RBI) philosophy, ensuring that inspection planning is grounded in quantified risk metrics, thereby enhancing resource efficiency and optimising maintenance interventions.

Chapters dedicated to non-linear pushover analysis and probabilistic failure modelling provide rigorous insight into structural performance. Readers are guided through methods for calculating key indicators, such as the Reserve Strength Ratio (RSR) and Probability of Failure (POF), which support informed decision-making based on high-fidelity assessments. The integration of Consequence of Failure (COF) analysis further enables a balanced understanding of overall risk exposure and its implications for asset management.

In addressing asset life extension, the book offers advanced methodologies for continuous risk monitoring, reduction strategies, and corrective maintenance planning. These are essential tools for sustaining the performance of ageing offshore platforms while maintaining safety, reliability and regulatory compliance. Practical case studies drawn from real-world scenarios reinforce theoretical concepts, offering actionable insights and benchmarking opportunities for industry practitioners.

Drawing on over two decades of experience in offshore asset integrity management, this book bridges the gap between academic research and industry practice. It is designed as a valuable reference for engineers, technical specialists, and researchers committed to implementing reliability-centred strategies in offshore structural inspection and maintenance.

CHAPTER 1

INTRODUCTION

The assessment of ageing assets is a critical component of asset integrity management, necessitating a structured and systematic evaluation of the asset's current condition, identification of operational and structural risks, and the implementation of targeted mitigation strategies. This process ensures sustained, safe and efficient operations, aligning with industry standards and regulatory requirements to minimise downtime, optimise performance and extend the asset's lifecycle.

The Matured Field Operation Model (MFOM) (Malaysia Petroleum Management, 2019), a well-established industry framework, serves as the foundation for this evaluation. MFOM encompasses a holistic approach to asset optimisation, integrating reservoir management, production efficiency strategies, and infrastructure maintenance to support the continued viability of oil and gas fields. Its primary objective is to ensure reliable and secure oil and gas production while adapting to the constraints imposed by the remaining duration of the Production Sharing Contract (PSC).

Through proactive risk mitigation, operational optimisation and strategic planning, MFOM enables operators to maximise asset value retention, minimise production losses and ensure long-term field integrity. This framework is instrumental in sustaining economic viability by addressing challenges such as declining reservoir performance, ageing infrastructure, and regulatory compliance while maintaining alignment with evolving industry best practices.

OVERVIEW OF ASSET LIFE EXTENSION

The expiration of the Production Sharing Contract (PSC) contributes to long-term planning challenges, hindering the ability to undertake substantial expenditures. Nonetheless, the necessity to sustain production, ensure safety, and preserve system integrity remains essential. The MFOM framework seeks to address these difficulties by:

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Among the elements discussed in the book are:

- Structural Integrity Management System (SIMS)
- Risk-Based Inspection (RBI)
- Quantified Risk Assessment (QRA)
- Risk-Based Inspection for Structural Integrity
- Risk Matrix for Scour, Flooded Member, Marine Growth, Settlement, Cathodic Protection
- Material Properties
- Consequence of Failure (COF)
- Pushover Non-Linear Analysis
- Reserve Strength Ratio (RSR)
- Air Gap Analysis
- Probability of Failure (POF)
- Standard Inspection Interval
- Standard Criteria for Structural Platforms
- Risk Monitoring
- Risk Mitigation
- Corrective Maintenance
- Structure Strength versus Operation Time
- Case Study for POF

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