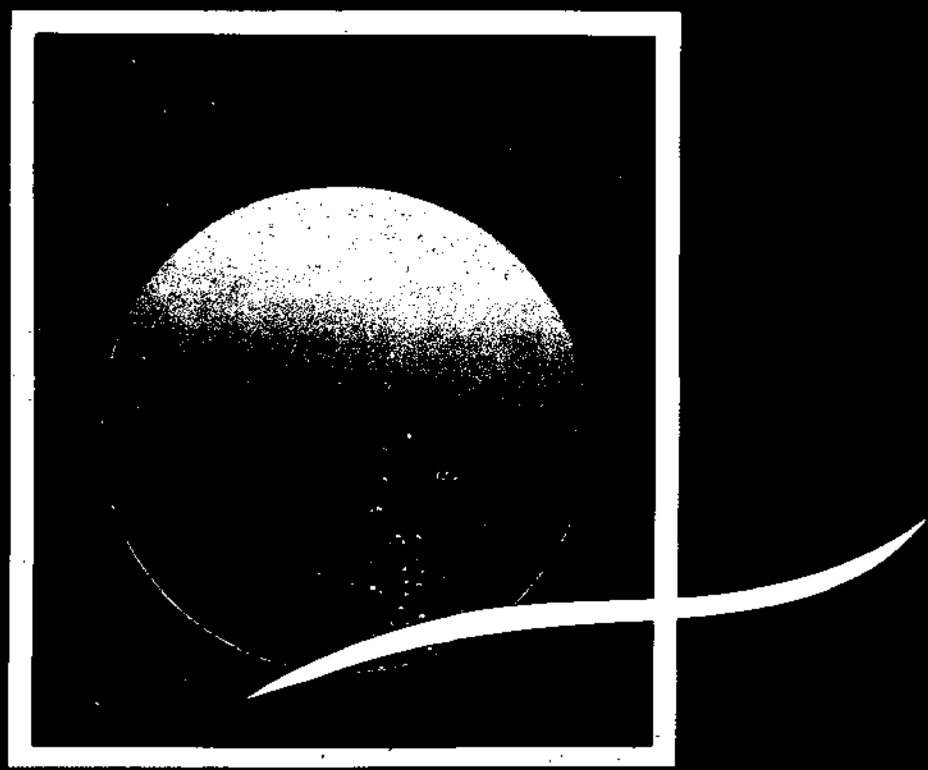
Underwater inspection of steel offshore installations: implementation of a new approach



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Underwater inspection of steel offshore installations: implementation of a new approach

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THE MARINE TECHNOLOGY DIRECTORATE LIMITED

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Foreword

The project leading to this report was undertaken by UEG using technical services contractors for each of the seven studies directed at meeting the overall objectives. The studies and their contractors are given in Section 1.3. During the course of the work the UEG Project Managers were R.J. Simpson, R.K. Venables and R.W. Barrett.

The project was funded by the following participants:

American Bureau of Shipping
Britoil Plc
British Gas Plc
BUE Group
Comex Houlder Ltd
Conoco (UK) Ltd
The Department of Energy (UK)
Det norske Veritas
Earl & Wright Ltd
Elf UK Plc
Exxon Production Research Company
Harwell Laboratory
McAlpine Sea Services Ltd
Marathon Oil Company
Maersk Olie og Gas A/S
Minerals Management Service, US Department of the Interior
Norwegian Petroleum Directorate
OSEL Group
Petroleo Brasileiro S.A.
Phillips Petroleum Company UK Ltd
SonSub Services Ltd (formerly Sonat Subsea)
Joint Swedish Group
US Coast Guard
Wimpey Offshore

A Steering Group, comprising representatives of participants, UEG and the technical services contractors, provided the forum for discussion and commented on this report prior to publication. During the course of the project the Steering Group comprised:

Participants

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	Mr. D. Stannard
	Mr. S. Walker

Project management †

Mr. R.J. Simpson *	Project Manager (to Dec 86)
Mrs. L. Negus *	Project Administrator (to Sept 87)
Mr. R.K. Venables	Steering Group Chairman and Project Manager (to Dec 87)
Mr. R.W. Barrett	Steering Group Chairman and Project Manager to completion

* No longer at this organisation

† During the course of the project, UEG staff

Summary

This report is the outcome of a major joint industry sponsored project initiated by UEG. Its overall aim is to improve the effectiveness of underwater inspection of offshore installations, particularly through the use of a more rational method of planning inspection operations. The heart of this method is that that an installation owner should be provided with a level of confidence in the condition of each component of the installation commensurate with the consequences of failure of that component.

After an introductory Part which outlines this method and sets it in the context of other inspection planning philosophies, major chapters of a second Part review and discuss:

- types of damage and deterioration
- applying the proposed inspection planning method to existing installations
- the management of inspection operations offshore
- inspection operations – including inspection methods, cleaning, intervention and monitoring
- the assessment of any damage found.

A final Part discusses the adaptation of the proposed planning method to the design of new installations, and suggests how attention to detail design of new structures can ease the practical tasks of underwater inspectors in future.

Contents

PART B:
EFFECTIVE IMPLEMENTATION

PART C:
INTERACTION BETWEEN DESIGN AND INSPECTION

TABLES

FIGURES

1 Introduction

1.1 BACKGROUND TO THE PROJECT

Underwater inspection and defect assessment are of great concern to all involved in ensuring the long-term integrity of offshore installations. Over the years since first gas and then oil were developed from North Sea fields, the offshore industry has made substantial technical progress and gained considerable experience of structural inspection under water and of defect assessment.

The industry drew on experience gained on offshore installations elsewhere in the world but, as in many other facets of North Sea operations, the harsh environment there has led to stringent inspection requirements and associated technical advances. The industry has also drawn on the considerable research and experience of non-destructive testing and defect assessment in the nuclear and aircraft industries.

And yet, despite these advances, it was clear that many questions – some of fundamental importance to improving the effectiveness of underwater inspection – remained:

- What items should be inspected and how often?
- Will defects be recognised when they are 'seen'?
- How are the items to be inspected to be selected?
- What is the smallest detectable defect?
- How frequently should we inspect?
- How does the design, and particularly the estimated fatigue life of particular structural elements, affect the need for, and the objective, nature and frequency of any inspection.
- What type and size of defect is sufficiently small not to jeopardise the continued safety of an installation?
- What is the significance of a given defect in a given position?
- How does the underwater environment affect the feasibility, accuracy and frequency of any inspection?

UEG was, from the start of its work on offshore structures, actively involved in many aspects of in-service performance of installations. In 1978, still the 'early days' of North Sea development, UEG published its Report UR10 'Underwater inspection of offshore installations: guidance to designers'[1.1] which addressed and provided recommendations on actions which designers could take to ease and reduce the underwater inspection of the installations they design. Its recommendations remain remarkably pertinent today.

Whereas UR10 concentrated on design detailing, this project addressed broader issues of philosophy behind inspection planning and how a new approach could be brought to inspection of existing structures as well as to the design of new structures.

With that background, UEG set up the project which has led to this report. The aims were:

- to provide a forum for offshore industry representatives to discuss and develop a cogent philosophy for the underwater inspection of offshore installations and pipelines
- to prepare detailed practical guidance to match the results of the first objective.

1.2 SCOPE AND LIMITATIONS

The ensuing project was targetted at the underwater inspection of installations world-wide, drawing on the extensive experience already gained in the major offshore oil and gas production areas. It was aimed to cover all types of installations, and concrete platforms were the subject of one of the studies within the project – see Section 1.3.

This report, however, concentrates on providing analysis, a new approach and practical guidance on the underwater inspection of steel offshore installations. The majority of the report concentrates on fixed structures, with relevant comments added on the special considerations for some other kinds of installations. Within the studies related to steel structures, advice was sought on aspects of inspection appropriate to different types of installations as follows:

- fixed steel tubular structures
- floating structures moored long term on station
- tethered buoyant platforms
- production risers, fixed and compliant
- pipelines
- subsea installations.

The project was undertaken by UEG using technical services contractors for seven studies – see Section 1.3. The project was funded by a group of interested organisations, including oil companies, governments, contractors, designers, suppliers and a certifying authority.

A Steering Group comprising contributors' representatives, UEG staff and representatives of the technical services contractors provided the forum for discussion and commented on this report prior to its circulation to contributors. UEG were project managers and provided the Chairman of the Steering Group.

1.3 STUDIES WITHIN THE PROJECT

Several studies have been undertaken within the project, all directed towards meeting the overall objectives and the preparation of this and other reports. The seven studies and their technical services contractors were:

Study One: Methods of underwater inspection and intervention for steel structures and subsea installations – Inspection Integrity Quest Partners

Study Two: Interaction between design and inspection of steel structures – Earl & Wright Ltd

Study Three: Inspection of concrete structures – McAlpine Offshore Ltd

Study Four: Damage assessment – Wimpey Offshore

Study Five: Management of resources and manpower planning – Thalassa Advanced Technologies Ltd

Study Six: Significance and inspection of marine fouling – Aberdeen University Marine Studies Ltd

Study Seven: The potential for probabilistic methods in underwater inspection – A/S Veritas Research.

Apart from the individual study contractors, considerable additional input was provided by Mr J de Prey of UEG in preparing Chapter 6.

Reviews and appraisals of various chapters were undertaken by Mr R D Allen of ATOM and Mr J Bevan of Submex Ltd.

The whole report was technically edited and prepared for printing by Mr M J Wright of Techword Services.

1.4 LAYOUT OF THIS PROJECT REPORT

This report is presented in three distinct but complementary parts:

- *Part A: The need for change and the basis of a new approach* – is aimed at all readers interested in improving the effectiveness of underwater inspection. It reviews the motivations behind inspection planning appropriate to different structures and circumstances, reviews current practice (and its limitations), analyses the need for a more rational approach and a number of alternatives, and finally presents the basis of a new, more rational approach to inspection planning.
- *Part B: Effective implementation* – reviews damage and deterioration, provides practical guidance in the management of inspection (including implementation of the new approach to inspection planning outlined in Part A), provides practical guidance on inspection and monitoring operations, including inspection methods, cleaning, intervention methods and monitoring, and concludes with a major section on the assessment of damage.
- *Part C: Interaction between design and inspection* – discusses the adaptation of the principles developed in Part B to the design of new structures. Aspects of design detailing to ease the practical tasks of inspection are also addressed.