Guidelines for caisson life cycle integrity management

energy institute

GUIDELINES FOR CAISSON LIFE CYCLE INTEGRITY MANAGEMENT

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This publication has been produced as a result of work carried out within the Technical Team of the EI, funded by the EI's Technical Partners. The EI's Technical Work Programme provides industry with cost-effective, value-adding knowledge on key current and future issues affecting those operating in the energy sector, both in the UK and internationally.

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CONTENTS

Page

Contents continued

LIST OF FIGURES AND TABLES

Page

Figures

Tables

FOREWORD

This publication has been produced directly by the Energy Institute (EI) Ageing and Life Extension Committee (ALECOM) with technical drafting and editing by Wood. The intention of this publication is to provide guidance for the life cycle integrity management of caissons in order to facilitate good practice throughout the industry.

The guidance introduces the topic of caisson life cycle and how to address caissons within the integrity management system. It provides guidance and information on associated inspection techniques, risk assessment approaches, caisson design and analysis and brownfield repair. A number of case studies are included in an Annex A to share experienced failures in the field and the resulting lessons learned.

Although it is anticipated that following this publication will assist those involved in the maintenance and operation of ageing structures, the information contained in this publication is provided as guidance only. While every reasonable care has been taken to ensure the accuracy of its contents, the EI, and the technical representatives listed in the acknowledgements, cannot accept any responsibility for any action taken, or not taken, on the basis of this information. The EI shall not be liable to any person for any loss or damage which may arise from the use of any of the information contained in any of its publications.

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1 INTRODUCTION AND SCOPE

1.1 BACKGROUND AND SCOPE

Caisson failures continue to represent a major economical, operational and safety risk to most offshore operator companies. These risks can be multiplied by the large number of caissons often present across a fleet of assets. The consequences of caisson failure vary and in the worst cases can lead to production deferment, damage to the jacket structure, or hydrocarbon release. When required, caisson repairs are often carried out on a reactive basis with limited options available; these repairs typically involve installation of external clamps, wraps, or internal swage liners. Where subsea intervention is required to facilitate installation of the repair, costs can quickly escalate into the order of £1M. In some instances, complete removal and replacement of the caisson is the only viable option. In the context of ageing and life extension (ALE), large scale caisson repair and replacement programmes are often required. Caissons can also suffer from accelerated ageing effects meaning that consideration of caisson management on newer installations is required.

Therefore, life cycle integrity management of caissons is extremely important. The successful delivery of which relies upon numerous aspects, including:

- knowledge of caisson inventory and design;
- a thorough understating of the role that individual caissons play in platform operations;
- a detailed and specific risk assessment;
- appropriate inspection planning, execution, and anomaly sentencing;
- tracking anomalies as a system of threats rather than individually;
- the ability to carry out appropriate structural assessments;
- knowledge of in-service repairs and replacement design/installation in a brownfield environment, and
- feedback into greenfield caisson designs.

The scope of this document is to provide guidance on life cycle management of caissons in order to facilitate good practice throughout the industry.

This guidance should be read in conjunction with *Guidance for corrosion management in oil and gas production and processing.*

1.2 INDUSTRY RESPONSE

The industry first became aware of caisson issues in the early 90s, as a result of a number of failures. In the following years caisson integrity became firmly established as an industry-wide issue. In 2009 various industry surveys were carried out to determine the extent of the issue; typically these surveys found that approximately 30–50 % of caissons had integrity issues. This percentage will have increased through time.

During this time the industry was focused on Key Programmes (KP) of the Health and Safety Executive (HSE) – KP3 and KP4. KP3 ran from 2004–2007 and focused on asset integrity. Subsequently KP4 ran from 2011 to 2013 with a focus on ALE. While these did not explicitly

cover caissons, they highlighted the importance of structural integrity management to asset integrity and gave focus to knowing the condition of platform infrastructure and what this means in terms of ageing. Oil and Gas UK (OGUK) published its HS086 *Guidance on the management of ageing and life extension of offshore structures* in 2014, which provided a discussion on caissons' threats, risk assessment and prioritisation. Also, in 2014 HOIS issued *Guidance on in-service inspection and integrity management of caissons*.

1.3 CAISSON DESCRIPTION

Caissons typically extend down from the topside into the sea water below, enabling the discharge of fluids, receipt of sea water, or to act as a conduit for risers or other similar infrastructure. They are not pressure retaining but do act as a barrier against environmental loading. Caissons are considered as structural items and fall under the remit of the structural integrity management (SIM) system. Note that input from various disciplines e.g. corrosion, materials, and mechanical are also often required to support caisson integrity.

Table 1 highlights common types of caisson.

Table 1: Common caisson types

Caisson type	Example	Production critical	Safety critical	Operations support
Pump caissons	Sea water lift	✓		
	Firewater lift		✓	
Discharge caissons	Hazardous and non-hazardous drains			✓
	Drill cuttings			✓
	Water overflow	✓		
Carrier caissons	J/I-tube caissons	✓	✓	✓
	Riser caissons	✓	✓	