Geoff MacAngus-Gerrard

Offshore Electrical Engineering Manual

Second Edition

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Notice From the Author

No book is a substitute for common sense and a thorough understanding of the particular installation design.

However, not all safety, reliability or maintenance problems can be detected or resolved easily and it is hoped that this book will be a useful tool in their detection and resolution.

BP's New FPSO Glen Lyon *(Courtesy BP)*

Preface to Second Edition

Many things have changed in the oil and gas industry since the first edition was published in 1992, four years after the Piper Alpha disaster.

Chief among these were the changes in the UK statutory legislation following on from Piper Alpha. Regrettably, I was too busy at the time to carry out the necessary revisions to this book, but now have the opportunity as I approach retirement to rectify that omission.

The change of name to 'Manual' reflects the intention to avoid covering theoretical material covered well in university courses, but to concentrate on the practicalities and precautions necessary to create an electrical design which has all the attributes expected of it in today's world, i.e., safe to use and maintain, robust in harsh conditions, reliable, efficient and environmentally sound.

I hope readers will appreciate the following significant content changes, which reflect the new offshore regulations, or have become necessary because of the modern information technology. These are as follows:

1. The addition of material related to the UK Offshore Safety Case and PFEER Regulations,
2. The addition of a section on offshore wind farms and their (offshore) substations,
3. The use of weblink references where possible,
4. Because of the constant revisions to standards, dates of standards are no longer quoted unless unavoidable,
5. At the time of writing, the IEE Recommendations for the Electrical and Electronic Equipment of Mobile and Fixed Offshore Installations, which has served us well over the years, is about to be superseded by a UK harmonised version of BS EN 61892, and this is reflected in the new text.

I look forward with interest as to what 'BREXIT' and the other global political upheavals create, but I am hopeful that the drive towards global harmonisation of standards will continue.

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FIRST EDITION, OFFSHORE ELECTRICAL ENGINEERING (SEE REVISION NOTES)

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REVISION NOTES

1. Now part of Kvaerner
2. Now part of the Hubbell Group
3. Now part of Mott MacDonald
4. Now Wood Group PSN Ltd
5. GEC and Alsthom are now part of the US company General Electric (GE)

6. Hill Graham (Ansaldo) became part of the Robicon Corporation and acquired Siemens Energy and Automation Inc.
7. The Marine side of Rolls-Royce no longer produces Aero-Derivative Gas Turbine offshore packages
8. Sun Oil has pulled out of the United Kingdom and the Balmoral semisubmersible is operated by Premier Oil UK
9. Now part of the Zumtobel Group
10. Now part of Aker Solutions

SECOND EDITION, OFFSHORE ELECTRICAL ENGINEERING MANUAL

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PART

Introduction and Scope

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CHAPTER

The Offshore Electrical Dimension

1

INTRODUCTION

Designing for provision of electrical power offshore involves practices similar to those likely to be adopted in onshore chemical plants and oil refineries. However, other aspects peculiar to offshore oil production platforms need to be recognised. It is suggested that those unfamiliar with offshore installations read the brief guide in PART 6 of this book before continuing further.

The aspects which affect electrical design include the following:

1. The space limitations imposed by the structure, which adds a three-dimensional quality to design problems, especially with such concerns as
   - a. hazardous areas
   - b. air intakes and exhausts of prime movers
   - c. segregation of areas for fire protection
   - d. avoidance of damage to equipment due to crane operations
2. Weight limitations imposed by the structure which require
   - a. The careful choice of equipment and materials to save weight.
   - b. The avoidance of structurally damaging torques and vibrations from rotating equipment.
   - c. The inherent safety hazards presented by a high steel structure surrounded by sea. Such hazards require
     - i. Particular attention to electrical shock protection in watery environments
     - ii. Good lighting of open decks, stairways and the sea surrounding platform legs
     - iii. Protection of materials and components from the corrosive marine environment and avoidance of stray corrosion cells due to contact between dissimilar metals

MARINE ENVIRONMENT

Wave heights in the North Sea can exceed 20 m, with wind speeds exceeding 100 knots.

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HAZARDS OFFSHORE

GAS

Accumulation of combustible gas can occur on an offshore installation from various sources, including the following:

1. Equipment and operational failures such as rupture of a gas line, flame out of an installation flare, a gland leak, etc.
2. Gas compressor surge/vibration causing failure of pipe flanges, loss of compressor seal oil, etc.
3. Drilling and workover activities.
4. In concrete substructures, the buildup of toxic or flammable gases due to oil stored in caisson cells.

CRUDE OIL AND CONDENSATES

1. Equipment and operational failures such as the rupture of an oil line, a gland leak, etc.
2. The high pressures involved in some cases could cause spontaneous ignition because of the electrostatic effects.

OPERATIONAL HAZARDS

1. Apart from the fire and explosion hazard of process leaks, there is a hazard to personnel purely from the mechanical effects of the leak jet and the sudden pressure changes caused by serious leaks in enclosed compartments.
2. Care must be taken in the siting of switchrooms, generator sets and motor drives to minimise the risk of damage due to crane operations, especially if sited near drilling equipment areas where heavy pipes and casings are being frequently moved.

ELECTRICAL SYSTEM DESIGN CRITERIA

The purpose of any offshore electrical supply system is to generate and distribute electricity to the user such that

1. power is available continuously at all times the user's equipment is required to operate,
2. the supply parameters are always within the range that the user's equipment can tolerate without damage, increased maintenance or loss of performance,
3. the cost per kilowatt hour is not excessive taking into consideration the logistical and environmental conditions in which generation and distribution are required,