Load Factor Study for API Recommended Practice 2A-LRFD

API TECHNICAL REPORT 2A-LFS
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Suggested revisions are invited and should be submitted to the Standards Department, API, 200 Massachusetts Avenue, NW, Suite 1100, Washington, DC 20001, standards@api.org.

Executive Summary

The motivation for this study is to evaluate the suitability of the load factors in API 2A-LRFD 1st Edition (1993) given the accumulated experience since the 1980s about hurricane hazards and platform performance. The specific objectives of this study are:

1) Review the methodology and analyses used in the 1980s to develop the load factor in the API 2A-LRFD 1st Edition and compare its methodology with the methodology presented in ISO 19902 (2007).

2) Analyze the component reliability levels with the improved understanding of hurricane hazards and platform performance and assess the effect of load factors on the component reliability.

3) Analyze the system reliability levels for three case study platforms that are being used to guide development of API 2A-LRFD 2nd Edition and assess the effect of load factors on the system reliability.

4) Provide design considerations when determining the load factors to be used in API 2A-LRFD 2nd Edition.

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1 Introduction

1.1 Background

The American Petroleum Institute (API) published the 1st Edition of the Load and Resistance Factor Design (LRFD) guideline, i.e. API 2A-LRFD (1993), in 1993 after about 10 years development and calibration work through the 1980s. The LRFD-format was intended to improve the conventional Working Stress Design (WSD) format in the following ways (Lloyd and Karsan 1988, Moses 1981, Moses and Russell 1980, Moses 1986, and Moses and Stahl 2000): (1) produce more uniform reliability levels by using load and resistance factors that account for the relative variability in the load and resistance; (2) provide greater flexibility to incorporate new technological findings and extend existing experience to new geographic areas and new platform types; and (3) keep pace with modern code development in other engineering applications.

Although API 2A-LRFD (1993) was widely recognized and had a significant influence on the development of the International Standard ISO 19902, it was not used commonly in the United States and was withdrawn in 2012 due to a lack of maintenance. API 2A-LRFD was re-introduced in 2014 as a draft 2nd Edition in an effort to align and merge the API and ISO standards as a single global standard (Ku and Farrel 2014). The motivation for this study is to evaluate the suitability of the load factors in API 2A-LRFD (1993) given the accumulated experience since the 1980s about hurricane hazards and platform performance.

1.2 Report Contents

This report contains six chapters and two annexes.

Chapter 1 summarizes the development of the LRFD-format for design fixed offshore platforms and describes the motivation and objectives of this study.

Chapter 2 presents basic design check equations for the WSD- and LRFD-formats and compares the calibration methodologies in API 2A-LRFD 1st Edition and ISO 19902.

Chapter 3 reviews the characterization of wave load uncertainty in the development of API 2A-LRFD 1st Edition and updates this characterization based on our current understanding of hurricane hazards.

Chapter 4 assesses the reliabilities achieved in the design of components using both the WSD- and LRFD-formats and investigates the effect of the environmental and gravity load factors on the reliability levels achieved for different components.

Chapter 5 assesses the component and system reliabilities for three case study platforms (3-leg, 4-leg, and 8-leg) and investigates the effect the environmental load factor on the system reliability.

Chapter 6 presents conclusions because of this work.

Annex A presents the detailed analyses of the reliability levels of each component.

Annex B presents the assumptions, models, and input parameters for the reliability analyses of the case study platforms.