# METHODOLOGY FOR ASSESSMENT BY REGULATORY BODIES OF THE SAFETY OF EXISTING STEEL OFFSHORE PLATFORMS

by

Rajiv Kumar Aggarwal

Supervised by

B. C. Gerwick, Jr.
R. G. Bea

DEPARTMENT OF CIVIL ENGINEERING
UNIVERSITY OF CALIFORNIA, BERKELEY

December 1991

Methodology for Assessment by Regulatory Bodies
of the Safety of Existing Steel Offshore Platforms

Rajiv Kumar Aggarwal

## ABSTRACT

This dissertation focuses on the development of a methodology for assessment of the safety of existing steel jacket platforms. The primary focus of this study has been on a methodology that can be used by regulatory bodies, owners, and operators to assess the safety of the offshore platforms located in the Gulf of Mexico.

The safety assessment of ageing offshore platforms has become of increasing importance in the recent years in the United States and worldwide in order to ensure their safe operation and continued production of crude oil and gas. This has created a dilemma for the government regulatory bodies, owners, and operators in the United States, where a major number of platforms exist. In recent years, their interest in maintaining the safety of offshore platforms against loss of life, environmental pollution, and loss of resources and property has increased due to the awareness of the public of the consequences of their failure.

Regulatory bodies, such as the Minerals Management Service (MMS) established in the United States, have a role to play to ensure that the structures operating in the offshore waters are safe to life, environment, property and loss of production. However, they do not have a methodology to make such routine assessments for the more than 4,500 platforms operating in the Gulf of Mexico.

In this study, a 4-cycle screening methodology has been developed for making routine assessments of the safety of platforms against storm wave loads. Simplified techniques have been developed for platform capacity evaluation which will be of special importance for identification of potentially critical platforms. Judgements on their safety can be made based on a probabilistic approach, which utilizes the nominal estimates and the uncertainties in the load, strength, and consequences of the failure of a platform.

Although the emphasis of this research is on safety assessment of the Gulf of Mexico platforms against the storm wave loads, the principles and theoretical background developed will be of use for assessment of the offshore structures in other areas and against other load sources.

The ideas developed in this study could also be utilized in the re-qualification and rehabilitation of other civil engineering structures. In the State of California, CALTRANS, a government body, needs a process to evaluate the safety of more than 9,000 existing bridges. There have also been increased concerns for safety of public buildings, and other important civil structures.

This research is believed to be timely, and of importance to regulatory bodies, owners, and operators of offshore platforms.

Ben C. Gerwick, Jr.

Prof. Ben C. Gerwick
Co Principal Investigator

Prof. Robert G. Bea
Co Principal Investigator

My education at UC Berkeley would not have been complete without the excellent courses from Profs. R. L. Wiegel, J. R. Paulling, W. C. Webster, V. E. Cole, A. DerKieureghian, A. K. Chopra, G. Powell, and W. Hester (deceased).

A number of organizations have provided the financial support for this work. This work is a result of research sponsored in part by NOAA, National Sea Grant College Program, Department of Commerce under grant number NA 89 AA-D-SG138, project number R-OE/11, through the California Sea Grant College Program, and in part by the California State Resources Agency. The U.S. Government is authorized to reproduce and distribute for governmental purposes.

In addition, this project has been sponsored by the Technology Assessment and Research Program of the Minerals Management Service (MMS), California State Lands Commission, Phillips Oil Company, and Chevron Oil Company. Background information and examples for this research were made available from the Joint Industry Project "AIM."

The support, advice, and contributions provided by the MMS (Charles Smith), California State Lands Commission (Martin Eskijian), California Seismic Safety Commission (Dick McCarthy), Shell Oil Company (Kris Digre), Marathon Oil Company (Ron Antes, Jim Saunders), Chevron Oil Company (Bill Krieger) are gratefully acknowledged. The discussions held with Royal Dutch Shell (J.W. van de Graff, P.S. Tromans), Belmar Engineering (Bob Visser), and Oceaneering-Solus Schall (Jim Donnelly) were of direct use.

I would like to extend my gratitude to Prof. Torgeir Moan (Norwegian Institute of Technology) for his interest in my work, discussions at U.C. Berkeley, for my previous education at his institute, and for providing the results of his research in the area of safety and reliability assessment.