Introduction

During the past decade the offshore industry has made significant advances to eliminate uncertainties and reduce conservatism in the design and operation of offshore structures. One of these advances is in the application of fracture mechanics procedures. Fracture mechanics is currently used in the design stage of offshore facilities to provide the basis for fatigue life prediction, steel selection and allowable weld imperfections. It is also used during the operational stage to make decisions on inspection and repair strategies, and to establish limits on operating conditions. However, the application of fracture mechanics to offshore structural components is complicated due to the three dimensional and mixed mode nature of stress state, the presence of material inhomogeneities such as local brittle zones in an otherwise highly tough material, and the introduction of complicated residual stress distributions during fabrication. These are in addition to the probabilistic nature of the applied loads.

In recognition of the importance of fracture mechanics to offshore developments a special session on the state of the art of fracture mechanics technology and its applications in the offshore industry was organized during the Seventh International OMAE Conference and Exhibit, February 7–12, 1988, Houston TX. The session includes six invited papers that were prepared by leading authorities on the subject. The first paper discusses the general aspects of the offshore fracture mechanics technology. Starting from a critical review of the current status of offshore structural fracture mechanics technology, it identifies fracture mechanics problems and suggests approaches to effectively deal with them. The second paper proposes the approach of linking a fracture mechanics fatigue analysis system for offshore structures with CAD/CAM to handle complex interacting problem posed by structural design, fabrication, and service. Such a possibility is hinged on fast modelling and analysis capability of a fracture mechanics analysis system. The feasibility of the approach is demonstrated by fatigue analysis of a tubular joint. The third paper treats the failure assessment diagram method as a tool for crack instability analyses of structural components. The failure assessment diagram method can provide a practical means for the crack instability analyses in complex offshore structures. The fourth paper provides an extensive review on probabilistic fracture mechanics and its application to offshore structures. The fifth paper deals with pipeline rupture problems. Based on the results of full scale tests on pipes, the fracture behavior of pipeline under rate high loading conditions is studied. The sixth paper reviews recent advances in fracture mechanics activities in Japan as applied to the offshore industry.

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