Advances in Structural Reliability

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ABSTRACT

This paper provides an overview over the developments of Structural Reliability applied to nuclear structures as presented during SMiRT Conferences. Early developments date back to SMiRT 2, held in Berlin in 1973. This review addresses methods and procedures of structural reliability, of stochastic structural dynamics and its applications in earthquake engineering, of stochastic fracture mechanics, load combination, structural fragility and damage analysis, quality assessment and probability based codified design. The Division covers theoretical developments as practical applications to nuclear structures and components. It is pointed our that structural reliability estimation of nuclear structures is a necessary prerequisite for performing a credible risk analysis.

1. INTRODUCTION

In view of the need to *quantify* the reliability of structural components e.g. in context with risk analyses, an entire Division is devoted to this subject since SMiRT-7, held in Chicago in 1983 [1] under the chairmanship of the late *Stanley Fistedis*. The initiation of this Division M was preceded by a series of three SMiRT Post Conference Seminars, devoted to the same subject, in 1977, 1979 and 1981 [2, 3, 4]with steadily increasing participation. It is interesting to note, that the late *Th.A. Jaeger* [5] also pointed out - quite at an early stage - the importance of structural reliability analyses as a basis for reactor safety studies. Already around this time and the following SMiRT Conferences, *Karl Pister* and *Sam Key*, the Division Coordinators of the preceding Division M- which then covered the field of Structural Analysis - devoted always a number of Sessions within their Division to Stochastic Methods in Structural Analysis as well as to Structural Reliability. Based on all these efforts - as mentioned above - the new Division M emerged. This Division contributed quite successfully to the subsequent SMiRT Conferences, i.e. to SMiRT 8 and 9 [6,7].
The Division M addressed a number of important basic subjects, i.e. Methods of Analyses such as Stochastic Structural Dynamics, Methods of Structural Reliability, Stochastic Fracture Mechanics as well as Applications to Nuclear Structures in the areas of Load Combination, Structural Fatigue and Damage Analysis, Quality Assessment, Stochastic Earthquake Engineering and Probability Bases for Design Codes and Standards.
It is a well known fact, that within the first generic risk studies of nuclear power plants (see e.g.[8,9]) the aspect of reliability estimation of the structures involved, such as containment structures, primary piping, etc. received considerable less attention than the reliability analysis of mechanical, electromechanical as well as electronic systems. Within these studies, no serious attempt was made to quantify the reliability of the structures involved by utilizing the appropriate methods already available at that time. Since then considerable progress has been made. More recent and