

# Preface

The work on the present book **Safety of Light Water Reactors** was begun upon suggestion of Dr. L. Ascheron, Scientific Editor, Springer Verlag after the Fukushima reactor accident. The main task of this book is, in our opinion, to describe the scientific results of the past decades and the comparably high safety standard of the current/modern international reactor safety engineering.

This includes scientific results and technical developments that minimize the consequences of accidents to the population.

In the first part an overview of the nuclear power capacities, as well as the capacities for enrichment and reprocessing installed worldwide is provided. After a short presentation of the fundamentals of reactor physics, the radiological threshold values needed for understanding the Light Water Reactors still in operation in Germany are described as an example. In the case of Pressurized Water Reactors this includes the so-called Konvoi Series, as Boiling Water Reactors the SWR-72 of Kraftwerkunion (Siemens). As further European examples the new European Pressurized Water Reactor (EPR) and the new European Boiling Water Reactor SWR-1000 (KERENA) that were developed since 1995 by German and French reactor engineers are introduced. For the USA and Japan exemplarily the Pressurized Water Reactors AP1000 of Westinghouse and the US-APWR of Mitsubishi as well as the Boiling Water Reactors ABWR and ABWR-II (General Electric, Toshiba and Hitachi) are presented.

Broad room is then dedicated to the results of the safety research programs on core melt accidents performed at the former Kernforschungszentrum Karlsruhe (Nuclear Research Center Karlsruhe, now KIT) during the past two decades. Via the German and French reactor safety commissions these results became part of the new safety concept of the EPR and the SWR-1000.

The reactor accidents of Three-Mile-Island (USA), Chernobyl (Ukraine) and Fukushima (Japan) are described in detail. The safety concept of the German Light Water Reactors still in operation, including the plant internal emergency measures that were introduced after the Chernobyl-accident, as well as the new safety concept of EPR and SWR-1000 are then thoroughly compared and discussed with the

conclusions of the severe reactor accidents that occurred so far, especially the Fukushima accident.

Since the September 11 attacks on the American World Trade Center in 2001 it is intensely discussed in public how nuclear power plants are designed against a postulated airplane impact and which hazards for the population result from such an event. For this reason this topic is covered by a special section.

Despite the high safety standards of Light Water Reactors the plant internal emergency measures are an integral part of nuclear safety culture. By means of the decision support system RODOS (Real-time On-line DecisiOn System) potential protective and countermeasures are presented that are available for the decision maker to minimize the consequences of an accident to the population. The book further describes which scientific methods and models are used to analyse the radiological situation and initiate the appropriate measures. Thereby it is not restricted to the so-called early emergency management measures but also describes model approaches that can be used for predictions of long-term prevention measures. The Fukushima accident is used exemplarily as an application of the RODOS system.

The described further development of computer-assisted decision support systems is mainly based on European research approaches. Therefore this chapter ends with a short outlook on the development of scientific and institutional aspects of the nuclear emergency managements.

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