Design Of The Reactor Core For Nuclear Power Plants

This vital reference is the only one-stop resource on how to assess, prevent, and manage severe nuclear accidents in the light water reactors (LWRs) that pose the most risk to the public. LWRs are the predominant nuclear reactor in use around the world today, and they will continue to be the most frequently utilized in the near future. Therefore, accurate determination of the safety issues associated with such reactors is central to a consideration of the risks and benefits of nuclear power. This book emphasizes the prevention and management of severe accidents, in order to teach nuclear professionals how to mitigate potential risks to the public to the maximum extent possible.

Engineers, researchers, students and the personnel of vendors, safety authorities and nuclear power generation organizations require the knowledge offered by this volume's globally renowned experts to ensure they obtain a core competency in nuclear safety. Organizes and presents all the latest thought on LWR nuclear safety in one consolidated volume, provided by the top experts in the field, ensuring high-quality, credible and easily accessible information Explains how developments in the field of LWR severe accidents have provided more accurate determinations of risk, thereby shedding new light on the debates surrounding nuclear power safety, particularly in light of the recent tragedy in Japan Concentrates on prevention and management of accidents, developing methodologies to estimate the consequences and associated risks Concerns around global warming have led to a nuclear renaissance in many countries. Meanwhile the nuclear industry is already warning of a need to train more nuclear engineers and scientists who are needed in a range of areas from healthcare and radiation detection to space exploration and advanced materials, as well as for the nuclear power industry. Here Karl

Whittle provides a solid overview of the intersection of nuclear engineering and materials science at a level approachable by advanced students from materials, engineering and physics. The text explains the unique aspects needed in the design and implementation of materials for use in demanding nuclear settings. In addition to material properties and their interaction with radiation, the book

covers a range of topics including reactor design, fuels, fusion, future technologies and lessons learned from past incidents. Accompanied by problems, videos and teaching aids the book is suitable for a course text in nuclear materials and a reference for those already working in the field.
Source of neutrons in the proposed Advanced Neutron Source facility is a multipurpose research reactor

providing 5-10 times the flux, for neutron beams, of the best existing facilities. Baseline design for the reactor core, based on the "no new inventions" rule, was an assembly of two annular fuel elements similar to those used in the Oak Ridge and Grenoble high flux reactors, containing highly enriched U silicide particles. DOE commissioned a study of the use of medium- or low-enriched U; a three-element core design was studied as a means to provide extra volume to accommodate the additional U compound required when the fissionable 235U has to be diluted with 238U to reduce the enrichment. This paper describes the design and optimization of that three-element core.

In order to address the energy needs of developing countries and remote communities, Oregon State University has proposed the Multi-Application Small Light

Water Reactor (MASLWR) design. In order to achieve five years of operation without refueling, use of 8% enriched fuel is necessary. This dissertation is focused on core design issues related with increased fuel enrichment (8.0%) and specific MASLWR operational conditions (such as lower operational pressure and temperature, and increased leakage due to small core). Neutron physics calculations are performed with the commercial nuclear industry tools CASMO-4 and SIMULATE-3, developed by Studsvik Scandpower Inc. The first set of results are generated from infinite lattice level calculations with CASMO-4, and focus on evaluation of the principal differences between standard PWR fuel and MASLWR fuel. Chapter 4-1 covers aspects of fuel isotopic composition changes with burnup, evaluation of kinetic parameters and reactivity coefficients. Chapter 4-2 discusses gadolinium self-shielding and shadowing effects, and subsequent impacts on power generation peaking and Reactor Control System shadowing. The second aspect of the research is dedicated to core design issues, such as reflector design (chapter 4-3), burnable absorber distribution and programmed fuel burnup and fuel use strategy (chapter 4-4).

This section also includes discussion of the parameters important for safety and evaluation of Reactor Control System options for the proposed core design. An evaluation of the sensitivity of the proposed design to uncertainty in calculated parameters is presented in chapter 4-5. The results presented in this dissertation cover a new area of reactor design and operational parameters, and may be applicable to other small and large pressurized water reactor designs.

Assessment and Development of Structural Design Criteria for High Temperature and High Neutron Fluence Applications

Trial Application of the Draft Structural Design Criteria for Breeder Reactor Core Components to a Typical Blanket Assembly Duct

Fuel Temperatures in an Argonaut Reactor Core

Following a Hypothetical Design Basis Accident (DBA)
Design for Reactor Core Safety in Nuclear Power Plants
Securing the Safe Performance of Graphite Reactor Cores
Severe Accident Phenomenology
THEDRA
Probability Theory and Reactor Core Design
Management of Ageing in Graphite Reactor Cores
Design of the Reactor Core for Nuclear Power Plants. Safety Guide

NSG1.12

The reactor core is the central part of a nuclear reactor where nuclear fission occurs. It consists of four basic systems and components: the fuel (including fuel rods and the fuel assembly structure), the coolant, the moderator and the control rods, as well as additional structures such as reactor pressure vessel internals, core support plates, and the lower and upper internal structure in light water reactors. This Safety Guide provides recommendations on meeting the safety requirements established in SSR-2/1 (Rev. 1) applied to the design of the reactor core for nuclear power plants. The publication addresses *the safety aspects of the core design and includes neutronic, thermohydraulic, thermomechanical, and structural mechanical aspects. Other aspects considered are those relating to reactor core control, shutdown and monitoring, and core management.*

Efforts are being pursued to develop and qualify a system-level model of a reactor core isolation (RCIC) steam-turbine-driven pump. The model is being developed with the intent of employing it to inform the design of experimental configurations for full-scale RCIC testing. The model is expected to be especially valuable in sizing equipment needed in the testing.

An additional intent is to use the model in understanding more fully how RCIC apparently managed to operate far removed from its design envelope in the Fukushima Daiichi Unit 2 accident. RCIC modeling is proceeding along two avenues that are expected to complement each other well. The first avenue is the continued development of the system-level RCIC model that will serve in simulating a full reactor system or full experimental configuration of which a RCIC system is part. The model reasonably represents a RCIC system today, especially given design operating conditions, but lacks specifics that are likely important in representing the off-

design conditions a RCIC system might experience in an emergency situation such as a loss of all electrical power. A known specific lacking in the system model, for example, is the efficiency at which a flashing slug of water (as opposed to a concentrated jet of steam) could propel the rotating drive wheel of a RCIC turbine. To address this specific, the second avenue is being pursued wherein computational fluid dynamics (CFD) analyses of such a jet are being carried out. The results of the CFD analyses will thus complement and inform the system modeling. The system modeling will, in turn, complement the CFD analysis by providing the *system information needed to impose appropriate boundary conditions on the CFD simulations. The system model will be used to inform the selection of configurations and equipment best suitable of supporting planned RCIC experimental testing. Preliminary investigations with the RCIC model indicate that liquid water ingestion by the turbine decreases the developed turbine torque; the RCIC speed then slows, and thus the pump flow rate to the RPV decreases. Subsequently, RPV water level decreases due to continued boiling and the liquid fraction flowing to the RCIC decreases, thereby accelerating the RCIC and refilling the RPV. The*

feedback cycle then repeats itself and/or reaches a quasi-steady equilibrium condition. In other words, the water carry-over is limited by cyclic RCIC performance degradation, and hence the system becomes self-regulating. The indications achieved to date with the system model are more qualitative than quantitative. The avenues being pursued to increase the fidelity of the model are expected to add quantitative realism. The end product will be generic in the sense that the RCIC model will be incorporable within the larger reactor coolant system model of any nuclear power plant or experimental configuration.
This publication makes

recommendations concerning safety features for incorporation into the design of the reactor core for a nuclear power plant. It supersedes a previous Safety Guide on Design for Reactor Core Safety in Nuclear Power Plants (IAEA Safety Series No. 50-SG-D14). This Safety Guide takes account of developments in the design of the reactor core since the earlier Safety Guide was issued, and includes guidance on general and specific design considerations. Contents: 1. Introduction; 2. General safety considerations in design; 3. Specific safety considerations in design; 4. Qualifica.

This book describes the fast

reactor (FR), a type of new reactor for nuclear plants, currently under research and development. The book targets young researchers and engineers who will be charged with commercializing this new type of reactor to lead to the development of new components and systems for improved plant reliability and economy. This volume also helps readers to understand the methods of integrating the power plant in its entirety, from the reactor core to all of the various systems and components, and teaches the way of thinking that forms the background of these methods. This background includes the various organizational and management *issues that are encountered as projects move forward and will be explored in great detail based on actual design and construction experience with Japan's prototype FR, Monju.*

Effects of Fuel Particle and Reactor Core Design on Modular HTGR Source Terms
Nuclear Reactor Technology Development and Utilization
A Safety Guide
Bases for Reactor Core Design Requirements
Fast Reactor System Design
Monte Carlo Simulations of a Future Generation Nuclear Reactor Core Design
Nuclear Materials Science
Nuclear Reactor Design

Reactor Core Mechanics

Thermal Design of Nuclear Reactors

Nuclear power currently contributes nearly a quarter of the electricity needs of the UK. Much of this is from nuclear reactor plants developed some fifty years ago. Consequently, in the next few decades, many of these reactors and components are coming to the end of their 'useful' life and strategies for the effective management of these decommissioned parts are paramount.

Management of Ageing

Processes in Graphite Reactor Cores discusses in detail both the scientific challenges and the issues involved in this subject. It begins with an introductory section on the fundamentals of reactor design and goes on to discuss graphite core behaviour under irradiation; graphite-component behaviour and its assessment; and whole core behaviour. The book concludes with a section on the lessons learned from decades of experience. Written by leading experts in the field, this high level *book is ideal for both academia and industry, and would also be of relevance to policy makers and governments.*

Physics of Nuclear Reactors presents a comprehensive analysis of nuclear reactor physics. Editors P. Mohanakrishnan, Om Pal Singh, and Kannan Umasankari and a team of expert contributors combine their knowledge to guide the reader through a toolkit of methods for solving transport equations, understanding the physics of reactor design principles, *and developing reactor safety strategies. The inclusion of experimental and operational reactor physics makes this a unique reference for those working and researching nuclear power and the fuel cycle in existing power generation sites and experimental facilities. The book also includes radiation physics, shielding techniques and an analysis of shield design, neutron monitoring and core operations. Those involved in the development and operation of nuclear reactors and the fuel cycle* *will gain a thorough understanding of all elements of nuclear reactor physics, thus enabling them to apply the analysis and solution methods provided to their own work and research. This book looks to future reactors in development and analyzes their status and challenges before providing possible worked-through solutions. Cover image: Kaiga Atomic Power Station Units 1 – 4, Karnataka, India. In 2018, Unit 1 of the Kaiga Station surpassed the world record of continuous operation, at*

962 days. Image courtesy of DAE, India. Includes methods for solving neutron transport problems, nuclear cross-section data and solutions of transport theory Dedicates a chapter to reactor safety that covers mitigation, probabilistic safety assessment and uncertainty analysis Covers experimental and operational physics with details on noise analysis and failed fuel detection

Thermal Design of Nuclear Reactors

This publication makes recommendations

concerning safety features for incorporation into the design of the reactor core for a nuclear power plant, taking account of recent developments in the design of the reactor core and including guidance on general and specific design considerations. It supersedes IAEA Safety Series No. 50-SG-D14.
A Code for Thermal Design Reliability Analysis of a Reactor Core
Reactor Core Design for High-temperature Gas-cooled Reactors
Nuclear Safety in Light

Water Reactors
Physics of Nuclear Reactors
Modeling of the Reactor Core Isolation Cooling Response to Beyond Design Basis Operations - Interim Report
Design of the Reactor Core for Nuclear Power Plants: IAEA Safety Standards Series No. Ssg-52
Reactor Core Physics Design and Operating Data for Cycles 1 and 2 of the Zion Unit 2 PWR Power Plant
Optimizing a Three-element Core Design for the Advanced Neutron Source Reactor

Part 2: Neutron-physical Requirements for Design Andoperation of the Reactor Core and Adjacent Systems

Reactor Core Physics Design and Operating Data for Cycles 1 and 2 of TMI Unit 1 PWR Power Plant

The book is a sequel to the successful RSC publication Managing of Ageing Processes in Graphite Reactor Cores, but with the emphasis on the challenges for the future safe performance. It is hoped that the contributed papers will also help in the design, construction, operation and eventual decommissioning of the new generation of graphite-moderated reactors. Papers presented in the book represent contributions from the most eminent specialists in the field and reflect the UK's contribution over the past 50 years to graphite reactor technology that will remain significant for years to come, especially in the development of Generation IV designs.

Nuclear Reactor Technology Development and Utilization presents the theory and principles of the most common advanced nuclear reactor systems and provides a context for the value and utilization of nuclear power in a variety of applications both inside and outside a traditional nuclear setting. As countries across the globe realize their plans for a sustainable energy future, the need for innovative nuclear reactor design is increasing, and this book will provide a deep understanding of how these technologies can aid in a region ' s goal for clean and reliable energy. Dr Khan and Dr Nakhabov, alongside their team of expert contributors, discuss a variety of important topics, including nuclear fuel cycles, plant decommissioning and hybrid energy systems, while considering a variety of diverse uses such as nuclear desalination, hydrogen generation and radioisotope production. Knowledge acquired enables the reader to conduct further research in academia and industry, and apply the latest design, development, integration, safety and economic guidance to their work and research. Combines reactor fundamentals with a contemporary look at evolving trends in the design of advanced reactors and their application to both nuclear

and non-nuclear uses Analyses the latest research and uses of hybrid systems which bring together nuclear technology with renewable energy technologies Presents applications, economic factors and an analysis of sustainability factors in one comprehensive resource
This book focuses on core design and methods for design and analysis. It is based on advances made in nuclear power utilization and computational methods over the past 40 years, covering core design of boiling water reactors and pressurized water reactors, as well as fast reactors and high-temperature gas-cooled reactors. The objectives of this book are to help graduate and advanced undergraduate students to understand core design and analysis, and to serve as a background

reference for engineers actively working in light water reactors. Methodologies for core design and analysis, together with physical descriptions, are emphasized. The book also covers coupled thermal hydraulic core calculations, plant dynamics, and safety analysis, allowing readers to understand core design in relation to plant control and safety.

This publication represents a general consensus among participating experts of the best common practices that can be used at nuclear power plants (NPPs) in reload design and core management. It outlines the main issues to be considered when developing and improving reload design and core management and presents lessons learned, as well as detailing challenges which may be encountered. Guidance provided here also covers best practice for different reload strategies and how to optimize reactor reload design and core management during the lifetime of a NPP. The publication reflects the advice of experts with experience of reactors of various types on how the operating organization may achieve its goals.

Analysis of an Advanced Gas-cooled Fast Reactor Core Design

PM-1 Reactor Core Final Design Report

Fast Flux Test Facility. CONCEPTUAL SYSTEM DESIGN DESCRIPTION FOR THE REACTOR CORE SYSTEM

Safety Guide

Use of Hastelloy X-280 in Reactor Core Test Alternate Conceptual Design

Reload Design and Core Management in Operating Nuclear Power Plants

Fast Flux Test Facility
Design of the Reactor Core for Nuclear Power Plants
Design Criteria for Nuclear Reactor Core Structures
Fast Reactor Core Design Parameter Study