Lead Cooled Fast Neutron Reactor Brest Nikiet

Handbook of Generation IV Nuclear Reactors
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Thermodynamics In Nuclear Power Plant Systems
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TMS 2020 149th Annual Meeting & Exhibition Supplemental Proceedings
Proceedings of a Meeting at the University of Strathclyde, 25 March 1977
History and Status of the EBR
Handbook of Nuclear Engineering
Nuclear Power Plant Design and Analysis Codes
Structural Materials for Heavy Liquid Metal Cooled Fast Reactors
Proceedings of a Technical Meeting
Technical and Institutional Options for the Future
Nuclear Power Warts and All
Sodium Fast Reactors with Closed Fuel Cycle
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Technologies and Major Equipment of Circuits Cooled with Pb, Pb-Bi

SANTOS HAMMOND

Handbook of Generation IV Nuclear Reactors Woodhead Publishing
Interest in fast reactor development has increased with the Department of Energy's introduction of the Global Nuclear Energy Partnership (GNEP) [1]. The GNEP program plans development of a sodium cooled Advanced Burner Reactor (ABR) that can be used to reduce the amount spent LWR fuel in storage and the number of high level waste sites needed for expansion of nuclear power throughout the world over the 21st century. In addition, the program proposes to make nuclear power more available while reducing the proliferation concerns by revising policies and technology for control of weapons useable materials. This would be accomplished with establishment of new institutional arrangements based on selective siting of reprocessing, enrichment and waste disposal facilities. The program would also implement development of small reactors suitable for use in developing countries or remote regions with small power grids. Over the past several years, under the Department of Energy (DOE) NERI and GEN IV programs research has been conducted on small lead cooled reactors. The Small Secure Transportable Autonomous Reactor (SSTAR) [2] is the most recent version of this type of reactor and research is continuing on it in the GEN IV program in parallel with GNEP. SSTAR is a small (10MWe-100MWe) reactor that is fueled once for life. It complements the GNEP program very well in that it serves one of the world markets not currently addressed by large reactors and its development requirements are similar to those for the ABRs. In particular, the fuel and structural materials for these fast spectrum reactors share common thermal and neutron environments. The coolants, sodium in ABR and lead or lead-bismuth eutectic (LBE) in SSTAR, are the major developmental difference. This report discusses the status of structural materials for fast reactor core and primary system components and selected aspects of their development.
An Autonomous Long-term Fast Reactor System and the Principal Design Limitations of the Concept Woodhead Publishing
This publication presents both an overview and detailed information on more than 150 experimental facilities being used for developing and deploying innovative liquid metal-cooled (sodium, lead and lead-bismuth) fast neutron systems, both critical and subcritical. Facilities, both under construction and those in operation are considered. It is expected that by providing the end users with detailed information on existing and future experimental facilities able to support innovative liquid metal cooled fast neutron systems, the publication will facilitate cooperation between organizations and knowledge transfer. An overview of the existing and future experimental facilities is presented in the body text of this publication. The profiles of all facilities in the form of individual papers are available on the attached CD-ROM and in the related on-line database maintained by the IAEA Catalogue of Facilities in Support of Liquid Metal-cooled Fast Neutron Systems (LMFNS Catalogue).
Thermodynamics In Nuclear Power Plant Systems Woodhead Publishing
The objectives of this dissertation were to find a principal domain of promising and technologically feasible reactor physics characteristics for a multi-purpose, modular-sized, lead-cooled, fast neutron spectrum reactor fueled with an advanced uranium-transuranic-nitride fuel and to determine the principal limitations for the design of an autonomous long-term multi-purpose fast reactor (ALM-FR) within the principal reactor physics characteristic domain. The objectives were accomplished by producing a conceptual design for an ALM-FR and by analysis of the potential ALM-FR performance characteristics. The ALM-FR design developed in this dissertation is based on the concept of a secure transportable autonomous reactor for hydrogen production (STAR-H2) and represents further refinement of the STAR-H2 concept towards an economical, proliferation-resistant, sustainable, multi-purpose nuclear energy system. The development of the ALM-FR design has been performed considering this reactor within the frame of the concept of a self-consistent nuclear energy system (SCNES) that satisfies virtually all of the requirements for future nuclear energy systems: efficient energy production, safety, self-feeding, non-proliferation, and radionuclide burning. The analysis takes into consideration a wide range of reactor design aspects including selection of technologically feasible fuels and structural materials, core configuration optimization, dynamics and safety of long-term operation on one fuel loading, and nuclear material non-proliferation. Plutonium and higher actinides are considered as essential components of an advanced fuel that maintains long-term operation. Flexibility of the ALM-FR with respect to fuel compositions is demonstrated acknowledging the principal limitations of the long-term burning of plutonium and higher actinides. To ensure consistency and accuracy, the modeling has been performed using state-of-the-art computer codes developed at Argonne National Laboratory. As a result of the computational analysis performed in this work, the ALM-FR design provides for the possibility of continuous operation during about 40 years on one fuel loading containing mixture of depleted uranium with plutonium and higher actinides. All reactor physics characteristics of the ALM-FR are kept within technological limits ensuring safety of ultra-long autonomous operation. The results obtained provide for identification of physical features of the ALM-FR that significantly influence flexibility of the design and its applications. The special emphasis is given to existing limitations on the utilization of higher actinides as a fuel component.
Superphenix International Atomic Energy Agency
Sodium Fast Reactors with Closed Fuel Cycle delivers a detailed discussion of an important technology that is being harnessed for commercial energy production in many parts of the world. Presenting the state of the art of sodium-cooled fast reactors with closed fuel cycles, this book:Offers in-depth coverage of reactor physics, materials, design, s
Fundamentals, Types, and Benefits Explained Woodhead Publishing
Since 2002, the Department of Energy's (DOE's) Generation IV Nuclear Energy Systems (Gen IV) Program has addressed the research and development (R & D) necessary to support next-generation nuclear energy systems. The six most promising systems identified for next-generation nuclear energy are described within this roadmap. Two employ a thermal neutron spectrum with coolants and temperatures that enable hydrogen or electricity production with high efficiency (the Supercritical Water Reactor-SCWR and the Very High Temperature Reactor-VHTR). Three employ a

fast neutron spectrum to enable more effective management of actinides through recycling of most components in the discharged fuel (the Gas-cooled Fast Reactor-GFR, the Lead-cooled Fast Reactor-LFR, and the Sodium-cooled Fast Reactor-SFR). The Molten Salt Reactor (MSR) employs a circulating liquid fuel mixture that offers considerable flexibility for recycling actinides and may provide an alternative to accelerator-driven systems. At the inception of DOE's Gen IV program, it was decided to significantly pursue five of the six concepts identified in the Gen IV roadmap to determine which of them was most appropriate to meet the needs of future U.S. nuclear power generation. In particular, evaluation of the highly efficient thermal SCWR and VHTR reactors was initiated primarily for energy production, and evaluation of the three fast reactor concepts, SFR, LFR, and GFR, was begun to assess viability for both energy production and their potential contribution to closing the fuel cycle. Within the Gen IV Program itself, only the VHTR class of reactors was selected for continued development. Hence, this document will address the multiple activities under the Gen IV program that contribute to the development of the VHTR. A few major technologies have been recognized by DOE as necessary to enable the deployment of the next generation of advanced nuclear reactors, including the development and qualification of the structural materials needed to ensure their safe and reliable operation. The focus of this document will be the overall range of DOE's structural materials research activities being conducted to support VHTR development. By far, the largest portion of material's R & D supporting VHTR development is that being performed directly as part of the Next-Generation Nuclear Plant (NGNP) Project. Supplementary VHTR materials R & D being performed in the DOE program, including university and international research programs and that being performed under direct contracts with the American Society for Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, will also be described. Specific areas of high-priority materials research that will be needed to deploy the NGNP and provide a basis for subsequent VHTRs are described, including the following: (1) Graphite: (a) Extensive unirradiated materials characterization and assessment of irradiation effects on properties must be performed to qualify new grades of graphite for nuclear service, including thermo-physical and mechanical properties and their changes, statistical variations from billot-to-billot and lot-to-lot, creep, and especially, irradiation creep. (b) Predictive models, as well as codification of the requirements and design methods for graphite core supports, must be developed to provide a basis for licensing. (2) Ceramics: Both fibrous and load-bearing ceramics must be qualified for environmental and radiation service as insulating materials. (3) Ceramic Composites: Carbon-carbon and SiC-SiC composites must be qualified for specialized usage in selected high-temperature components, such as core stabilizers, control rods, and insulating covers and ducting. This will require development of component-specific designs and fabrication processes, materials characterization, assessment of environmental and irradiation effects, and establishment of codes and standards for materials testing and design requirements. (4) Pressure Vessel Steels: (a) Qualification of short-term, high-temperature properties of light water reactor steels for anticipated VHTR off-normal conditions must be determined, as well as the effects of aging on tensile, creep, and toughness properties, and on thermal emissivity. (b) Large-scale fabrication process for higher temperature alloys, such as 9Cr-1MoV, including ensuring thick-section and weldment integrity must be developed, as well as improved definitions of creep-fatigue and negligible creep behavior. (5) High-Temperature Alloys: (a) Qualification and codification of materials for the intermediate heat exchanger, such as Alloys 617 or 230, for long-term very high-temperature creep, creep-fatigue, and environmental aging degradation must be done, especially in thin sections for compact designs, for both base metal and weldments. (b) Constitutive models and an improved methodology for high-temperature design must be developed.

Polonium Extraction Techniques for a Lead-bismuth Cooled Fast Reactor CreateSpace

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

Development, Validation, and Application Woodhead Publishing

The compatibility of structural materials, such as steels with lead and lead-bismuth eutectic, poses a critical challenge in the development of heavy liquid metal (HLM) cooled fast reactors. Factors such as the high temperatures, fast neutron flux and irradiation exposure and corrosiveness provide a severe environment for the materials in these advanced reactor systems. The compatibility of liquid coolant with structural materials is critical for the development of innovative nuclear energy systems. To understand the current status of the research and development in this area as well as to provide a forum to exchange information on structural materials for HLM cooled reactors at the national and international levels, the IAEA organized a technical meeting. This resulted in the current publication which presents the summaries of the technical and the group sessions, conclusions and recommendations, and the papers presented at the event.

Plentiful Energy Springer

Handbook of Generation IV Nuclear ReactorsWoodhead Publishing

Minor Actinide Burning in Thermal Reactors Springer Science & Business Media

Materials have been presented as to experience in creating and operating Russian and partially foreign research and industrial test benches and reactor plants using heavy liquid-metal coolants (HLMC), i.e. lead-bismuth and lead coolants. Main performance data of reactor circuits, major equipment and their design solutions have been described. There has been provided information on specific features of operating conditions, including operating basis accidents of power circuits cooled with lead and lead-bismuth coolants. This book may be recommended as a teaching aid for students, masters and graduate students learning with specializations related to the nuclear power industry and principally to innovative fast neutron reactors cooled with HLMC. It may be of some interest for researchers, scientific workers and engineers engaged in creating and operating such installations.

Technical and Scientific Achievements IOS Press

Disposal of radioactive waste from nuclear weapons production and power generation has caused public outcry and political consternation. Nuclear Wastes presents a critical review of some waste management and disposal alternatives to the current national policy of direct disposal of light water reactor spent fuel. The book offers clearcut conclusions for what the nation should do today and what solutions should be explored for tomorrow. The committee examines the currently used "once-through" fuel cycle versus different alternatives of separations and transmutation technology systems, by which hazardous radionuclides are converted to nuclides that are either stable or radioactive with short half-lives. The volume provides detailed findings and conclusions about the status and feasibility of plutonium extraction and more advanced separations technologies, as well as three principal transmutation concepts for commercial reactor spent fuel. The book discusses nuclear proliferation; the U.S. nuclear regulatory structure; issues of health, safety and transportation; the proposed sale of electrical energy as a means of paying for the transmutation system; and other key issues.

Technologies for Separations and Transmutation Elsevier

The Integral Fast Reactor (IFR) is a fast reactor system developed at Argonne National Laboratory in the decade 1984 to 1994. The IFR project developed the technology for a complete system; the reactor, the entire fuel cycle and the waste management technologies were all included in the development program. The reactor concept had important features and characteristics that were completely new and fuel cycle and waste management technologies that were entirely new developments. The reactor is a “fast” reactor – that is, the chain reaction is maintained by “fast” neutrons with high energy – which produces its own fuel. The IFR reactor and associated fuel cycle is a closed system. Electrical power is generated, new fissile fuel is produced to replace the fuel burned, its used fuel is processed for recycling by pyroprocessing – a new development – and waste is put in final form for disposal. All this is done on one self-sufficient site.The scale and duration of the project and its funding made it the largest nuclear energy R and D program of its day. Its purpose was the development of a long term massive new energy source, capable of meeting the nation's electrical energy needs in any amount, and for as long as it is needed, forever, if necessary. Safety, non-proliferation and waste toxicity properties were improved as well, these three the characteristics most commonly cited in opposition to nuclear power.Development proceeded from success to success. Most of the development had been done when the program was abruptly cancelled by the newly elected Clinton Administration. In his 1994 State of the Union address the president stated that “unnecessary programs in advanced reactor development will be terminated.” The IFR was that program.This book gives the real story of the IFR, written by the two nuclear scientists who were most deeply involved in its conception, the development of its R and D program, and its management.Between the scientific and engineering papers and reports, and books on the IFR, and the non-technical and often impassioned dialogue that continues to this day on fast reactor technology, we felt there is room for a volume that, while accurate technically, is written in a manner accessible to the non-specialist and even to the non-technical reader who simply wants to know what this technology is.

Fundamentals of Nuclear Reactor Physics Handbook of Generation IV Nuclear Reactors

Molten Salt Reactors is a comprehensive reference on the status of molten salt reactor (MSR) research and thorium fuel utilization. There is growing awareness that nuclear energy is needed to complement intermittent energy sources and to avoid pollution from fossil fuels. Light water reactors are complex, expensive, and vulnerable to core melt, steam explosions, and hydrogen explosions, so better technology is needed. MSRs could operate safely at nearly atmospheric pressure and high temperature, yielding efficient electrical power generation, desalination, actinide incineration, hydrogen production, and other industrial heat applications. Coverage includes: Motivation -- why are we interested? Technical issues – reactor physics, thermal hydraulics, materials, environment, ... Generic designs -- thermal, fast, solid fuel, liquid fuel, ... Specific designs – aimed at electrical power, actinide incineration, thorium utilization, ... Worldwide activities in 23 countries Conclusions This book is a collaboration of 58 authors from 23 countries, written in cooperation with the International Thorium Molten Salt Forum. It can serve as a reference for engineers and scientists, and it can be used as a textbook for graduate students and advanced undergrads. Molten Salt Reactors is the only complete review of the technology currently available, making this an essential text for anyone reviewing the use of MSRs and thorium fuel, including students, nuclear researchers, industrial engineers, and policy makers. Written in cooperation with the International Thorium Molten-Salt Forum Covers MSR-specific issues, various reactor designs, and discusses issues such as the environmental impact, non-proliferation, and licensing Includes case studies and examples from experts across the globe

The Breeder Reactor KIT Scientific Publishing

Fundamentals of Nuclear Reactor Physics offers a one-semester treatment of the essentials of how the fission nuclear reactor works, the various approaches to the design of reactors, and their safe and efficient operation . It provides a clear, general overview of atomic physics from the standpoint of reactor functionality and design, including the sequence of fission reactions and their energy release. It provides in-depth discussion of neutron reactions, including neutron kinetics and the neutron energy spectrum, as well as neutron spatial distribution. It includes ample worked-out examples and over 100 end-of-chapter problems. Engineering students will find this applications-oriented approach, with many worked-out examples, more accessible and more meaningful as they aspire to become future nuclear engineers. A clear, general overview of atomic physics from the standpoint of reactor functionality and design, including the sequence of fission reactions and their energy release In-depth discussion of neutron reactions, including neutron kinetics and the neutron energy spectrum, as well as neutron spatial distribution Ample worked-out examples and over 100 end-of-chapter problems Full Solutions Manual

Status Report on the Small Secure Transportable Autonomous Reactor (SSTAR) Springer Nature

Handbook of Generation IV Nuclear Reactors presents information on the current fleet of Nuclear Power Plants (NPPs) with water-cooled reactors (Generation III and III+) (96% of 430 power reactors in the world) that have relatively low thermal efficiencies (within the range of 32 36%) compared to those of modern advanced thermal power plants (combined cycle gas-fired power plants – up to 62% and supercritical pressure coal-fired power plants – up to 55%). Moreover, thermal efficiency of the current fleet of NPPs with water-cooled reactors cannot be increased significantly without completely different innovative designs, which are Generation IV reactors. Nuclear power is vital for generating electrical energy without carbon emissions. Complete with the latest research, development, and design, and written by an international team of experts, this handbook is completely dedicated to Generation IV reactors. Presents the first comprehensive handbook dedicated entirely to generation IV nuclear reactors Reviews the latest trends and developments Complete with the latest research, development, and design information in generation IV nuclear reactors Written by an international team of experts in the field

Focus on Very High Temperature Reactor Materials Woodhead Publishing

The construction of nuclear power plants in the United States is stopping, as regulators, reactor manufacturers, and operators sort out a host of technical and institutional problems. This volume summarizes the status of nuclear power, analyzes the obstacles to resumption of construction of nuclear plants, and describes and evaluates the technological alternatives for safer, more economical reactors. Topics covered include Institutional issues--including regulatory practices at the federal and state levels, the growing trends toward greater competition in the generation of electricity, and nuclear and nonnuclear generation options. Critical evaluation of advanced reactors--covering attributes such as cost, construction time, safety, development status, and fuel cycles. Finally, three alternative federal research and development programs are presented.

Updated Generation IV Reactors Integrated Materials Technology Program Plan, Revision 2 LAP Lambert Academic Publishing

This report provides an update on development of a pre-conceptual design for the Small Secure Transportable Autonomous Reactor (SSTAR) Lead-Cooled Fast Reactor (LFR) plant concept and supporting research and development activities. SSTAR is a small, 20 MWe (45 MWt), natural circulation, fast reactor plant for international deployment concept incorporating proliferation resistance for deployment in non-fuel cycle states and developing nations, fissile self-sufficiency for efficient utilization of uranium resources, autonomous load following making it suitable for small or immature grid applications, and a high degree of passive safety further supporting deployment in developing nations. In FY 2006, improvements have been made at ANL to the pre-conceptual design of both the reactor system and the energy converter which incorporates a supercritical carbon dioxide Brayton cycle providing higher plant efficiency (44 %) and improved economic competitiveness. The supercritical CO2 Brayton cycle technology is also applicable to Sodium-Cooled Fast Reactors providing the same benefits. One key accomplishment has been the development of a control strategy for automatic control of the supercritical CO2 Brayton cycle in principle enabling autonomous load following over the full power range between nominal and essentially zero power. Under autonomous load following operation, the reactor core power adjusts itself to equal the heat removal from the reactor system to the power converter through the large reactivity feedback of the fast spectrum core without the need for motion of control rods, while the automatic control of the power converter matches the heat removal from the reactor to the grid load. The report includes early calculations for an international benchmarking problem for a LBE-cooled, nitride-fueled fast reactor core organized by the IAEA as part of a Coordinated Research Project on Small Reactors without Onsite Refueling; the calculations use the same neutronics computer codes and methodologies applied to SSTAR. Another section of the report details the SSTAR safety design approach which is based upon defense-in-depth providing multiple levels of protection against the release of radioactive materials and how the inherent safety features of the lead coolant, nitride fuel, fast neutron spectrum core, pool vessel configuration, natural circulation, and containment meet or exceed the requirements for each level of protection. The report also includes recent results of a systematic analysis by LANL of data on corrosion of candidate cladding and structural material alloys of interest to SSTAR by LBE and Pb coolants; the data were taken from a new database on corrosion by liquid metal coolants created at LANL. The analysis methodology that considers penetration of an oxidation front into the alloy and dissolution of the trailing edge of the oxide into the coolant enables the long-term corrosion rate to be extracted from shorter-term corrosion data thereby enabling an evaluation of alloy performance over long core lifetimes (e.g., 30 years) that has heretofore not been possible. A number of candidate alloy specimens with special treatments or coatings which might enhance corrosion resistance at the temperatures at which SSTAR would operate were analyzed following testing in the DELTA loop at LANL including steels that were treated by laser peening at LLNL; laser peening is an approach that alters the oxide-metal bonds which could potentially improve corrosion resistance. LLNL is also carrying out Multi-Scale Modeling of the Fe-Cr system with the goal of assisting in the development of cladding and structural materials having greater resistance to irradiation.

Structural Materials for Generation IV Nuclear Reactors Springer Science & Business Media

Storage and Hybridization of Nuclear Energy: Techno-economic Integration of Renewable and Nuclear Energy provides a unique analysis of the storage and hybridization of nuclear and renewable energy. Editor Bindra and his team of expert contributors present various global methodologies to obtain the techno-economic feasibility of the integration of storage or hybrid cycles in nuclear power plants. Aimed at those studying, researching and working in the nuclear engineering field, this book offers nuclear reactor technology vendors, nuclear utilities workers and regulatory commissioners a very unique resource on how to access reliable, flexible and clean energy from variable-generation. Presents a unique view on the technologies and systems available to integrate renewables and nuclear energy Provides insights into the different methodologies and technologies currently available for the storage of energy Includes case studies from well-known experts working on specific integration concepts around the world

Storage and Hybridization of Nuclear Energy Academic Press

Operating at a high level of fuel efficiency, safety, proliferation-resistance, sustainability and cost, generation IV nuclear reactors promise enhanced features to an energy resource which is already seen as an outstanding source of reliable base load power. The performance and reliability of materials when subjected to the higher neutron doses and extremely corrosive higher temperature environments that will be found in generation IV nuclear reactors are essential areas of study, as key considerations for the successful development of generation IV reactors are suitable structural materials for both in-core and out-of-core applications. Structural Materials for Generation IV Nuclear

Reactors explores the current state-of-the art in these areas. Part One reviews the materials, requirements and challenges in generation IV systems. Part Two presents the core materials with chapters on irradiation resistant austenitic steels, ODS/FM steels and refractory metals amongst others. Part Three looks at out-of-core materials. Structural Materials for Generation IV Nuclear Reactors is an essential reference text for professional scientists, engineers and postgraduate researchers involved in the development of generation IV nuclear reactors. Introduces the higher neutron doses and extremely corrosive higher temperature environments that will be found in generation IV nuclear reactors and implications for structural materials Contains chapters on the key core and out-of-core materials, from steels to advanced micro-laminates Written by an expert in that particular area

Nuclear Wastes National Academies Press

One promising concept for future nuclear reactors uses liquid metals like Pb as reactor coolant. In this work, fretting of fuel clad materials is investigated in Pb environment at relevant operating conditions. A novel test apparatus is presented that allows fretting tests in liquid lead with high accuracy and reproducibility also during long term tests. Tolerable operating conditions concerning fretting wear by evaluating the specific wear coefficient and the concept of fretting maps are given.

Thermal-Hydraulics of Water Cooled Nuclear Reactors CRC Press

Thermal Hydraulics Aspects of Liquid Metal cooled Nuclear Reactors is a comprehensive collection of liquid metal thermal hydraulics research and development for nuclear liquid metal reactor applications. A deliverable of the SESAME H2020 project, this book is written by top European experts who discuss topics of note that are supplemented by an international contribution from U.S. partners within the framework of the NEAMS program under the U.S. DOE. This book is a convenient source for students, professionals and academics interested in liquid metal thermal hydraulics in nuclear applications. In addition, it will also help newcomers become familiar with current techniques and knowledge. Presents the latest information on one of the deliverables of the SESAME H2020 project Provides an overview on the design and history of liquid metal cooled fast reactors worldwide Describes the challenges in thermal hydraulics related to the design and safety analysis of liquid metal cooled fast reactors Includes the codes, methods, correlations, guidelines and limitations for liquid metal fast reactor thermal hydraulic simulations clearly Discusses state-of-the-art, multi-scale techniques for liquid metal fast reactor thermal hydraulics applications