Nuclear Blanket And Shielding Problems In Demonstration

Journal of the British Nuclear Energy Society
Fusion Nuclear Science Pathways Assessment
Project Independence Blueprint
Experimental Breeder Reactor-II (EBR-II) Shield Design
Fusion Neutronics
Fundamentals of Its Utilization for Energy Supply
Proceedings of the magnetic fusion energy blanket & shield workshop
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Thermal and chemical aspects of the thermonuclear blanket problem
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Transcript of First-ninth Public Hearing
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Journal of the British Nuclear Energy Society Springer Science & Business Media
The Department of Energy (DOE) Office of Fusion Energy (OFE) and the Division of Reactor Research and Technology (DRRT) jointly sponsored the development of a coupled fine-group cross section library. This 171-neutron, 36-gamma-ray group library was based upon ENDF/B-IV and was intended to be applicable to fusion reactor neutronics and LMFBR core and shield analysis. Versions of the library are available from the Radiation Shielding Information Center (RSIC) at the Oak Ridge National Laborary in both AMPX and CCCC formats. Computer codes for energy group collapsing, interpolation on Bondarenko factors for resonance self-shielding and temperture corrections, and various other useful data manipulations are also available. The experience gained in the generation, validation and utilization of this library along with its broad range of applicability has led to the request for updating this data set using ENDF/B-V. Additional support in this regard has been provided by the Defense Nuclear Agency (DNA) and by the Electric Power Research Institute (EPRI) in support of weapons analyses and light water reactor shielding and dosimetry problems, respectively. The purpose of the report is to provide detailed specifications and rationale for the proposed ENDF/B-V update (designated VITAMIN-E) to the VITAMIN-C library.
Fusion Nuclear Science Pathways Assessment Springer
Nuclear Science AbstractsUS ITER (International Thermonuclear Experimental Reactor) Shield and Blanket Design Activities
Project Independence Blueprint John Wiley & Sons Incorporated
This report summarizes nuclear-related work in support of the US effort for the International Thermonuclear Experimental Reactor (ITER) Study. The purpose of this work was to prepare for the first international ITER workshop devoted to defining a basic ITER concept that will serve as a basis for an indepth conceptual design activity over the next 2-1/2 years. Primary tasks carried out during the past year included: design improvements of the inboard shield developed for the TIBER concept, scoping studies of a variety of tritium breeding blanket options, development of necessary design guidelines and evaluation criteria for the blanket options, further safety considerations related to nuclear components and issues regarding structural materials for an ITER device. 44 refs., 31 figs., 29 tabs.
Experimental Breeder Reactor-II (EBR-II) Shield Design Elsevier
A description of the EBR-II shield and the methods employed in arriving at the final design are presented. The major shield design problems for that reactor are enumerated and discussed.
Fusion Neutronics Nuclear Science AbstractsUS ITER (International Thermonuclear Experimental Reactor) Shield and Blanket Design ActivitiesThis paper summarizes nuclear-related work in support of the US effort for the International Thermonuclear Experimental Reactor (ITER) Study. Primary tasks carried out during the past year include design improvements of the inboard shield developed for the TIBER concept, scoping studies of a variety of tritium breeding blanket options, development of necessary design guidelines and evaluation criteria for the blanket options, further safety considerations related to nuclear components, and issues regarding structural materials for an ITER device. The blanket concepts considered are the aqueous/Li salt solution, a water-cooled, solid breeder blanket, a helium-cooled, solid-breeder blanket, a blanket cooled by helium containing lithium-bearing particulates, and a blanket concept based on breeding tritium from He3. 1 ref., 2 tabs.Proceedings of the magnetic fusion energy blanket & shield workshopa technical assessmentERDA Energy Research AbstractsIndexEnergy Research AbstractsProceedings of the Topical Meeting on the Technology of Controlled Nuclear FusionFusion Energy UpdateExperimental Breeder Reactor-II (EBR-II) Shield DesignA description of the EBR-II shield and the methods employed in arriving at the final design are presented. The major shield design problems for that reactor are enumerated and discussed.Safety Issues Associated with Plutonium Involvement in the Nuclear Fuel Cycle
A theoretical study was made of the blanket that must surround a thermonuclear plasma to provide energy conversion and removal, neutron and gamma-ray shielding, and regeneration of the tritium burned in the D-T reaction. Power distributions and heat transfer were calculated and materials problems analyzed for blanket assemblies that A.J. Impink, Jr. has shown are capable of tritium regeneration. The blanket arrangement chosen as a model consisted of a molybdenum vacuum wall in the form of a long cylindrical shell, cooled by fused Li_2BeF_4 and surrounded by an annulus, 55 cm thick, consisting of fused Li_2BeF_4 and graphite to channel the flow of coolant. Nuclear heating was calculated on a digital computer for neutron flux distributions calculated by Impink. In vacuum walls of 1, 2, and 3 cm of molybdenum, 16, 25, and 31%, respectively, of the D-T neutron energy are absorbed. The total heat liberated in the inner blanket is 17.5 Mev per fusion. The absorption of secondary gamma rays accounts for half of the total heating and almost all of the heating of the vacuum wall. Heat transfer and thermal stress limit the thermonuclear power to 400-500 watts/sq. cm of neutron energy incident on the molybdenum first wall, which is 2 cm thick.
Fundamentals of Its Utilization for Energy Supply Cambridge University Press
There has been an increase in interest worldwide in fusion research over the last decade and a half due to the recognition that a large number of new, environmentally attractive, sustainable energy sources will be needed to meet ever increasing demand for electrical energy. Based on a series of course notes from graduate courses in plasma physics and fusion energy at MIT, the text begins with an overview of world energy needs, current methods of energy generation, and the potential role that fusion may play in the future. It covers energy issues such as the production of fusion power, power balance, the design of a simple fusion reactor and the basic plasma physics issues faced by the developers of fusion power. This book is suitable for graduate students and researchers working in applied physics and nuclear engineering. A large number of problems accumulated over two decades of teaching are included to aid understanding.
Proceedings of the magnetic fusion energy blanket & shield workshop
This paper summarizes nuclear-related work in support of the US effort for the International Thermonuclear Experimental Reactor (ITER) Study. Primary tasks carried out during the past year

include design improvements of the inboard shield developed for the TIBER concept, scoping studies of a variety of tritium breeding blanket options, development of necessary design guidelines and evaluation criteria for the blanket options, further safety considerations related to nuclear components, and issues regarding structural materials for an ITER device. The blanket concepts considered are the aqueous/Li salt solution, a water-cooled, solid breeder blanket, a helium-cooled, solid-breeder blanket, a blanket cooled by helium containing lithium-bearing particulates, and a blanket concept based on breeding tritium from He3. 1 ref., 2 tabs.

ERDA Energy Research Abstracts

This book provides a systematic and comprehensive introduction to fusion neutronics, covering all key topics from the fundamental theories and methodologies, as well as a wide range of fusion system designs and experiments. It is the first-ever book focusing on the subject of fusion neutronics research. Compared with other nuclear devices such as fission reactors and accelerators, fusion systems are normally characterized by their complex geometry and nuclear physics, which entail new challenges for neutronics such as complicated modeling, deep penetration, low simulation efficiency, multi-physics coupling, etc. The book focuses on the neutronic characteristics of fusion systems and introduces a series of theories and methodologies that were developed to address the challenges of fusion neutronics. Further, it introduces readers to the unique principles and procedures of neutronics design, experimental methodologies and methodologies for fusion systems. The book not only highlights the latest advances and trends in the field, but also draws on the experiences and skills collected in the author’s more than 40 years of research. To make it more accessible and enhance its practical value, various representative examples are included to illustrate the application and efficiency of the methods, designs and experimental techniques discussed.

Safety Issues Associated with Plutonium Involvement in the Nuclear Fuel Cycle

Thermal Design of Nuclear Reactors

Shielding of Fusion Reactors

Treats not only the physical, but the technological, ecological, and economic basis for using controlled nuclear fusion to produce energy. Topics on the development of fusion are examined without reference to the currently favored magnetic confinement and tokamak lines of fusion research except where problems are specific to them, in the case of a tokamak with deuterium-tritium plasma, for example. Discusses other less developed but potentially promising concepts for the future production of powerful neutron sources.

Controlled Thermonuclear Research

The "VOLGA" conferences, hosted in odd-numbered years by the Department of Theoretical and Experimental Reactor Physics of the Moscow Engineering Physics Institute (MEPhI), are some of the most prestigious technical meetings held in Russia. Traditionally, these conferences present the opportunity for reactor physicists from around the world to gather at MEPhI's holiday camp on the banks of the Volga river (near Tver) to exchange ideas and explore innovative concepts related to nuclear power development. In 1997, NATO became involved in the "VOLGA" meetings for the first time by co-sponsoring "VOLGA97" as an advanced research workshop. This workshop broke with tradition a bit in that the venue was moved from MEPhI's holiday camp to a location nearer Moscow. The workshop program was effectively organized in order to cover a broad range of topics relating to the theme of the meeting. Generally, the papers concerned safety related questions associated with utilizing both weapons-grade and reactor-grade plutonium in the nuclear fuel cycle, including facility requirements, licensing issues, proliferation risks, and a variety of advanced concepts for alternative fuel cycles. The program contained a total of ninety-nine papers presented in five days of sessions.

Plasma Physics and Fusion Energy

The blanket and shield assemblies of fusion reactors will contain a significant number of very sizable penetrations (neutral beam injection ducts, pumping ports, etc.). The combination of high-energy neutrons and large penetrations will introduce severe design problems that are quite different from those encountered previously. Fusion reactors with their penetrations are very complex geometric structures and in calculating nuclear effects (heating, activation, etc.) tradeoffs must be made between computing efficiency and the accuracy in the geometric modeling. The types of problems that arise due to large penetrations will be illustrated by the calculations that have been carried out to aid in the design of the shielding for the neutral beam injectors of the Tokamak Fusion Test Reactor being built at Princeton University.

A joint study of tokamak reactor first-wall/blanket/shield technology was conducted by Argonne National Laboratory (ANL) and McDonnell Douglas Astronautics Company (MDAC). The objectives of this program were the identification of key technological limitations for various tritium-breeding-blanket design concepts, establishment of a basis for assessment and comparison of the design features of each concept, and development of optimized blanket designs. The approach used involved a review of previously proposed blanket designs, analysis of critical technological problems and design features associated with each of the blanket concepts, and a detailed evaluation of the most tractable design concepts. Tritium-breeding-blanket concepts were evaluated according to the proposed coolant. The ANL effort concentrated on evaluation of lithium- and water-cooled blanket designs while the MDAC effort focused on helium- and molten salt-cooled designs. A joint effort was undertaken to provide a consistent set of materials property data used for analysis of all blanket concepts. Generalized nuclear analysis of the tritium breeding performance, an analysis of tritium breeding requirements, and a first-wall stress analysis were conducted as part of the study. The impact of coolant selection on the mechanical design of a tokamak reactor was evaluated. Reference blanket designs utilizing the four candidate coolants are presented.

Neutron Blanket Calculations for Thermonuclear Reactors, II

The optimization problem consists of four key elements: a figure of merit for the reactor, a technique for estimating the neutronic performance of the blanket as a function of the design variables, constraints on the design variables and neutronic performance, and a method for optimizing the figure of merit subject to the constraints. The first reactor concept investigated uses a liquid lithium blanket for breeding tritium and a steel blanket to increase the fusion energy multiplication factor. The capital cost per unit of net electric power produced is minimized subject to constraints on the tritium breeding ratio and radiation damage rate. The optimal design has a 91-cm-thick lithium blanket denatured to 0.1% 6Li. The second reactor concept investigated uses a BeO neutron multiplier and a LiAlO2 breeding blanket. The total blanket thickness is minimized subject to constraints on the tritium breeding ratio, the total neutron leakage, and the heat generation rate in aluminum support tendons. The optimal design consists of a 4.2-cm-thick BeO multiplier and 42-cm-thick $LiAlO_2$ breeding blanket enriched to 34% ^6Li.

Cumulative index

With the strong commitment of the US to the success of the ITER burning plasma mission, and the project overall, it is prudent to consider how to take the most advantage of this investment. The production of energy from fusion has been a long sought goal, and the subject of several programmatic investigations and time line proposals [1]. The nuclear aspects of fusion research have largely been avoided experimentally for practical reasons, resulting in a strong emphasis on plasma science. Meanwhile, ITER has brought into focus how the interface between the plasma and engineering/technology, presents the most challenging problems for design. In fact, this situation is becoming the rule and no longer the exception. ITER will demonstrate the deposition of 0.5 GW of neutron heating to the blanket, deliver a heat load of 10-20 MW/m2 or more on the divertor, inject 50-100 MW of heating power to the plasma, all at the expected size scale of a power plant. However, in spite of this, and a number of other technologies relevant power plant, ITER will provide a low neutron exposure compared to the levels expected to a fusion power plant, and will purchase its tritium entirely from world reserves accumulated from decades of CANDU reactor operations. Such a decision for ITER is technically well founded, allowing the use of conventional materials and water coolant, avoiding the thick tritium breeding blankets required for tritium self-sufficiency, and allowing the concentration on burning plasma and plasma-engineering interface issues. The neutron fluence experienced in ITER over its entire lifetime will be ˜0.3 MW-yr/m2, while a fusion power plant is expected to experience 120-180 MW-yr/m2 over its lifetime. ITER utilizes shielding blanket modules, with no tritium breeding, except in test blanket modules (TBM) located in 3 ports on the midplane [2], which will provide early tests of the fusion nuclear environment with very low tritium production (a few g per year).

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