Publications Catalogue 2006





IAEA
International Atomic Energy Agency

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Contents at a Glance

Atoms for Peace

The IAEA serves as the world's intergovernmental forum for scientific and technical cooperation in the nuclear field. It was set up as the world's "Atoms for Peace" organization in 1957 within the United Nations family. The IAEA works with its Member States and multiple partners worldwide to promote safe, secure and peaceful nuclear technologies.

The IAEA's mission is guided by the interests and needs of Member States, strategic plans and the vision embodied in the IAEA Statute. Three main pillars — or areas of work — underpin the IAEA's mission: Safety and Security; Science and Technology; and Safeguards and Verification.

IAEA Publications

The IAEA is one of the leading publishers in the field of nuclear science and technology, with titles on nuclear and radiological safety, emergency response, nuclear power, nuclear medicine, nuclear waste management, nuclear law and safeguards as well as relevant topics in food and agriculture, earth science, industry and the environment.

Key publications include the IAEA Safety Standards, which detail the principles of safety for protection against ionizing radiation, and IAEA Safety Reports, which describe good practices and give practical examples and detailed methods that can be used to meet safety requirements.

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Publications Catalogue 2006

including full details of publications published in 2004–2005 and forthcoming in 2006 and a stocklist of publications published in 2002–2003

Introduction

This Publications Catalogue lists all sales publications of the IAEA published in 2004, 2005 and forthcoming in 2006.

Most IAEA publications are issued in English, some are also available in Arabic, Chinese, French, Russian or Spanish. This is indicated at the bottom of the book entry.

A complete listing of all IAEA priced publications is available on the IAEA's web site:
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Prices of books are quoted in Euros. Prices do not include local taxes and are subject to change without notice. Shipping will be charged at cost. Publications are normally sent by surface mail. Delivery by air mail, courier service or by air freight is possible upon request.

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Contents

Radiation Medicine and Nutrition

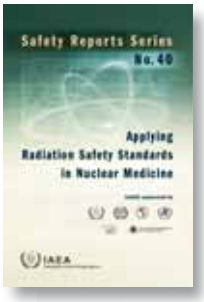
Screening of Newborns for Congenital Hypothyroidism

Guidance for Developing Programmes

Congenital hypothyroidism, when undiagnosed or if there is a lack of proper treatment management, results in an unnecessary health, economic and social burden. Formalized screening programmes to detect congenital hypothyroidism in newborn infants, and its timely treatment, can prevent lifelong human suffering caused by severe mental retardation. With the involvement of the IAEA, such screening programmes have been introduced successfully in a large number of countries. However, in many other countries, such programmes have not yet been established. This publication is intended to assist these countries in establishing and sustaining a comprehensive screening system for newborns and draws on experience gained over more than a decade. It provides information for making sound screening policy decisions and describes how a newborn screening system should be set up, offering guidance on assessing the quality of the system. The intended result is that more successful programmes will be established bringing about a significant improvement in child health care, worldwide.

(2006) • ISBN 92-0-109905-3 • STI/PUB/1234 • €40.00

Nuclear Medicine (including Radiopharmaceuticals)



Applying Radiation Safety Standards in Nuclear Medicine

Safety Reports Series No. 40

The International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources (BSS), jointly sponsored, inter alia, by the IAEA, the International Labour Organization, the WHO and the Pan American Health Organization, establish requirements on the legal persons responsible for designing, running and decommissioning practices involving ionizing radiation. These requirements are basic and general in nature. This report is intended to be of assistance to both regulators and users of radiation sources in nuclear medicine in applying the BSS to this practice. Regulators will find it useful for reviewing applications for authorization and for the inspection of the practice. Users of radiation in nuclear medicine may follow the guidance provided in order to comply with BSS requirements or equivalent national requirements. Experts recruited on IAEA missions to advise on the implementation of the BSS for the practice of nuclear medicine are expected to use the guidance given in this report rather than their own national regulations and guidance.

(124 pp.; 2005) • ISBN 92-0-111104-5 • STI/PUB/1207 • €28.00

Development of Kits for ^{99m}Tc Radiopharmaceuticals for Infection Imaging

IAEA TECDOC Series No. 1414

Development of ^{99m}Tc labelling strategies can be useful in the preparation of infection imaging agents by laboratories in Member States. With techniques that were developed for the testing of label stability in vitro and in vivo, with the laboratories participating in the project becoming proficient in labelling the chosen molecules with ^{99m}Tc using a variety of techniques, and with in vivo and in vitro quality assurance measurements standardized by all participants and applied, ^{99m}Tc agents were viewed as reliably labelled. Additionally, with the identification of ^{99m}Tc ubiquicidin peptide 29–41 as a radiolabelled agent with potential clinical utility, the project has made a major contribution to nuclear medicine by providing the first convenient ^{99m}Tc labelled 'specific' infection imaging agent.

(2004) • ISBN 92-0-111304-8 • IAEA-TECDOC-1414 • €15.00

Development of ^{99m}Tc Agents for Imaging Central Neural Systems Receptors

Technical Reports Series No. 426

Radiopharmaceuticals for imaging the receptors in the brain are of great interest in the management of several receptor related diseases such as epilepsy, Alzheimer's disease, Parkinson's disease, and depression and other psychiatric disorders. Technetium-99m is the ideal radioisotope for imaging, due to its low cost, its easy and universal availability through commercially available generator systems, and its physical decay characteristics. The IAEA organized a coordinated research programme (CRP) aimed at the development of ^{99m}Tc central neural system receptor imaging agents. This report summarizes the work carried out by different research groups during the CRP. The research projects presented by the participants include the development and evaluation of serotonin receptor ligands, benzodiazepinic receptor ligands, dopamine receptor ligands, and the study of novel cores for ^{99m}Tc labelling, as well as molecular modelling.

(198 pp., 88 figs; 2004) • ISBN 92-0-115303-1 • STI/DOC/010/426 • €33.00

Nuclear Medicine Resources Manual

This resources manual provides comprehensive guidance at an international level in many aspects of nuclear medicine practice, including education, training, facilities and equipment, quality systems, and radiopharmacy and clinical practice. The manual has been written with routine clinical practice in mind and therefore provides advice on many practical points that should help both new and also more developed nuclear medicine centres. The new centres will find specific information essential for setting up the provision of the service, and the more developed centres will find numerous updated protocols and suggestions on improving operational performance. The manual will be of interest to nuclear medicine physicians, radiologists, medical educationalists, diagnostic centre managers, medical physicists, medical technologists, radiopharmacists, specialist nurses, clinical scientists, laboratory scientists, and those engaged in high quality systems in public health.

**(2006) • ISBN 92-0-107504-9 •
STI/PUB/1198 • €65.00**

Radiation Therapy

Forthcoming

Applying Radiation Safety Standards in Radiotherapy

Safety Reports Series No. 38

The International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources (BSS), jointly sponsored, inter alia, by the IAEA, the ILO, the WHO and the PAHO, establish requirements on the legal persons responsible for designing, running and decommissioning practices involving ionizing radiation. These requirements are basic and general in nature. This report is intended to be of assistance to both regulators and users of radiation sources in radiotherapy in applying the BSS to this practice. Regulators will find it useful for reviewing applications for authorization and for the inspection of the practice. Users of radiation in radiotherapy may follow the guidance provided in order to comply with BSS requirements or equivalent national requirements. Experts recruited on IAEA missions to advise on the implementation of the BSS for the practice of radiotherapy are expected to use the guidance given in this report rather than their own national regulations and guidance.

**(Forthcoming 2006) • ISBN 92-0-110904-0 •
STI/PUB/1205 • €28.00**

Radiation Oncology Physics: A Handbook for Teachers and Students

This publication is aimed at students and teachers involved in programmes that train professionals for work in radiation oncology. It provides a comprehensive overview of the basic medical physics knowledge required in the form of a syllabus for modern radiation oncology. It will be particularly useful to graduate students and residents in medical physics programmes, to residents in radiation oncology, as well as to students in dosimetry and radiotherapy technology programmes. It will assist those preparing for their professional certification examinations in radiation oncology, medical physics, dosimetry or radiotherapy technology. It has been endorsed by several international and national organizations, and the material presented has already been used to define the level of knowledge expected of medical physicists worldwide.

**(657 pp., 137 figs; 2005) • ISBN 92-0-107304-6 •
STI/PUB/1196 • €65.00**

"All the chapters and sections have been very well organized and structured specifically from the viewpoint of presenting lectures on the fundamental concepts of modern radiation therapy physics... ...the book successfully fills the gap in the teaching material for the speciality of medical physics, and does so in a single manageable volume with a logical, well-thought-out structure for presenting and learning modern radiation therapy physics."

Stanley H. Benedict,
Virginia Commonwealth University

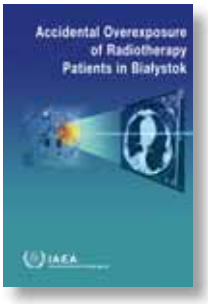
Radiation Protection in the Design of Radiotherapy Facilities

Safety Reports Series No. 47

This Safety Report provides practical guidance regarding the design and shielding of radiotherapy facilities. Methods for determining the necessary structural shielding for external beam units (^{60}Co units, linear accelerators, superficial and orthovoltage units, and simulators), as well as brachytherapy units, are described. Data used for determining the structural shielding necessary for all types of radiotherapy facilities are reproduced in this report and example calculations are provided for each type of facility. In addition, specific design features that could be incorporated into radiotherapy facilities, including those related to the security of radioactive sources, are discussed. This report is intended to be used primarily by radiological physicists in the planning and design of new radiotherapy facilities and in the remodelling of existing facilities. Sections of the report will also be of interest to architects, civil engineers, hospital administrators and others who are concerned with the design of radiotherapy facilities. In addition, the guidance in the report will be useful to regulatory personnel responsible for the licensing and inspection of these facilities.

**(2006) • ISBN 92-0-100505-9 •
STI/PUB/1223 • €29.00**

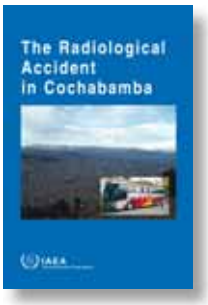
Radiation biology



Accidental Overexposure of Radiotherapy Patients in Bialystok

An accidental overexposure occurred in the Bialystok Oncology Centre which affected five patients undergoing radiotherapy. This report gives an account of the event, the subsequent dose assessment and the clinical consequences for the patients. It also discusses the lessons learned and provides recommendations for preventing similar events from occurring in future. As such the report is likely to be of use to the manufacturers and users of accelerators and to national bodies.

(103 pp., 38 figs; 2004) • ISBN 92-0-114203-X • STI/PUB/1180 • €24.00



The Radiological Accident in Cochabamba

In April 2002 an accident involving an industrial radiography source containing ^{192}Ir occurred in Cochabamba, Bolivia, some 500 km from the capital, La Paz. The source, in a remote exposure container, remained exposed within a guide tube, although this was not known at the time. The container, guide tube and other equipment were transported from Cochabamba to La Paz as cargo on a passenger bus. This bus had a full load of passengers for most of the eight hour journey. The equipment was subsequently collected by employees of the company concerned and transferred by taxi to the company's shielded facility. This publication gives an account of the event, the doses received and the medical assessment. It also presents information relevant to national authorities and regulatory organizations, emergency planners and a broad range of specialists, including physicists, radiation protection officers and medical specialists. It is hoped that dissemination of the information contained in the report will help reduce the likelihood of similar accidents occurring or, if they do occur, help mitigate their consequences.

(55 pp., 20 figs; 2004) • ISBN 92-0-107604-5 • STI/PUB/1199 • €19.00

Medical physics (including dosimetry)

Absorbed Dose Determination in External Beam Radiotherapy

An International Code of Practice for Dosimetry Based on Standards of Absorbed Dose to Water

Technical Reports Series No. 398

This Code of Practice, which has also been endorsed by WHO, PAHO and ESTRO, fulfils the need for a systematic and internationally unified approach to the calibration of ionization chambers in terms of absorbed dose to water and to the use of these detectors in determining the absorbed dose to water for the radiation beams used in radiotherapy. It provides a methodology for the determination of absorbed dose to water in the low, medium and high energy photon beams, proton beams and heavy ion beams used for external radiation therapy.

Contents: 1. Introduction; 2. Framework; 3. $N_{D,w}$ based formalism; 4. Implementation; 5. Code of Practice for Co-60 gamma ray beams; 6. Code of Practice for high energy photon beams; 7. Code of Practice for high energy electron beams; 8. Code of Practice for low energy kilovoltage X ray beams; 9. Code of Practice for medium energy kilovoltage X ray beams; 10. Code of Practice for proton beams; 11. Code of Practice for heavy ion beams; Appendix I: Relation between N_K and $N_{D,w}$ based Codes of Practice; Appendix II: Calculation of $k_{Q,Q0}$ and its uncertainty; Appendix III: Photon beam quality specification; Appendix IV: Expression of uncertainties.

English Edition (229 pp., 26 figs; 2000) • ISBN 92-0-102200-X3 • STI/DOC/010/398 • €51.00
Russian Edition (251 pp., 26 figs; 2004) • ISBN 92-0-404504-3 • STI/DOC/010/398 • €51.00
Spanish Edition (261 pp., 26 figs; 2005) • ISBN 92-0-302005-5 • STI/DOC/010/398 • €51.00

Forthcoming

Applying Radiation Safety Standards in Diagnostic Radiology and Interventional Procedures Using X Rays

Safety Reports Series No. 39

The International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources (BSS), jointly sponsored, inter alia, by the IAEA, the ILO, the WHO and the PAHO, establish requirements on the legal persons responsible for designing, running and decommissioning practices involving ionizing radiation. These requirements are basic and general in nature. This report is intended to be of assistance to both regulators and users of radiation sources in diagnostic radiology and interventional procedures using X rays in applying the BSS to this practice. Regulators will find it useful for reviewing applications for authorization and for the inspection of the practice. Users of radiation in radiology may follow the

guidance provided in order to comply with BSS requirements or equivalent national requirements. Experts recruited on IAEA missions to advise on the implementation of the BSS for the practice of diagnostic radiology and interventional procedures using X rays are expected to use this regulatory guidance report rather than their own national regulations and guidance.

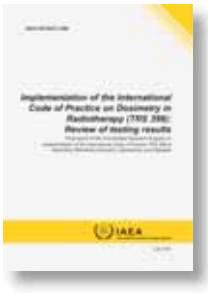
**(Forthcoming 2006) • ISBN 92-0-111004-9 •
STI/PUB/1206 • €28.00**

Commissioning and Quality Assurance of Computerized Planning Systems for Radiation Treatment of Cancer

Technical Reports Series No. 430

This report is intended to support hospitals in developing procedures for the commissioning and quality assurance (QA) of computerized treatment planning systems (TPSs). The relatively low cost of today's equipment has made TPSs widely available in industrialized and developing countries, but, with the exception of a few national recommendations for QA in North America and Western Europe, there are no publications available that professionals can follow to develop procedures to check their TPSs. The rationale for the multiple tests described in this report is related to the four major issues of a well structured QA programme in computerized treatment planning, namely education, verification, documentation and communication.

**(281 pp., 27 figs; 2004) • ISBN 92-0-105304-5 •
STI/DOC/010/430 • €42.00**



Implementation of the International Code of Practice on Dosimetry in Radiotherapy (TRS 398): Review of Testing Results

IAEA TECDOC Series No. 1455

The purpose of this report is twofold: to provide guidelines to Secondary Standards Dosimetry Laboratories (SSDLs) on how to establish a standard of absorbed dose to water in a ^{60}Co gamma ray beam and to provide guidelines to clinical physicists on the changes that can be expected when IAEA Technical Reports Series No. 398 (TRS-398) is adopted in a hospital environment in place of another code of practice based on air kerma standards. The results of measurements made with ^{60}C beams, low and medium energy X ray beams, high energy photon and electron beams, and proton and heavy ion beams are grouped in tabular and graphical forms for different ionization chambers and beam energies showing the expected differences in absorbed dose determination between TRS-398 and other existing codes of practice.

**(2005) • ISBN 92-0-105005-4 •
IAEA-TECDOC-1455 • €15.00**

Optimization of the Radiological Protection of Patients: Image Quality and Dose in Mammography (Coordinated Research in Europe)

IAEA TECDOC Series No. 1447

In view of the vast potential of mammography as an imaging modality to achieve early detection of breast cancer, and the recommendations of various national and international organizations to achieve optimization in mammography, the IAEA initiated a coordinated research project in 1999. The project was confined to six countries in Eastern Europe. The purpose was to access the situation with regard to image quality and patient dose, identify corrective actions needed to achieve optimization, implement corrective actions and evaluate the impact. Useful observations were made, and ultimately it was possible to achieve, on average, a 25% reduction in dose while maintaining image quality. It is hoped that this publication will prove useful to Member States in setting up programmes for optimization of radiological protection in mammography.

**(2005) • ISBN 92-0-102305-7 •
IAEA-TECDOC-1447 • €15.00**

Optimization of the Radiological Protection of Patients Undergoing Radiography, Fluoroscopy and Computed Tomography

IAEA TECDOC Series No. 1423

National surveys in the UK and USA have indicated that there are large variations in patient doses for routine radiographic examinations, sometimes as high as 20 times or more. This indicates that variations in developing countries, where there may also be older machines or poor maintenance facilities, should be a matter of concern. This publication contains the results of a coordinated research project carried out in countries in Eastern Europe, Africa and Asia. Considerable variations were observed in general radiography. The experience with optimization indicated significant reductions in patient dose with acceptable image quality consistent with the clinical purpose of the examination. The methodology, based on patient dose measurements, comparison with reference values, assessment of image quality, the introduction of quality control (QC) and corrective actions, wherever needed, and re-evaluation of patient doses and image quality, has demonstrated its effectiveness for the optimization of radiation protection programmes. This publication also contains the results of a situation analysis of patient doses and QC status in fluoroscopy and in computed tomography.

**(2004) • ISBN 92-0-113504-1 •
IAEA-TECDOC-1423 • €15.00**

Radiological Protection for Medical Exposure to Ionizing Radiation

Safety Guide

Safety Standards Series No. RS-G-1.5

This Safety Guide provides recommendations on how safety requirements may be fulfilled for the protection of patients and visitors against exposure to ionizing radiation in medical practice. Recommendations cover the establishment of guidance levels for diagnostic medical exposures, acceptance testing processes for radiation equipment, calibration of radiotherapy units and reporting of accidental medical exposures.

Contents: 1. Introduction; 2. Regulatory programme for radiological protection for medical exposure; 3. Specific aspects of radiological protection for medical exposure in diagnostic and interventional radiology; 4. Specific aspects of radiological protection for medical exposure in nuclear medicine; 5. Specific aspects of radiological protection for medical exposure in radiotherapy; Annex I: General requirements; Annex II: Medical exposure; Annex III: Schedule II. Dose limits. Dose limitation for comforters and visitors of patients; Annex IV: Schedule III. Guidance levels of dose, dose rate and activity for medical exposure; Glossary.

Chinese Edition (65 pp.; 2005) • ISBN 92-0-516604-9 • STI/PUB/1117 • €14.50
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French Edition (89 pp.; 2004) • ISBN 92-0-202204-6 • STI/PUB/1117 • €14.50
Russian Edition (99 pp.; 2004) • ISBN 92-0-402104-7 • STI/PUB/1117 • €14.50

Standardized High Current Solid Targets for Cyclotron Production of Diagnostic and Therapeutic Radionuclides

Technical Reports Series No. 432

Radionuclides continue to play an important role in diagnostic and therapeutic applications in modern nuclear medicine. Many of these radionuclides are produced using cyclotron accelerators, and the corresponding laboratory production methodologies and technologies are subject to constant improvements. This publication summarizes the laboratory protocols developed over a three year period for the production of radionuclides using solid target technology, in particular ^{201}Tl, ^{123}I, ^{124}I and ^{103}Pd, which are important radioisotopes for use in medical diagnosis and therapy. This publication is a suitable guide for radioisotope laboratories, cyclotron and radiochemical production facilities, and will be of interest to those dealing with production and applications of radioisotopes and radiopharmaceuticals for nuclear medicine and industrial purposes. A CD-ROM is included.

(71 pp.; 2004) • ISBN 92-0-109304-7 • STI/DOC/010/432 • €40.00

Food and Agriculture

Determination of Human Pathogen Profiles in Food by Quality Assured Microbial Assays

IAEA TECDOC Series No. 1431

This publication includes the results of a Coordinated Research Project (CRP). Major food microbial contaminants were identified in some of the main foods exported in the international food market. Thousands of samples in a wide variety of foods were selected to be studied during different points of the food chain: meat (chicken, beef and pork), seafood (shellfish such as shrimp, prawns, scampi, squid, and lobsters, and different types of fish such as salmon, cuttle fish, rohu, fin herring, catfish, milkfish and tilapia), spices (pepper and paprika), frozen vegetables (asparagus, peas and corn) and other products (coconut and dairy products). The analysis included pathogenic bacteria such as *Salmonella spp.* (several serotypes), *Escherichia coli, E. coli 0157:H7, Staphylococcus aureus, Clostridium perfringens, Bacillus cereus, Vibrio choleare, Vibrio parahaemolitycus* and *Yersinia enterolitica*. This CRP produced data to conduct better risk assessments on food in importing as well as exporting countries.

(2005) • ISBN 92-0-115704-5 • IAEA-TECDOC-1431 • €15.00

Food irradiation

Irradiation as a Phytosanitary Treatment of Food and Agricultural Commodities

IAEA TECDOC Series No. 1427

This publication includes the results of a Coordinated Research Project (CRP). The results contain data on the effect of low doses of irradiation at different stages of development of almost 30 different species of insects and mite which represent major trade problems. It is important to note that some of the projects resulted in the first approvals against non-fruit fly pests (sweet potato weevil and mango seed weevil). This publication also includes information about the tolerance to irradiation of some commodities, packaging materials, methodologies used and the effect of a few combined treatments. This CRP includes also a number of firsts such as the first large-scale confirmatory tests for several non-fruit fly pests, the first commercial shipment of cut flowers using irradiation as part of a quarantine treatment, and extensive studies on the response of mites to irradiation.

(2004) • ISBN 92-0-113804-0 • IAEA-TECDOC-1427 • €15.00

Insect pest control

Biology, History, Threat, Surveillance and Control of the Cactus Moth, *Cactoblastis cactorum*

Alien invasive insect pests are increasingly threatening agriculture and the environment. In the context of rapidly growing international travel and trade, the potential for moving dangerous pest species to new geographical regions and locations has been increasing. One such species is the cactus moth, *Cactoblastis cactorum* (Pyralidae). As a result of worldwide increases in opuntia cultivation and increased reliance on opuntia as a source of food, and on income from its products, the invasion by *C. cactorum* has a potential impact on thousands of subsistence farmers. Furthermore, *C. cactorum* is considered a serious threat to the high diversity of opuntia species in North America. The sterile insect technique (SIT) is the ideal tool to complement efforts to eliminate beachheads of alien insect invasions. An increased role is foreseen for the use of SIT in suppression of alien invasive species, which will help FAO and IAEA Member States deal with the threat of outbreaks of such pests.

(2004) • ISBN 92-0-108304-1 • IAEA/FAO-BSC/CM • €30.00

Environmental Benefits of Medfly SIT in Madeira and their Inclusion in a Cost–benefit Analysis

IAEA TECDOC Series No. 1475

This study was funded by the Joint FAO/IAEA Programme of Nuclear Techniques in Food and Agriculture. It presents an economic model and the methods selected for the evaluation of environmental benefits of the Mediterranean fruit fly sterile insect technique (SIT) in Madeira (Madeira-Med). It quantifies the key costs and benefits of Madeira-Med to carry out an economic analysis to assess the economic returns of SIT use in Madeira, including the benefits obtained from environmental savings. Recent cost–benefit analyses for proposed insect pest eradication or suppression programmes have included some environmental factors; however, a systematic valuation of these factors, as developed in this study, had not been carried out in previous analyses.

(2005) • ISBN 92-0-110505-3 • IAEA-TECDOC-1475 • €15.00

Forthcoming

Status and Risk Assessment of the Use of Transgenic Arthropods in Plant Protection

IAEA TECDOC Series No. 1483

New technologies, such as genetic engineering, may offer possibilities to increase the effectiveness of the sterile insect

technique (SIT) for the control of insect pests. Although the basic technology for transformation is now quite effective for many insect species, the complex issues related to their release remains unclear. This is especially so considering the current public perception of transgenic technology in general. In order to try to initiate the development of a responsible regulatory framework for any eventual release of transgenic insects, the FAO, IAEA and IPPC convened a consultants meeting in Rome during 2002. The consultants reviewed the current status of insect transgenesis, identified current technical constraints and developed draft risk assessment protocols. This publication summarizes the deliberations of the group and provides full texts of the working papers.

(Forthcoming 2006) • ISBN 92-0-113005-8 • IAEA-TECDOC-1483 • €15.00

Mutation plant breeding

Genetic Improvement of Under-utilized and Neglected Crops in Low Income Food Deficit Countries through Irradiation and Related Techniques

IAEA TECDOC Series No. 1426

This publication contains the results of an FAO/IAEA Coordinated Research Project (CRP). It highlights the integration of radiation induced mutations in vitro culture and molecular genetics methods into the conventional breeding of neglected and under-utilized crops. The successful results included are: plant regeneration strategies in *Dioscorea spp.*, grass peas and bambara ground nuts, root rot disease tolerant putative mutants of cocoyam, and a genetic diversity bank of bamabara ground nuts, quinoa, narajilla, okra, *Amaranthus tricolor*, and *A. cruentus*. This publication is relevant to individuals working in the area of enhancing the genetic improvement of such crops and for further advancing international programmes for improving food security, nutrition, socioeconomic aspects, employment generation and sustainable food production.

(2004) • ISBN 92-0-113604-8 • IAEA-TECDOC-1426 • €15.00

Mutational Analysis of Root Characters in Food Plants

Roots play a critical role in efficient uptake of water and nutrient from the soil through adaptation of its architecture, construction plasticity, specialized structures, physiological responses and beneficial relationships with microorganisms. Roots also serve as storage organs for carbohydrates, they anchor plants in soil and may act as perennating structures that last for many years. However, information on the genetic analysis of root traits is scarce and few characterized root mutants of crop plants are available, mainly because of the difficulty in accessing and studying this below ground organ. A Coordinated Research Programme on Mutation Analysis of Root Characters in Annual Food Plants Related to Plant Performance was implemented over a period of over five years (1999–2004). This publication is a collection of 14 research articles describing the work and achievements made by the participants, covering topics from methodologies for evaluating root structure and function, induced root mutants, and molecular genetic and physiological analysis, as well as other related studies in different crops. This publication will go a long way in setting the stage for the prevalent generation, selection and use of root mutants in crop improvement programmes.

(Forthcoming 2006) • ISBN 92-0-103106-8 • IAEA-TECDOC-1493 • €15.00

Plant biotechnology

Low Cost Options for Tissue Culture Technology in Developing Countries

IAEA TECDOC Series No. 1384

This publication describes options for reducing costs in the establishment and operation of plant tissue culture facilities and focuses primarily on plant micropropagation. It includes the basics of tissue culture technology, bioreactors, low cost options in the design of laboratories, use of media and containers, energy and labour saving, integration and adoption of low cost options, increasing plant survival after propagation, and outreach of material to growers and farmers in developing countries. The publication will be of particular value to the micropropagation industry in developing countries for the enhancement of agricultural productivity to enable sustainable food production where infrastructure and facilities for tissue culture are not readily available and where there is a scarcity of financial support. The publication will also serve plant propagators, managers of tissue culture laboratories, scientists and organizations contemplating the establishment of new laboratories, and ongoing commercial concerns, which may incorporate low cost options.

(2004) • ISBN 92-0-115903-X • IAEA-TECDOC-1384 • €15.00

Soil fertility and irrigation

Nutrient and Water Management Practices for Increasing Crop Production in Rainfed Arid/Semi-arid Areas

IAEA TECDOC Series No. 1468

The efficient use of scarce water resources is vital for ensuring adequate and stable agricultural production in many developing countries located in arid and semi-arid regions. The results from ten Member States have shown that crop yields can increase and yield variation be reduced in rainfed agriculture with proper management of cropping systems, stored rainfall water and judicious use of inputs such as supplemental water

use, chemical fertilizers and organic residues. This publication shows how improved fertilizer management practices, when suited to local conditions, can reduce by up to 50% the current recommended fertilizer nitrogen rates without significant loss of crop yields. The amount and distribution of rainfall during the growing season had a strong impact on crop yields and the utilization of applied nitrogen, while the application of nitrogen fertilizer enhanced water use efficiency of crops through improved ground cover and reduced evapo-transpiration. The inclusion of grain legumes as intercrops or rotation crops in millet based cropping systems also helped to significantly increase the efficiency of nitrogen use by millet.

**(2005) • ISBN 92-0-109405-1 •
IAEA-TECDOC-1468 • €15.00**

**CD Edition (2005) • ISBN 92-0-113505-X •
IAEA-TECDOC-CD-1468 • €15.00**

AGROCHEMICALS

Validation of Thin-layer Chromatographic Methods for Pesticide Residue Analysis

IAEA TECDOC Series No. 1462

Thin layer chromatography (TLC) was widely used in the 1960s and 1970s for pesticide residue analysis, but only to a limited extent since gas-liquid chromatography (GLC) and high performance liquid chromatography (HPLC) became readily available. In recent years, there have been various developments in the quality of plate coating and in detection systems, as well as in extraction and cleanup methods, which make it possible to apply TLC according to the current international quality standards. The TLC methods described in this publication are intended for laboratories where an irregular supply of electricity, a lack of service or a limited budget do not allow the continuous use of GLC and HPLC techniques, and where the application of mass spectrometric detection is not feasible. TLC analytical techniques allow for screening, semi-quantitative determination and confirmation of pesticide residues and other organic trace contaminants with minor requirements on equipment and laboratory infrastructure. TLC methods are therefore particularly suitable for laboratories working on limited budgetary resources.

**(2005) • ISBN 92-0-108205-3 •
IAEA-TECDOC-1462 • €15.00**

ANIMAL PRODUCTION AND HEALTH

Improving Artificial Breeding of Cattle in Africa Guidelines and Recommendations

IAEA TECDOC Series No. 1437

This manual of protocols, procedures, guidelines and recommendations was produced under an IAEA Technical Cooperation Project. It is the result of an interactive collaboration between the national coordinators of the project, several experts in artificial insemination (AI) in the participating Member States, two IAEA experts who assisted with the project and the technical officer from the Joint FAO/IAEA Division. The manual is intended for livestock specialists involved in the provision of AI services to cattle farmers in Africa, including those in ministries of agriculture/livestock, departments of livestock and veterinary services, AI centres, semen distribution centres and field level AI service points. It is also a useful resource for teachers and students in faculties of veterinary and animal sciences, and those involved in the training of AI technicians.

**(2005) • ISBN 92-0-100705-1 •
IAEA-TECDOC-1437 • €15.00**

Improving Artificial Breeding of Cattle in Asia Guidelines and Recommendations

IAEA TECDOC Series No. 1480

This manual of protocols, procedures, guidelines and recommendations was produced under an IAEA Technical Cooperation Project entitled “Improving Animal Productivity and Reproductive Efficiency”, which was implemented within the framework of the RCA programme, with the technical support of the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture. It is the result of an interactive collaboration between the national project coordinators of the project, several experts in artificial insemination (AI) in the participating Member States, IAEA experts who assisted with the project and the technical officer from the Joint FAO/IAEA Division. This manual is intended for livestock specialists involved in the provision of AI services to cattle farmers in Asia, including those in the Ministries of Agriculture/Livestock, Departments of Livestock and Veterinary Services, AI centres, semen distribution centres and field level AI service points. It is also a useful resource for teachers and students in the faculties of veterinary and animal sciences, and those involved in the training of AI technicians.

**(2005) • ISBN 92-0-112005-2 •
IAEA-TECDOC-1480 • €15.00**

Nuclear Measurements, Techniques and Instrumentation

Technical Data on Nucleonic Gauges

IAEA TECDOC Series No. 1459

This nucleonic gauge manual and directory provides a reference database of nucleonic control systems available to potential users in the fields of exploration, exploitation and processing of natural resources and in the manufacturing industries. The basic principles of the most popular techniques are reviewed and reference data links to suppliers are provided. Information sheets on many typical commercial devices are also included. It will help end-users to select the most suitable alternative to solve a particular problem or to measure a certain parameter in a specific process.

(2005) • ISBN 92-0-107805-6 • IAEA-TECDOC-1459 • €15.00

Physics

Emerging Applications of Radiation in Nanotechnology

IAEA TECDOC Series No. 1438

Nanotechnology is one of the fastest growing areas in science and engineering. For synthesis of nanoparticles and nanocomposites with improved characteristics, radiation based technology using X rays, beams and ion beams is the key to a variety of different approaches to micropatterning. Radiation processed nanomaterials with high abrasion and high scratch resistance or biomedical usage (controlled release drug delivery systems) are of increasing importance. The ability to fabricate structures with nanometric precision is fundamental to any exploitation of nanotechnology. This publication covers selected developments in nanotechnology and on this basis presents the potential role of radiation applications in the field. It is the first publication on radiation applications in nanotechnology and therefore will play an important role in stimulating further research on the subject.

(2005) • ISBN 92-0-100605-5 • IAEA-TECDOC-1438 • €15.00

Radioisotope Handling Facilities and Automation of Radioisotope Production

IAEA TECDOC Series No. 1430

Radioisotopes make important contributions in various sectors of economic significance including medicine, food processing, industry, agriculture and research. Radioisotope handling facilities may be upgraded for production of radiopharmaceuticals, radioisotope generators and radioactive sources, and for medical and industrial applications. Handling of radioactivity needs special facilities to shield the radiation emitted and to prevent contamination of the environment. In addition, radioisotopes for medical applications must comply with GMP requirements. The automation of radioisotope handling facilities for various operations in hot cells such as target handling, radiochemical processing, radiopharmaceuticals manufacturing, dispensing or autoclaving is crucial. Radioisotope handling facilities that are optimized to significantly reduce radiation dose and increase GMP compliance are elaborated upon in this publication.

(2004) • ISBN 92-0-116104-2 • IAEA-TECDOC-1430 • €15.00

Chemistry

Advances in Radiation Chemistry of Polymers

IAEA TECDOC Series No. 1420

The radiation chemistry of polymers is one of the most important fields in the sciences concerning radiation induced chemical and physical changes in materials. Polymers are the most often irradiated materials, those most often modified and the main component of radiation sterilized medical products. The changes in their structure may be either beneficial or undesirable. This is the reason why the R&D concerning these materials is broad, and most developments concerning radiation processing are foreseen in this area. Different aspects of basic research and R&D were presented during the meeting on 'Advances in Radiation Chemistry of Polymers' held at the Notre Dame Radiation Laboratory, University of Notre Dame, Indiana, USA, and this publication contains the proceedings of this meeting. The leading experts in the field participated at the meeting, and the present status of the subject and the trends foreseen in it were discussed. Therefore this publication is the most up to date available on the subject.

(2004) • ISBN 92-0-112504-6 • IAEA-TECDOC-1420 • €15.00

Dosimetry (techniques)

Calibration of Photon and Beta Ray Sources Used in Brachytherapy

IAEA TECDOC Series No. 1274

This publication discusses calibration techniques of the most commonly used gamma and beta ray brachytherapy sources. For ^{137}Cs low dose rate (LDR) source calibrations, the IAEA Dosimetry Laboratory maintains reference sources calibrated at a primary standards dosimetry laboratory. These sources can be used to calibrate well type ionization chambers maintained at the secondary standards dosimetry laboratories. In Section 7 of this publication ^{137}Cs LDR calibrations are discussed in detail.

English Edition (2002) •
IAEA-TECDOC-1274 • €15.00
Spanish Edition (2004) • ISBN 92-0-300404-1 •
IAEA-TECDOC-1274 • €15.00

Nuclear analytical techniques

Analytical Applications of Nuclear Techniques

The contributions from some of the world's leading nuclear analysts included in this book describe a variety of nuclear techniques and applications, such as those in the fields of environment and health, industrial processes, non-destructive testing, forensic and archaeological investigations and cosmochemistry, and in method validation. The descriptive articles demonstrate the advantages of nuclear techniques in, for example, analysing trace elements in submilligram samples in a single strand of hair or in kilogram samples of municipal waste. Halogenated organic compounds as well as major and trace inorganic constituents are analysed in a variety of solid and liquid matrices. Several different techniques are applied to investigate the authenticity of art objects and the origin of extraterrestrial material. Many applications of nuclear analytical techniques in industrial process control or in the production of high-tech materials are described, highlighting the socioeconomic benefit of these techniques in our daily lives. The book is intended to stimulate students, teachers and non-nuclear scientists to take the 'nuclear' option into consideration when deciding on a new field of study or an alternative analytical technique.

(203 pp., 41 fig.; 2004) • ISBN 92-0-114703-1 •
STI/PUB/1181 • €25.00

Forthcoming

Database of Prompt Gamma Rays from Slow Neutron Capture for Elemental Analysis

Technical Reports Series No. 447

Neutron-capture prompt-gamma activation analysis (PGAA) is particularly valuable as a non-destructive nuclear method in the measurement of elements that do not form neutron capture products with delayed gamma ray emissions. Inaccurate and incomplete data have been a significant hindrance in the qualitative and quantitative analysis of complicated capture-gamma spectra by means of PGAA. The reason for producing this database was to improve the quality and quantity of required data in order to make possible the reliable application of PGAA in fields such as materials science, geology, mining, archaeology, environment, food analysis and medicine. The database provides a variety of tables for all natural elements (from H to U) including the following data: isotopic composition, thermal radiative cross-section (total and partial), Westcott g-factors, energy of the gamma rays (prompt and delayed), decay mode, half-life and branching ratios.

The CD-ROM included in this publication contains the database, the retrieval system and important electronic documents related to the project.

(Forthcoming 2006) • ISBN 92-0-101306-X •
STI/DOC/010/447 • €70.00

In Situ Applications of X Ray Fluorescence Techniques

IAEA TECDOC Series No. 1456

X ray fluorescence (XRF) spectrometry was perhaps the first spectroscopic technique which could successfully be applied in the field and in industrial environments for in situ analysis of various materials. Modern, high resolution, portable XRF analysers bring to field sites not only an excellent performance often matching that of laboratory instruments but also unsurpassed savings in time and labour. This publication describes the results of the coordinated research project on 'In situ Applications of XRF Techniques', including improvements in the construction of field-portable XRF analysers, methods and procedures for correction of major interfering effects to improve interpretation and quantification of the analytical results, as well as complete operating procedures and guidelines for selected in situ applications for: (i) sampling and analysis of soils, sediments and rocks, (ii) non-destructive analysis of works of art and (iii) characterization of alloys and scrap metal sorting.

(2005) • ISBN 92-0-107105-1 •
IAEA-TECDOC-1456 • €15.00

Ion Beam Techniques for the Analysis of Light Elements in Thin Films, Including Depth Profiling

IAEA TECDOC Series No. 1409

This publication highlights the achievements of a Coordinated Research Project (CRP) in promoting the potential of accelerator-based nuclear techniques of analysis for light elements in thin films. The objectives of this CRP were to develop a coordinated research effort between accelerator laboratories and materials science research groups in order to assist and promote the development of quality assurance methods, to evaluate databases of the parameters needed for quantitative analysis, and to develop and apply techniques to selected problems concerning the surface modification of materials and the production of thin films. Through various case studies, this publication assesses and demonstrates the effectiveness of accelerator-based nuclear techniques for analysis to provide valuable data and knowledge not readily accessible using other methods.

(2004) • ISBN 92-0-110404-9 •
IAEA-TECDOC-1409 • €15.00

Isotopic and Nuclear Analytical Techniques for Health and Environment

C&S Papers CD Series No. 22

This publication is the CD-ROM proceedings of the 2003 International Conference on 'Isotopic and Nuclear Analytical Techniques for Health and Environment' organized by the IAEA. The conference brought together scientists, technologists and representatives of industry and regulatory authorities to exchange information and review the status of current applications of isotopic techniques and nuclear analytical techniques (NATs). Future trends and developments of NATs were also discussed. Potential opportunities were identified for application of isotopic techniques and NATs in health and environmental studies in developing countries, and mechanisms were explored for promoting and transferring such technologies. The purpose of the conference was to address developments and trends in health care, nutrition and environmental monitoring, and to exchange information in an international forum to identify future fields of application for isotopic techniques and NATs. In a round-table discussion, the conference addressed possible means and mechanisms for knowledge management and knowledge preservation in areas where interest in nuclear energy and nuclear applications is discouraged and declining, and for building capacity in areas where development potential is still available.

CD Edition (2004) • ISBN 92-0-100504-0 •
IAEA-CSP-22/CD • €15.00

Measurement of Residual Stress in Materials Using Neutrons

Proceedings of a technical meeting held in Vienna, Austria, 13-17 October, 2003

IAEA TECDOC Series No. 1457

Stress is developed during the synthesis and use of materials such as alloys and compounds. Measurement of residual stress is essential to improve the quality of synthesized materials and diagnosis of failure and/or reliability of fabricated components. Neutron scattering is a non-destructive technique and is useful for testing large samples. The method has applications in engineering industries, including the nuclear industry.

(2005) • ISBN 92-0-106305-9 •
IAEA-TECDOC-1457 • €15.00
CD Edition (2005) • ISBN 92-0-109005-6 •
IAEA-TECDOC-CD-1457 • €15.00

Forthcoming

Neutron Reflectometry: A Probe for Material Surfaces

Thin films and multilayers have applications in development of sensors, neutron guides and beam deflectors. Adsorption of surfactants and polymers is important in technological and industrial applications. Characterization of these thin films is essential for their use in appliances. The special features of neutron interaction with matter make neutron reflectometry a powerful tool for probing these surfaces and multilayers. It is also useful in the studies of surface corrosion of metals. The additional advantage of the method is that it can be effectively used with medium flux reactors also. This publication gives an introduction into the theory underlying this method, its potential applications and a description of existing facilities. It will be useful as a guide to the neutron beam user groups interested in developing a neutron reflectometer and enhance reactor utilization.

(Forthcoming 2006) • €70.00

Nuclear Analytical Methods for Platinum Group Elements

IAEA TECDOC Series No. 1443

This publication is intended to provide the reader with state of the art information on the various aspects of platinum group element (PGE) analysis and to advise which techniques might be most suitable for a particular analytical problem related to PGEs. In particular, many case studies are described in detail. Since in many cases nuclear techniques might not be available or sufficiently sensitive, non-nuclear techniques, such as atomic adsorption spectroscopy, voltametry or inductively coupled plasma mass spectroscopy, are also included in the discussion.

The complexity of the problem requires full exploitation of the analytical armoury to obtain reliable and accurate results.

**(2005) • ISBN 92-0-102405-3 •
IAEA-TECDOC-1443 • €15.00**

Quantifying Uncertainty in Nuclear Analytical Measurements

IAEA TECDOC Series No. 1401

Dedicated specifically to nuclear analytical techniques, this publication is intended to assist scientists using alpha, beta and gamma spectrometries, neutron activation and XRF analyses, and other nuclear analytical methods, in assessing and quantifying the sources of uncertainty in their daily measurements. It complements the 'Guide to the Expression of Uncertainty in Measurement' published by ISO and other organizations in 1993, and the EURACHEM Guide on 'Quantifying Uncertainty in Analytical Measurement', the second edition of which was published in 2000. Thirteen selected worked examples on quantification of measurement uncertainty covering a number of nuclear analytical techniques and different measurand/matrix combinations are elaborated in detail. This publication may therefore be used as a course material as well as guidance in the assessment of competence for accreditation and similar purposes for laboratories applying nuclear analytical techniques.

**(2004) • ISBN 92-0-108404-8 •
IAEA-TECDOC-1401 • €15.00**

Use of Isotope Techniques to Trace the Origin of Acidic Fluids in Geothermal Systems

IAEA TECDOC Series No. 1448

Acidic fluids occur in geothermal well discharges. As they cause serious damage to production wells and transmission pipelines, their origin needs to be understood in order to design appropriate preventive or treatment measures for sustainable geothermal energy production. Realizing the potential contribution of stable isotopes of the water molecule and those of sulphur compounds in tracing the sources of acidic fluids, especially the sulphate type of acidity in geothermal well discharges, the IAEA implemented a Coordinated Research Project (CRP) in which ten research groups carried out field and laboratory investigations on twenty geothermal fields. Scientists in this project used a variety of isotopes as tracers and temperature indicators for geothermal systems. The following major results were obtained: (1) identification of the origin of the water component in acidic fluids, (2) identification of the origin of sulphur compounds in acidic fluids, (3) mixing relations between waters from different sources to form acidic fluids and (4) a test of isotope geothermometry based on sulphur compounds in geothermal fluids. This publication is a compilation of the final reports of the research project with a summary of the findings.

**(2005) • ISBN 92-0-102805-9 •
IAEA-TECDOC-1448 • €15.00**

Validation of Thin-layer Chromatographic Methods for Pesticide Residue Analysis

IAEA TECDOC Series No. 1462

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**(2005) • ISBN 92-0-108205-3 •
IAEA-TECDOC-1462 • €15.00**

Research Reactors and Particle Accelerators (Applications)

Development Opportunities for Small and Medium Scale Accelerator Driven Neutron Sources

IAEA TECDOC Series No. 1439

This publication summarizes the results of the Technical Meeting on Development of Small and Medium Scale Accelerator Driven Neutron Sources, convened by the IAEA and held in Vienna in May 2004. The objective of this meeting was to explore the possibilities of medium energy accelerator driven neutron sources as a complement to research reactors for basic research in neutron science and applications in life sciences and industry. Neutrons can provide unique information on the reaction dynamics of complex biomolecular systems, complementing other analytical techniques such as electron microscopy, X rays and nuclear magnetic resonance. Small and medium power spallation neutron sources will become

more important, as many small neutron producing research reactors are being phased out. Recent developments in accelerator technology have made it possible to produce useful neutron fluxes at accelerator facilities suitable for universities and industrial laboratories. In addition to basic research, these alternative neutron sources will be important for educational and training purposes. In a wider perspective this technology should make it possible to introduce neutron research and applications to industrial and national research centres in IAEA Member States that are unable to afford a high energy spallation neutron source and have no access to a research reactor.

**(2005) • ISBN 92-0-101705-7 •
IAEA-TECDOC-1439 • €15.00**

Safety in the Utilization and Modification of Research Reactors

Safety Guide

Safety Series No. 35-G2

This Safety Guide, part of a set of publications in the IAEA Safety Series dealing with all the important areas of research reactor safety which includes Safety Standards, Safety Guides and Safety Practices, develops the general concepts presented in Safety Series Nos 35-S1 and 35-S2 and should be read in conjunction with them. This Safety Guide presents guidelines for the safe utilization and modification of research reactors to ensure that these projects are implemented without undue risks to personnel, the public, the environment or the reactor. While the Safety Guide is most applicable to existing reactors, it is also recommended for use by organizations planning to put a new reactor into operation.

**English Edition (47 pp., 1 fig.; 2005) •
ISBN 92-0-104694-4 • STI/PUB/961 • €17.50
French Edition (51 pp., 1 fig.; 2005) •
ISBN 92-0-203505-9 • STI/PUB/961 • €17.50**

Earth Sciences

Uranium geology, exploration and mining

Guidebook on Environmental Impact Assessment for In Situ Leach Mining Projects

IAEA TECDOC Series No. 1428

Assessment of the potential environmental impact of an in situ leach (ISL) project is the first step in the permission and licensing process. An Environmental Impact Assessment (EIA) serves as the basis for preparing an Environmental Impact Statement (EIS), which in turn identifies the potential environmental and socioeconomic impact of a proposed project and outlines measures to mitigate this impact. The EIS review process serves to inform the public about a proposed project as well as to provide regulatory agencies with assurance that ISL technology will comply with environmental standards, and that project sites can be rehabilitated to pre-mining use. This publication provides a step-by-step description of project parameters that must be addressed in conducting an EIA and preparing an EIS. It also includes EIA/EIS case histories for current operations in Australia, the Czech Republic, Kazakhstan and the United States of America. The publication will be useful to companies considering the development of ISL projects and to regulatory personnel who are responsible for writing environmental regulations and licensing ISL projects.

**(2005) • ISBN 92-0-113004-X •
IAEA-TECDOC-1428 • €15.00**

Recent Developments in Uranium Exploration, Production and Environmental Issues

IAEA TECDOC Series No. 1463

The uranium industry is in a period of transition. In Europe, the industry is in transition from uranium production to site rehabilitation. The WISMUT project in Germany, which is featured in this publication, is the largest and one of the most advanced rehabilitation projects in the world. By contrast, other countries such as China, India and Argentina are expanding their industries to meet growing uranium demand. Activities in these countries, which are also described in this publication, range from new project licensing to application of new technology to increase productivity and lower costs at existing operations. Changes within the uranium industry are nowhere more evident than in the marketplace, where the price of uranium has more than doubled in the past two years. There is a discussion of the reasons for this price rise and the adequacy of production capacity to meet reactor uranium requirements.

**(2005) • ISBN 92-0-108005-0 •
IAEA-TECDOC-1463 • €15.00
CD Edition (2005) • ISBN 92-0-112105-9 •
IAEA-TECDOC-CD-1463 • €15.00**

Hydrology

Fluvial Sediment Transport: Analytical Techniques for Measuring Sediment Load

IAEA TECDOC Series No. 1461

Sediment transport data are often used for the evaluation of land surface erosion, reservoir sedimentation, ecological habitat quality and coastal sediment budgets. Sediment transport by rivers is usually considered to occur in two major ways: (1) in the flow as a suspended load and (2) along the bed as a bed load. This publication provides guidance on selected techniques for the measurement of particles moving in both modes in the fluvial environment. The relative importance of the transport mode is variable and depends on the hydraulic and sedimentary conditions. The potential user is directed in the selection of an appropriate technique through the presentation of operating principles, application guidelines and estimated costs.

**(2005) • ISBN 92-0-107605-3 •
IAEA-TECDOC-1461 • €15.00**

Isotope Hydrology and Integrated Water Resources Management

C&S Papers CD Series No. 23

Global efforts to overcome the growing challenge of freshwater availability have been at the forefront of the world development agenda for nearly three decades. For developing policies towards sustainable management of freshwater resources, an improved understanding of the Earth's water cycle bas been widely recognized as one of the key elements of scientific information. The IAEA has played a crucial role in promoting and expanding the field of isotope hydrology. Starting in 1963, the IAEA's quadrennial symposia on isotope hydrology have played a central role in developing this scientific discipline. This publication contains 174 extended abstracts of papers presented during the 11th symposium in the series.

**(2004) • ISBN 92-0-108604-0 •
IAEA-CSP-23/P • €15.00**

**CD Edition (2004) • ISBN 92-0-114204-8 •
IAEA-CSP-23/CD • €15.00**

Status of Industrial Scale Radiation Treatment of Wastewater and Its Future

IAEA TECDOC Series No. 1407

Fundamental studies of the radiation process for wastewater treatment, its analogues and differences to other advanced oxidation technologies and of combined processes are presented in the report. Possible fields of application, technical solutions and economic factors concerning engineering and other applications are addressed. Developments concerning accelerator design, engineering and construction as well as other features of radiation sources are reviewed. Further discussions include the design of under-beam systems. Such progress and developments are critical for further applications. A reduction in cost and an improvement of technical reliability are expected; in particular high power accelerators are needed for environmental applications. The book points out that such applications should be carefully revised in accordance with the existing regulations and state of the art knowledge. The results of the discussions summarized in the publication may serve as the basis for the preparation of guidelines and feasibility studies for full-scale process implementation. Public awareness and technology acceptance are additional factors to be considered for further dissemination; therefore this publication is a valuable source providing necessary information for engineers, environmentalists and decision makers.

**(2004) • ISBN 92-0-110104-X •
IAEA-TECDOC-1407 • €15.00**

Use of Chlorofluorocarbons in Hydrology: A Guidebook

The Guidebook on the use of chlorofluorocarbons (CFCs) in hydrology provides a comprehensive overview on this available methodology to detect young groundwater components and to determine groundwater residence times. It gives an extensive introduction to the scientific basis, including a discussion of existing complications as contamination or degradation effects. Numerous case studies are presented and discussed. It provides a guide to the proper interpretation of data, places the CFC method in the context of other existing methods and discusses in detail CFC field sampling and analytical methods. Several computer programs are provided on the attached CD which aim to facilitate the interpretation of CFC data and their comparison with results based on conceptional water flow models.

**(2005) • ISBN 92-0-100805-8 •
STI/PUB/1238 • €52.00**

Industrial Applications

Development of Protocols for Corrosion and Deposits Evaluation in Pipes by Radiography

IAEA TECDOC Series No. 1445

All metals (and alloys) are subject to deterioration caused by corrosion. Corrosion is generally defined as a degradation of a material or its properties because of its reaction with the environment. Buildings, ships, machines, power plant equipment, oil and gas pipelines, bridges and automobiles are all subject to such attack. Several estimates give the total annual corrosion costs in the industrialized countries as about 4.6% of gross national product (GNP). Non-destructive testing methods, other than radiography, are restricted if the insulation is to be left intact. They also cannot give profiles of corrosion in terms of area or depth. Radiography with the wide range of radiation energy available, from low kilovolt X rays to ^{60}Co gamma rays, can be safely applied even with insulation in place.

**(2005) • ISBN 92-0-102105-4 •
IAEA-TECDOC-1445 • €15.00**

In Situ Applications of X Ray Fluorescence Techniques

IAEA TECDOC Series No. 1456

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**(2005) • ISBN 92-0-107105-1 •
IAEA-TECDOC-1456 • €15.00**

Measurement of Residual Stress in Materials Using Neutrons

Proceedings of a technical meeting held in Vienna, Austria, 13-17 October, 2003

IAEA TECDOC Series No. 1457

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**(2005) • ISBN 92-0-106305-9 •
IAEA-TECDOC-1457 • €15.00
CD Edition (2005) • ISBN 92-0-109005-6 •
IAEA-TECDOC-CD-1457 • €15.00**

Forthcoming

Small Angle Neutron Scattering

IAEA TECDOC Series No. 1486

Small angle neutron scattering (SANS) is a powerful non-destructive technique to study the inhomogeneities formed during the synthesis of materials such as ceramics, cements and alloys. The method is useful for studying large molecules such as polymers, biomolecules or magnetic domains which have applications in materials development. SANS provides information which is complementary or supplementary in some cases to other techniques such as X ray scattering or electron microscopy, while for certain situations, such as probing magnetic materials, it is a unique method. Another important feature is that these instruments can be installed on medium flux reactors and can be effectively used for important applications in the technological areas mentioned above to extend support to stakeholders, including university researchers and industrial users.

**(Forthcoming 2006) • ISBN 92-0-102806-7 •
IAEA-TECDOC-1486 • €15.00**

Technical Data on Nucleonic Gauges

IAEA TECDOC Series No. 1459

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sheets on many typical commercial devices are also included. It will help end users to select the most suitable alternative to solve a particular problem or to measure a certain parameter in a specific process.

**(2005) • ISBN 92-0-107805-6 •
IAEA-TECDOC-1459 • €15.00**

RADIATION PROCESSING

Directory of Gamma Processing Facilities in Member States

It is estimated that several hundred gamma irradiators are in operation worldwide. They are mainly used for sterilization of medical products, food irradiation and modification of materials. Their role is very important both for national economies and for R&D activities. This directory of commercial radiation processing facilities using gamma rays from radioisotopes is the first such directory to be published by the IAEA; it is a compilation of technical, utilization and administrative data based on the information supplied to the IAEA as of 2002. This directory includes radiation facilities that process products for various applications for commercial purposes (including industrial and pilot scale facilities). Thus, research laboratories and facilities are not included in the directory. The data were collected through questionnaires distributed to the organizations involved in operating such facilities in Member States. This directory will be a valuable tool for managers, engineers and scientists working in the field and it will facilitate networking amongst regional and interregional facilities.

**(2004) • ISBN 92-0-100204-1 •
IAEA-DGPF/CD • €15.00**

Emerging Applications of Radiation Processing

IAEA TECDOC Series No. 1386

This publication contains reports on the most recent developments in the implementation of radiation technology. Recent R&D trends are also discussed. The reports were prepared by leading international experts in the field. Technical solutions concerning electron accelerators (low, medium and high energy) are reviewed, while newly developed e/X high power units open new possibilities for bulk material processing. All the classical fields of radiation technology applications such as sterilization, food irradiation, polymer processing and rubber processing play an important economic role. Examples based on the two biggest market economies, the USA and Japan, are presented. Breakthroughs in environmental applications of radiation technology opening new horizons in process applications and solutions applied to flue gas treatment and wastewater treatment are reported. In the field of R&D the most promising fields are natural polymers and nanotechnology. This book will be of interest to scientists, engineers, managers and students working in the field of radiation processing.

**(2004) • ISBN 92-0-115803-3 •
IAEA-TECDOC-1386 • €15.00**

Radiation Processing of Polysaccharides

IAEA TECDOC Series No. 1422

Radiation processing is a convenient tool for imparting desirable effects in polymeric materials. In recent years, natural polymers have been investigated with renewed interest because of their unique characteristics, such as inherent biocompatibility, biodegradability and easy availability. Traditionally, the commercial exploitation of natural polymers such as carrageenans, alginates or starch has been based, to a large extent, on empirical knowledge. But now, research is being fuelled because applications of natural polymers are being sought in knowledge-demanding areas such as pharmacy and biotechnology. This book reports selected success stories concerning radiation processed natural polymers and applications of their derivatives in the health care products industries and agriculture. This publication will be of interest to individuals at nuclear institutions worldwide that have R&D programmes into the applications of radiation processing technologies. The book will also be of interest to managers and decision makers in industry (health care, food and agriculture), helping them to understand the important role radiation processing technology plays for polysaccharides.

**(2004) • ISBN 92-0-114104-1 •
IAEA-TECDOC-1422 • €15.00**

Radiation Processing of Gaseous and Liquid Effluents

IAEA TECDOC Series No. 1473

Strategies to tackle environmental pollution have been receiving increasing attention throughout the world in recent years. Power generation using fossil fuels such as coal, natural gas and petroleum is responsible for the release of pollutants into the atmosphere along with the off-gases from industries, power stations, residential heating systems and vehicles. During the combustion process various pollutants such as fly ash, sulphur oxides (SO_2 and SO_3), nitrogen oxides (NO_x = NO_2 + NO) and volatile organic compounds are emitted. Radiation processing using electron beam accelerators has shown very promising results in this regard. Over the last few years, radiation treatment techniques have been developed and deployed for ensuring environmental safety from gaseous and liquid effluents. It has been demonstrated that electron beam flue gas treatment (SO_x and NO_x removal), wastewater purification and sludge hygienization can be effectively deployed. This publication provides a good summary of all the relevant information in this field.

**(2005) • ISBN 92-0-110405-7 •
IAEA-TECDOC-1473 • €15.00**

Radiation Synthesis of Stimuli-responsive Membranes, Hydrogels and Adsorbents for Separation Purposes

IAEA TECDOC Series No. 1465

This coordinated research project concerned the development of novel materials prepared by radiation processing techniques. Fast stimuli-responsive hydrogels based on natural and synthetic polymers, temperature responsive membranes and selective adsorbents were produced and tested for different applications, in particular for drug delivery systems, health care and remediation of environmental pollution. This publication summarizes the present status and the prospects of this technology.

**(2005) • ISBN 92-0-108605-9 •
IAEA-TECDOC-1465 • €15.00**

TRACERS

Integration of Tracing with Computational Fluid Dynamics for Industrial Process Investigation

Final Report of a Coordinated Research Project 2001–2003

IAEA TECDOC Series No. 1412

This publication can be used as a basic course in tracer methodology in the curricula of chemical engineering, engineering processing, and oil and gas reservoir engineering faculties at universities. It is also expected to be of wider interest for the further development of skills and confidence to carry out field work. The report will also be of interest to industrial managers and decision makers, who are generally educated in areas outside of nuclear applications. This book seeks to inform both specialist and non-specialist readers about the application and impact of radiotracer technology in modern industry.

**(2004) • ISBN 92-0-114504-7 •
IAEA-TECDOC-1412 • €15.00**

Radiotracer Applications in Industry – A Guidebook

Technical Reports Series No. 423

This guidebook describes the principles and state of the art of radiotracer methodology and technology as applied to industrial engineering processing, wastewater purification systems, oil well interconnections and geothermal power characterization. Case studies of typical problems for process and recovery optimization are presented. The book will be of interest to both radioisotope practitioners and industrial end-users.

**(281 pp., 180 figs; 2004) • ISBN 92-0-114503-9 •
STI/DOC/010/423 • €45.00**

Nuclear and Radiological Safety

Uranium Mining and Milling

Occupational Radiation Protection in the Mining and Processing of Raw Materials

Safety Guide

Safety Standards Series No. RS-G-1.6

This Safety Guide, which is jointly sponsored by the IAEA and the ILO, supersedes Safety Series No. 26, Radiation Protection of Workers in the Mining and Milling of Radioactive Ores (1983 Edition). Safety Series No. 26 dealt mainly with activities involving uranium or thorium ores. This Safety Guide updates the previous guidance material and extends its coverage to include activities involving all raw materials for which radiation protection measures need to be considered, as well as including additional guidance on authorization of mining and processing activities, inspection and compliance. The main purpose of this Safety Guide is to provide practical guidance on meeting the requirements of the Basic Safety Standards as they relate to the radiation protection of workers in the mining and processing of raw materials, and thus to facilitate the preparation and adoption, by Member States, of national and local regulations rules and work procedures in this area of industrial activity. This Safety Guide is aimed at regulatory bodies, operators of mines and mineral processing facilities, health and safety committees, workers and their representatives, and health and safety professionals.

Contents: 1. Introduction; 2. Fulfilment of requirements and discharge of responsibilities; 3. Dose limitation; 4. Radiation protection programme; 5. Engineering and administrative protection measures; 6. Health surveillance; Appendix I: Responsibilities of employers and workers; Appendix II: Dose coefficients for radionuclides of different lung absorption types; Appendix III: General guidance on the radiation protection programme; Appendix IV: Radiation monitoring techniques; Appendix V: Protective respiratory equipment; Appendix VI: General guidance on health surveillance; Annex: Relationships between gross alpha activity and committed effective dose for the inhalation of ore dust containing uranium or thorium; Glossary.

(95 pp.; 2004) • ISBN 92-0-115003-2 • STI/PUB/1183 • €21.00

The Long Term Stabilization of Uranium Mill Tailings

IAEA TECDOC Series No. 1403

Mining and milling of uranium ores has been undertaken in many places around the world, resulting in large volumes of mining/milling residues with low activity concentrations of long lived nuclides that have often been disposed of in a haphazard fashion. This report summarizes the current state of the art of uranium mill tailings disposal and the results from an IAEA Coordinated Research Project (CRP) on technologies and strategies for their long term stabilization. The aim of the CRP was to develop conceptual and technical solutions that render tailings more inert over prolonged time spans, that render impounded materials and engineered structures stable over prolonged time spans, that minimize the need for active maintenance, and that are technically and economically feasible. The emphasis was on solutions that can be applied retrospectively, i.e. in a restoration/remediation context. It was recognized, however, that these objectives cannot be met by engineering design only, but must also involve appropriate management and planning procedures.

(2004) • ISBN 92-0-108904-X • IAEA-TECDOC-1403 • €15.00

Fuel Fabrication and Storage

Core Management and Fuel Handling for Nuclear Power Plants

Safety Guide

Safety Standards Series No. NS-G-2.5

This Safety Guide supplements and elaborates upon the safety requirements for core management and fuel handling established in Section 5 of Safety Standards Series No. NS-R-2, The Safety of Nuclear Power Plants: Operation (2000). It also relates to Safety Standards Series No. NS-G-2.4, The Operating Organization for Nuclear Power Plants (2001), which identifies fuel management as one of the functions to be performed by the operating organization. It supersedes Safety Series No. 50-SG-O10, Safety Aspects of Core Management and Fuel Handling (1985).

Contents: 1. Introduction; 2. Core management; 3. Handling and storage of fresh fuel; 4. Implementation of the refuelling programme; 5. Handling and storage of irradiated fuel; 6. Handling and storage of core components; 7. Preparation of fuel for dispatch; 8. Administrative and organizational aspects; 9. Documentation.

English Edition (43 pp.; 2000) • ISBN 92-0-111002-2 • STI/PUB/1125 • €14.00
Russian Edition (55 pp.; 2004) • ISBN 92-0-404204-4 • STI/PUB/1125 • €14.00

Nuclear Power Plants

Advanced Nuclear Power Plant Design Options to Cope with External Events

IAEA TECDOC Series No. 1487

This report presents the state of the art in design approaches for the protection from external event impact for nuclear power

plants (NPPs) with evolutionary and innovative reactors. It provides both the general and the technical information background to assist designers of advanced NPPs in the definition of consistent strategies in selected issues of the design and siting evaluation in relation to extreme external events.

**(2006) • ISBN 92-0-100506-7 •
IAEA-TECDOC-1487 • €15.00**

Assessment and Management of Ageing of Major Nuclear Power Plant Components Important to Safety: BWR Pressure Vessel Internals

IAEA TECDOC Series No. 1471

The objective of this report is to identify significant ageing mechanisms and degradation locations, as well as to document current practices for the assessment and management of the ageing of boiling water reactor (BWR) pressure vessel internals (RPVIs). The report emphasizes safety aspects and also provides information on current inspections as well as on monitoring and mitigation practices for managing ageing of BWR RPVs.

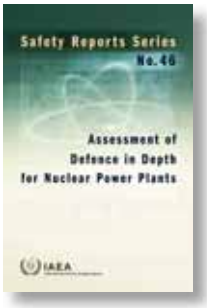
**(2005) • ISBN 92-0-109205-9 •
IAEA-TECDOC-1471 • €15.00**

Assessment and Management of Ageing of Major Nuclear Power Plant Components Important to Safety: BWR Pressure Vessels

IAEA TECDOC Series No. 1470

The objective of this report is to identify significant ageing mechanisms and degradation locations, as well as to document current practices for the assessment and management of the ageing of boiling water reactor (BWR) pressure vessels (RPVs). The report emphasizes safety aspects and also provides information on current inspections as well as on monitoring and mitigation practices for managing ageing of BWR RPVs.

**(2005) • ISBN 92-0-109305-5 •
IAEA-TECDOC-1470 • €15.00**



Assessment of Defence in Depth for Nuclear Power Plants

Safety Reports Series No. 46

This publication provides specific technical information on implementation of the concept in the siting, design, construction and operation of nuclear power plants (NPPs). It describes a method for verifying capabilities for implementation of defence in depth in existing NPPs. For given objectives of each level of defence, a set of challenges to achieve these objectives is identified as well as several constitutive mechanisms leading to these challenges, and a list of possible safety provisions which contribute to prevention of these mechanisms is provided. This book is intended to serve as a reference primarily for self-assessment of the comprehensiveness and quality of defence in depth provisions by NPP operators, but it can also be used by regulators or independent reviewers. It offers a complementary tool for evaluation of the strengths and weaknesses of defence in depth in a specific NPP.

**(120 pp., 78 figs; 2005) • ISBN 92-0-114004-5 •
STI/PUB/1218 • €28.00**

Forthcoming

Decommissioning of Research Reactors: Evolution, State of the Art, Open Issues

Technical Reports Series No. 446

Taking account of work done to date on decommissioning of research reactors, it is timely to provide an up to date basis for ongoing and foreseen activities in this field. The approach taken in this report is to review, from a historical perspective, decommissioning projects either completed in recent years or under way, and to assess progress, remaining issues and new questions. The intention is to facilitate timely, safe and efficient completion of decommissioning projects for research reactors by highlighting state-of-the-art technologies and planning/management methodologies, and by suggesting ways to overcome expected problems. The report is complemented by a CD-ROM providing details on several hundred research reactor decommissioning projects.

**(Forthcoming 2006) • ISBN 92-0-112605-0 •
STI/DOC/010/446 • €37.00**

Design of Emergency Power Systems for Nuclear Power Plants

Safety Guide

Safety Standards Series No. NS-G-1.8

This Safety Guide was prepared under the IAEA safety standards programme for nuclear power plants (NPPs). The basic requirements for the design of safety systems for NPPs are provided in Safety Standards Series No. NS-R-1: Safety of NPPs: Design. This Safety Guide describes how the revised basic requirements should be met for the design of emergency power supply systems for NPPs. This publication is a revision of Safety Series No. 50-SG-D7, Emergency Power Systems at NPPs. It takes account of developments in the design of emergency power supply systems in NPPs since 1991 and includes recommendations and guidance on non-electrical power sources. This Safety Guide was prepared through three technical meetings and extensive review by experts from 21 countries over a period of four years.

Contents: 1. Introduction; 2. General design basis for EPSs; 3. General recommendations on design; 4. Recommendations on the design of systems and features; 5. Design provisions for the inspection, testing and maintenance of the EPSs; 6. Confirmation of the design; Appendix: Guidance on on-site and off-site power; Glossary.

**English Edition (61 pp., 5 figs; 2004) • ISBN 92-0-103504-7 •
STI/PUB/1188 • €20.00**

Design of Fuel Handling and Storage Systems in Nuclear Power Plants

Safety Guide

Safety Standards Series No. NS-G-1.4

This Safety Guide supersedes Safety Series No. 50-SG-D10 with the same title issued in 1984. The purpose of this Safety Guide is to provide detailed recommendations for the design of fuel handling and storage systems in nuclear power plants. This publication is intended for use by organizations designing, manufacturing, constructing and operating fuel handling and storage facilities in nuclear power plants, as well as by regulatory bodies.

Contents: 1. Introduction; 2. Fuel handling and storage systems and their functions; 3. General design basis 4. Systems for the handling and storage of fresh fuel; 5. Systems for the handling and storage of irradiated fuel and other core components; 6. Handling of fuel casks; 7. Fuel handling at sites with several reactors; 8. Quality assurance and documentation; Annex: Flow charts for typical systems for the handling and storage of irradiated fuel.

English Edition (53 pp., 4 figs; 2003) • ISBN 92-0-107803-X • STI/PUB/1156 • €16.50
Russian Edition (76 pp., 4 figs; 2005) • ISBN 92-0-410805-3 • STI/PUB/1156 • €16.50

Design of Reactor Containment Systems for Nuclear Power Plants

Safety Guide

Safety Standards Series No. NS-G-1.10

This Safety Guide supersedes Safety Series No. 50-SG-D12, Design of the Reactor Containment Systems in Nuclear Power Plants, issued in 1985. The purpose of this Safety Guide is to provide recommendations for the design of the containment systems in nuclear power plants in compliance with the safety objectives and requirements established in Safety Standards Series No. NS-R-1, Safety of Nuclear Power Plants: Design. Management of energy, radionuclides and combustible gases is considered. This publication is intended for use by organizations designing, manufacturing, constructing and operating nuclear power plants, as well as by regulatory bodies.

Contents: 1. Introduction; 2. Containment systems and their safety functions; 3. General design basis of containment systems; 4. Design of containment systems for operational states and for design basis accidents; 5. Tests and inspections; 6. Design considerations for severe accidents; Appendix: Instrumentation for monitoring of the containment; Annex I: Examples of containment designs; Annex II: Illustration of categories of isolation features; Annex III: Severe accident phenomena.

English Edition (127 pp., 11 figs; 2004) • ISBN 92-0-103604-3 • STI/PUB/1189 • €18.00

Design of the Reactor Coolant System and Associated Systems in Nuclear Power Plants

Safety Guide

Safety Standards Series No. NS-G-1.9

This publication is a revision and combination of two previous Safety Guides: Safety Series No. 50-SG-D6, Ultimate Heat Sink and Directly Associated Heat Transport Systems for Nuclear Power Plants (1981), and Safety Series No. 50-SG-D13, Reactor Coolant and Associated Systems in Nuclear Power Plants (1986). The revision takes account of developments in the design of the reactor coolant and associated systems in nuclear power plants since the earlier Safety Guides were published. The other objectives of the revision are to ensure consistency with the Requirements for Design, issued in 2000, and to update the technical content. In addition, an appendix on pressurized heavy water reactors has been included.

Contents: 1. Introduction; 2. Extent of the RCS and associated systems; 3. General considerations in design; 4. Specific considerations in design; Appendix: The RCS and associated systems in pressure tube heavy water reactors; Annex I: Main components of the RCS; Annex II; Diagrams of the RCS and associated systems; Annex III: Safety classification and safety class interface devices for fluid systems.

(79 pp., 4 figs; 2004) • ISBN 92-0-103404-0 • STI/PUB/1187 • €18.00

Design of the Reactor Core for Nuclear Power Plants

Safety Guide

Safety Standards Series No. NS-G-1.12

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 reactor cores 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. Qualification and testing; 5. Quality assurance in design; Appendix I: Reactivity coefficients; Appendix II: Fuel pellet–cladding interaction; Appendix III: Design considerations for core management; Appendix IV: High burnup fuel cores; Appendix V: Mixed oxide fuel cores; References; Glossary.

(59 pp.; 2005) • ISBN 92-0-116004-6 • STI/PUB/1221 • €23.00

Effective Corrective Actions to Enhance Operational Safety of Nuclear Installations

IAEA TECDOC Series No. 1458

Implementing corrective actions and ensuring their effectiveness is one of the major steps of an operating experience feedback programme. In April 2003, the IAEA issued the peer review operational safety performance experience review (PROSPER) guidelines to provide advice and assistance to nuclear installations to strengthen and enhance their own operating experience programmes. The present publication develops the principles set forth in the PROSPER guidelines. It contains recommendations and good practices from the industry for successfully establishing effective corrective actions and preventing recurrence of events. It also provides a detailed methodology for effectively correcting and preventing reoccurrence of human errors. Use of the guidance provided by this publication will be helpful in prioritizing and implementing corrective actions in a timely manner that is compatible with the frequency and significance of the issue. These guidelines contain provisions to track the effectiveness of corrective actions following implementation and to periodically assess the overall performance of the corrective action programme.

(2005) • ISBN 92-0-107705-X •
IAEA-TECDOC-1458 • €15.00

Experience Gained from Fires in Nuclear Power Plants: Lessons Learned

IAEA TECDOC Series No. 1421

This publication includes a detailed analysis of the most recent events collected in IAEA databases and other bibliographical sources. It provides the technical background for the recently revised IAEA Safety Guide on fire protection for new and existing plants and also a collection of lessons learned that is useful for practical fire safety enhancement in operating plants. It aims at providing a comprehensive summary of the experience in Member States, with special emphasis on the development of a unified approach to management of the feedback of experience, also in view of an improvement of the available methodologies for fire hazard evaluation.

(2004) • ISBN 92-0-112604-2 •
IAEA-TECDOC-1421 • €15.00

Forthcoming

Feedback of Experience from Events in Nuclear Installations

Safety Guide

Safety Standards Series No. NS-G-2.11

This Safety Guide provides recommendations on all the main components of operational experience feedback systems, utilizing relevant information on events and abnormal conditions that have occurred at nuclear installations around the world. It focuses on the interaction between the different systems for using operational experience feedback and constitutes an update and an extension of Part I, A National System, of Systems for Reporting Unusual Events in Nuclear Power Plants (IAEA Safety Series No. 93).

Contents: 1. Introduction; 2. Need for and main element of a national system for the feedback of operational experience; 3. Screening of events; 4. Investigation and analysis of events; 5. Corrective actions; 6. Trending and review to recognize emergent problems; 7. Utilization, dissemination and exchange of operating experience information; 8. Reviewing the effectiveness of the process for feedback of operational experience; 9. Quality assurance; 10. Reporting of safety related events; Appendix I: Reporting criteria and categories; Appendix II: Type of reports, timing, format at content; Appendix III: Investigation and analysis of events; Appendix IV: Approval and implementation of corrective actions; References: Annex I: OEF data management; Annex II: Example of elements of a national operating experience.

(Forthcoming 2006) • ISBN 92-0-101406-6 •
STI/PUB/1243 • €23.00

Geotechnical Aspects of Site Evaluation and Foundations for Nuclear Power Plants

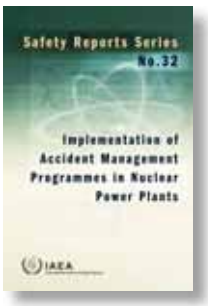
Safety Guide

Safety Standards Series No. NS-G-3.6

This publication is a revision of the former safety standards of IAEA Safety Series No. 50-SG-S8. The scope has been extended to cover not only foundations but also design questions related to geotechnical science and engineering, such as the bearing capacity of foundations, design of earth structures and design of buried structures.

Contents: 1. Introduction; 2. Site investigation; 3. Site considerations; 4. Considerations for the foundations; 5. Earth structures; 6. Buried structures; 7. Monitoring of geotechnical parameters.

(53 pp.; 2005) • ISBN 92-0-107204-X •
STI/PUB/1195 • €19.00



Implementation of Accident Management Programmes in Nuclear Power Plants

Safety Reports Series No. 32

This publication provides a description of the elements which should be addressed by the team responsible for the preparation, development and implementation of a plant specific accident management programme at a nuclear power plant. The issues addressed include formation of the team, selection of accident management strategies, safety analyses required, evaluation of the performance of plant systems, development of accident management procedures and guidelines, staffing and qualification of accident management personnel, and training needs. The report is intended to facilitate the work to be done by nuclear power plant operators, utilities

and their technical support organizations, but it can also be used for the preparation of relevant national regulatory requirements.

(121 pp., 16 figs; 2004) • ISBN 92-0-113803-2 • STI/PUB/1167 • €28.00

Implications of Power Uprates on Safety Margins of Nuclear Power Plants

IAEA TECDOC Series No. 1418

This publication addresses the specific topics relating to the utilization of safety margins for nuclear power plant (NPP) uprates. Progress made in the development and application of modern computer codes for safety analysis and a better understanding of the phenomena involved in plant design and operation enable analysts to determine licensing margins with higher precision. There is a general tendency for utilities to take advantage of unnecessarily large conservatism in safety analyses and to utilize them for reactor power uprates, better utilization of nuclear fuel, higher operational flexibility and justification of lifetime extension. The present publication presents the results of a technical meeting on the Implications of Power Uprates on Safety Margins of NPPs which was organized in cooperation with the Nuclear Energy Agency of the OECD.

(2004) • ISBN 92-0-112004-4 • IAEA-TECDOC-1418 • €15.00

Improvement of In-service Inspection in Nuclear Power Plants

IAEA TECDOC Series No. 1400

This publication describes strategies for improving the effectiveness of in-service inspection (ISI). The role of ISI in maintaining or improving safety and the relationship of ISI improvement to cost are examined. The strategies for improving ISI effectiveness discussed in this publication consider the entire framework of ISI, including effective selection of the proper scope of inspection and the effectiveness of non-destructive examination as demonstrated through inspection qualification programmes. Improving the effectiveness of ISI in an economical and organized way requires adoption of a strategy that meets the specific objectives of each plant owner.

(2004) • ISBN 92-0-108104-9 • IAEA-TECDOC-1400 • €15.00

Innovative Small and Medium Sized Reactors: Design Features, Safety Approaches and R&D Trends

IAEA TECDOC Series No. 1451

Design and technology development for small and medium sized reactors (SMRs) is ongoing in many countries, and there are growing expectations of increased support from the IAEA to interested Member States in the definition of common technology and infrastructure development needs and in the coordination of international R&D efforts for such reactors. This publication presents a variety of innovative water cooled, gas cooled, liquid metal cooled and non-conventional SMR designs developed worldwide, and examines the technology and infrastructure development needs that may be common to several concepts or lines of such reactors. This publication also gives an updated definition of small reactors without on-site refuelling and a preliminary review of the passive safety design options for SMRs.

(2005) • ISBN 92-0-103205-6 • IAEA-TECDOC-1451 • €15.00

Instrumentation and Control Systems Important to Safety in Nuclear Power Plants

Safety Standards Series No. NS-G-1.3

Safety Guide

This Safety Guide recommends how the requirements established in Safety Standards Series No. NS-R-1, Safety of Nuclear Power Plants: Design (2000), should be met for instrumentation and control (I&C) systems important to safety. It supersedes Safety Series No. 50-SG-D3, Protection Systems and Related Features in Nuclear Power Plants (1980) and No. 50-SG-D8, Safety Related Instrumentation and Control Systems for Nuclear Power Plants (1984).

Contents: 1. Introduction; 2. Instrumentation and control systems important to safety; 3. The design basis; 4. General design guidelines; 5. System specific design guidelines; 6. Human–machine interface; 7. Design process for instrumentation and control systems important to safety.

Chinese Edition (2005) • ISBN 92-0-513905-X • STI/PUB/1116 • €14.50
English Edition (91 pp., 5 figs; 2002) • 92-0-110802-8 • STI/PUB/1116 • €14.50
French Edition (107 pp., 5 figs; 2005) • ISBN 92-0-201305-5 • STI/PUB/1116 • €14.50

Management of Continual Improvement for Facilities and Activities: A Structured Approach

IAEA TECDOC Series No. 1491

In recent years there has been an upward trend in the safety and operational performance of nuclear installations. Continual improvement of the processes of organizations has led to enhanced safety performance and efficiency benefits such as cost reductions and improved cycle times. Many organizations have experienced significant cost improvement largely by or through better financial management. Without the use of a structured methodology to identify and implement improvements, changes to an organization to reduce costs through cutting staff and activities could eventually fail to produce the desired changes and even have a negative effect on safety and overall performance. The objectives of this publication are to explain how an approach to continual improvement can be implemented and how to conduct process improvements. It also describes good practices and the problems that may be encountered, based on experiences in a number of different organizations in the nuclear field. A number of case studies and a summary of some of the many improvement techniques available are provided. The methodology used in this publication contains steps and practices that are common to many of the continual improvement strategies. This publication will assist readers in successfully applying continual improvement in their own

organizations in the pursuit of enhanced safety and improved performance.

(Forthcoming 2006) • ISBN 92-0-102906-3 • IAEA-TECDOC-1491 • €15.00

Meteorological Events in Site Evaluation for Nuclear Power Plants

Safety Guide

Safety Standards Series No. NS-G-3.4

This Safety Guide makes recommendations and provides guidance on conducting hazard assessments of extreme and rare meteorological phenomena. It will be of interest to safety assessors and regulators involved in the licensing process as well as to designers of nuclear power plants.

Contents: 1. Introduction; 2. General approach to hazard assessment; 3. Information and investigations necessary (database); 4. Hazard determination on the basis of extreme values; 5. Hazard determination for rare meteorological phenomena; Annex: Distributions of extreme values

English Edition (34 pp.; 2003) • ISBN 92-0-102103-8 • STI/PUB/1148 • €12.50
Russian Edition (36 pp.; 2005) • ISBN 92-0-414405-X • STI/PUB/1148 • €12.50

Modifications to Nuclear Power Plants

Safety Guide

Safety Standards Series No. NS-G-2.3

This Safety Guide provides recommendations and guidance on controlling activities relating to modifications at nuclear power plants so as to reduce risk and to ensure that the configuration of the plant is under control at all times and that the modified configuration conforms to the approved basis for granting an operation licence. The recommendations cover the whole process from conception to completion for modifications to structures, systems and components, operational limits and conditions, procedures and software, and the management systems and tools for plant operation. The Safety Guide recommends how to meet the requirements established in Safety Standards Series No. NS-R-2, The Safety of Nuclear Power Plants: Operation (2000).

Contents: 1. Introduction; 2. General; 3. Roles and responsibilities; 4. Modifications relating to plant configuration; 5. Modifications to management systems; 6. Temporary modifications; 7. Implementation of modifications relating to plant configuration; 8. Implementation of organizational changes; 9. Quality assurance; 10. Training; 11. Management of documentation.

Chinese Edition (27 pp., 1 fig.; 2005) • ISBN 92-0-516904-8 • STI/PUB/1111 • €12.50
English Edition (33 pp., 1 fig.; 2001) • ISBN 92-0-101501-1 • STI/PUB/1111 • €12.50
French Edition (41 pp., 1 fig.; 2005) • ISBN 92-0-202804-4 • STI/PUB/1111 • €12.50
Russian Edition (41 pp., 1 fig.; 2004) • ISBN 92-0-402904-8 • STI/PUB/1111 • €12.50

Natural Circulation in Water Cooled Nuclear Power Plants: Phenomena, Models and Methodology for System Reliability Assessments

IAEA TECDOC Series No. 1474

An important new approach incorporated into several advanced LWR and HWR designs involves the use of passive safety systems. This approach is expected to provide a very high level of safety and improved economics through design simplification. Considering the weak driving forces of passive systems based on natural circulation, careful design and analysis methods must be employed to ensure that the systems perform their intended function. This publication describes the present state of knowledge of natural circulation in water cooled nuclear power plants and passive system reliability. It presents extensive information on phenomena, models, predictive tools and experiments that currently support design and analysis of natural circulation systems, and highlights areas where additional research is needed.

(2005) • ISBN 92-0-110605-X • IAEA-TECDOC-1474 • €15.00

OSART Mission Highlights 2001–2003 Operational Safety Practices in Nuclear Power Plants

IAEA TECDOC Series No. 1446

The IAEA's Operational Safety Review Team (OSART) programme has provided advice and assistance to Member States for 20 years to enhance the safety of nuclear power plants during construction, commissioning and operation. OSART has been and will continue to be utilized to collect and share current best safety practices in nuclear power plants worldwide, to collect practical feedback to the safety standards, to promote appropriate application of the safety standards to nuclear power plants and to introduce OSART methodology for the nuclear industries to establish their own self-assessment programmes.

(2005) • ISBN 92-0-102205-0 • IAEA-TECDOC-1446 • €15.00

Precursor Analyses – The Use of Deterministic and PSA Based Methods in the Event Investigation Process at Nuclear Power Plants

IAEA TECDOC Series No. 1417

This publication outlines the methodology that is used for evaluation of the safety significance of unusual events in nuclear power plants. It describes a synergistic process that makes more effective use of operating experience event information by combining the insights and knowledge gained from two approaches, traditional deterministic root cause event investigation and PSA based event analysis. The precursor analysis described in this publication enables better determination of the safety significance of events so

that adequate corrective measures can be better planned and utilized.

**(2004) • ISBN 92-0-111604-7 •
IAEA-TECDOC-1417 • €15.00**

Forthcoming

Principles and Guidelines on Plant Life Management for Long Term Operation of Light Water Reactors

Technical Reports Series No. 448

This report explains the general approach to Plant Life Management (PLiM), shows and defines the relationship between nuclear power plant maintenance and PLiM, assembles a list of good practices and formulates guidelines for ageing management of critical structures, systems and components. Additionally, the issues of PLiM for long term operation are discussed in terms of human, technological, economic and regulatory aspects, as well as the importance of the exchange of information regarding lessons learned. PLiM is not only a technical system but is also an attitude of the owners to retain plants in operation as long as possible from a safety and business point of view. Asset management is thus a significant parameter and driving force for PLiM implementation.

**(Forthcoming 2006) • ISBN 92-0-101506-2 •
STI/DOC/010/448 • €35.00**

Protection Against Internal Fires and Explosions in the Design of Nuclear Power Plants

Safety Guide

Safety Standards Series No. NS-G-1.7

Safety Guide NS-G-1.7 is a revision of an earlier Safety Guide, Safety Series No. 50-SG-D2. This and other new Safety Guides recommend how to meet the design requirements established in Safety Standards Series No. NS-R-1, Safety of Nuclear Power Plants: Design. Its technical content is based on the most recent operational experience and has been extended to cover the design of plants in relation to internal explosions. The appendices provide guidance for the design and upgrading of fire detection and suppression systems.

Contents: 1. Introduction; 2. General concepts; 3. The approach to design for buildings; 4. Design measures for fire prevention; 5. Provisions for fire detection and extinguishing; 6. Mitigation of secondary fire effects; 7. Safety classification and quality assurance; Appendix I: Applications of the fire containment approach and the fire influence approach; Appendix II: Access and rescue routes; Appendix III: Fire barriers; Appendix IV: Protection against electrical cable fires; Appendix V: Fire detection systems; Appendix VI: Automatic water sprinkler and spray systems; Appendix VII: Gaseous fire extinguishing systems.

**(63 pp., 2 figs; 2004) • ISBN 92-0-103304-4 •
STI/PUB/1186 • €15.00**

Protection against Internal Hazards other than Fires and Explosions in the Design of Nuclear Power Plants

Safety Guide

Safety Standards Series No. NS-G-1.11

This publication is a revision of the former safety standards given in Safety Series No. 50-SG-D4, dealing with protection against missiles and the consequences for the safety of nuclear power plants. This revised publication also includes other internal hazards: collapses and falling objects, pipe whips, jet effects and flooding.

Contents: 1. Introduction; 2. General considerations; 3. Review of internal hazards.

**English Edition (43 pp.; 2004) • ISBN 92-0-104904-8 •
STI/PUB/1191 • €20.00**

Radiation Protection Aspects in the Design of Nuclear Power Plants

Safety Guide

Safety Standards Series No. NS-G-1.13

Prepared as part of the IAEA's programme on safety standards for nuclear power plants (NPPs), this Safety Guide deals with the provisions that should be made in the design of NPPs to protect site personnel, the public and environment against radiological hazards in operational states, decommissioning and accident conditions, including severe accidents. It also provides recommendations for ensuring radiation protection in the design of new NPPs, design modifications to operating plants, and safety reviews of operating NPPs. Comprehensive annexes provide additional information on the subjects addressed in this Safety Guide.

Contents: 1. Introduction; 2. Safety objectives, dose limitation and optimization; 3. Radiation protection aspects in design; 4. Protection of site personnel in operational states and during decommissioning; 5. Protection of the public during plant operation and decommissioning; 6. Guidelines for estimating radiation dose rates during plant operation and decommissioning; 7. Monitoring for radiation protection during plant operation and decommissioning; 8. Process radiation monitoring; 9. Auxiliary facilities; 10. Protection of site personnel under accident conditions; 11. Protection of the public under accident conditions; 12. Radiation and contamination monitoring under accident conditions; References; Annex I: Application of the optimization principle; Annex II: Sources of radiation during normal operation and decommissioning; Annex III: Sources of radiation under accident conditions; Annex IV: Example of zoning for design purposes; Glossary;

**(115 pp., 4 figs; 2005) • ISBN 92-0-107905-2 •
STI/PUB/1233 • €22.00**

Safety Assessment and Verification for Nuclear Power Plants

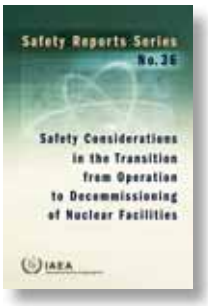
Safety Guide

Safety Standards Series No. NS-G-1.2

This Safety Guide provides recommendations to the designers of nuclear power plants for a comprehensive safety assessment in the initial design process and for modifications to the design, as well as recommendations to operating organizations for independent verification of the safety assessment for new nuclear power plants. The guidance can also be applied to safety reviews for existing plants. The methods and recommendations can be used by regulatory bodies for the conduct of the regulatory review and assessment. The Safety Guide recommends how to meet the requirements established in Safety Standards Series No. NS-R-1, The Safety of Nuclear Power Plants: Design (2000). It supersedes Safety Series No. 50-SG-D11 (1986). Guidance is also provided for Contracting Parties to the Convention on Nuclear Safety in meeting their obligations under Article 14, Assessment and Verification of Safety.

Contents: 1. Introduction; 2. Safety assessment, safety analysis and independent verification; 3. Engineering aspects important to safety; 4. Safety analysis; 5. Independent verification.

Chinese Edition (forthcoming 2006) • ISBN 92-0-513805-3 • STI/PUB/1112 • €14.50
English Edition (83 pp., 1 fig.; 2004) • ISBN 92-0-403004-6 • STI/PUB/1112 • €14.50
French Edition (62 pp., 1 fig.; 2004) • ISBN 92-0-206705-8 • STI/PUB/1112 • €14.50
Russian Edition (99 pp., 1 fig.; 2004) • ISBN 92-0-403004-6 • STI/PUB/1112 • €14.50



Safety Considerations in the Transition from Operation to Decommissioning of Nuclear Facilities

Safety Reports Series No. 36

A growing number of nuclear facilities around the world are being shut down for various reasons. The transition period between operations and implementation of the decommissioning strategy includes some routine operations and others that may be specific to the transition stage. These transitional operations are undertaken following procedures authorized by the regulatory body. In this period, a number of modifications, both technical and organizational, are required to adjust the facility to new objectives and requirements. This Safety Report provides information regarding the safety concerns associated with the transition period and suggests solutions for managing them. It addresses issues that are generically applicable to any nuclear facility and those that are specific to various types of nuclear facility.

(38 pp., 1 fig.; 2004) • ISBN 92-0-115103-9 • STI/PUB/1184 • €16.00

Forthcoming

Safety Culture in the Maintenance of Nuclear Power Plants

Safety Reports Series No. 42

Building upon earlier IAEA publications on this topic, this Safety Report reviews how challenges to the maintenance of nuclear power plants can affect safety culture. It also highlights indications of a weakening safety culture. The challenges described are in areas such as maintenance management, human resources management, plant condition assessment and the business environment. The steps that some Member States have taken to address safety culture aspects are detailed and singled out as good practices, with a view to disseminating and exchanging experiences and lessons learned.

(49 pp.; 2005) • ISBN 92-0-112404-X • STI/PUB/1210 • €22.00

Safety of Nuclear Power Plants: Design

Safety Requirements

Safety Standards Series No. NS-R-1

This Safety Requirements publication establishes design requirements for safety functions and associated structures, systems and components important to the safe operation of nuclear power plants. It also establishes requirements for a comprehensive safety assessment to identify the potential hazards that may arise in the operation of plants. In relation to the design process, preventive and mitigatory features for severe accidents, the management of safety, design management, plant ageing and wearing out effects, computer based safety systems, external and internal hazards, human factors, feedback of operational experience, and safety assessment and verification are considered. It supersedes Safety Series No. 50-C-D (Rev. 1), Code on the Safety of Nuclear Power Plants: Design (1988).

Contents: 1. Introduction; 2. Safety objectives; 3. Requirements for management of safety; 4. Principal technical requirements; 5. Requirements for plant design; 6. Requirements for design of plant systems; Appendix I: Postulated initiating events; Appendix II: Redundancy, diversity and independence; Annex: Safety functions for boiling water reactors, pressurized water reactors and pressure tube reactors; Glossary.

Chinese Edition (55 pp.; 2005) • ISBN 92-0-517504-8 • STI/PUB/1099 • €14.50
English Edition (67 pp.; 2005) • ISBN 92-0-101900-9 • STI/PUB/1099 • €14.50
French Edition (77 pp.; 2005) • ISBN 92-0-206605-1 • STI/PUB/1099 • €14.50
Russian Edition (83 pp.; 2005) • ISBN 92-0-405003-9 • STI/PUB/1099 • €14.50
Spanish Edition (71 pp.; 2004) • ISBN 92-0-307004-4 • STI/PUB/1099 • €14.50

Safety of Nuclear Power Plants: Operation

Safety Requirements

Safety Standards Series No. NS-R-2

This Safety Requirements publication establishes the requirements to be met to ensure the safe operation of nuclear power plants. This publication supersedes Safety Series No. 50-C-O (Rev. 1), Code on the Safety of Nuclear Power Plants: Operation (1988). It restructures the code in the light of the Safety Fundamentals publication, Safety Series No. 110, The Safety of Nuclear Installations (1993), and Safety Series No. 115, International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources (1996). It introduces new topics to reflect current international practices, new concepts and technical developments.

Contents: 1. Introduction; 2. Operating organization; 3. Qualification and training of personnel; 4. Commissioning programme for the plant; 5. Plant operations; 6. Maintenance, testing, surveillance and inspection of structures, systems and components important to safety; 7. Plant modifications; 8. Radiation protection and radioactive waste management; 9. Records and reports; 10. Periodic safety review; 11. Decommissioning; Glossary.

Chinese Edition (24 pp.; 2005) • ISBN 92-0-517604-4 • STI/PUB/1096 • €11.50
English Edition (31 pp.; 2004) • ISBN 92-0-100700-0 • STI/PUB/1096 • €11.50
French Edition (37 pp.; 2004) • ISBN 92-0-215204-7 • STI/PUB/1096 • €11.50
Russian Edition (41 pp.; 2004) • ISBN 92-0-404903-0 • STI/PUB/1096 • €11.50
Spanish Edition (35 pp.; 2004) • ISBN 92-0-309504-7 • STI/PUB/1096 • €11.50

Status of Innovative Small and Medium Sized Reactor Designs 2005

Reactors with Conventional Refuelling Schemes

IAEA TECDOC Series No. 1485

The objective of this report is to provide Member States, including those just considering the initiation of nuclear power programmes, and those already having practical experience in nuclear power, with balanced and objective information on important development trends and objectives of innovative small and medium sized reactors (SMRs) for a variety of uses, on the achieved state of the art in design and technology development for such reactors and on their design and regulatory status. The publication is intended for many categories of stakeholders, including regulators, electricity producers, designers, non-electricity producers and policy makers. The main sections of this publication, addressed to all the above mentioned groups of stakeholders, provide a summary of the major specifications, applications and user-related special features of innovative SMRs. The annexes, intended mainly for designers and technical managers, provide detailed design descriptions of innovative SMRs, focusing on their potential to provide solutions in the areas of concern associated with future nuclear energy systems.

(2006) • ISBN 92-0-101006-0 • IAEA-TECDOC-1485 • €15.00

The Operating Organization for Nuclear Power Plants

Safety Guide

Safety Standards Series No. NS-G-2.4

This Safety Guide provides recommendations on setting up an operating organization for nuclear power plants so as to facilitate their safe operation, and on the organizational elements necessary for a strong safety culture and an international level of performance. The Safety Guide highlights the important elements of effective management in relation to nuclear safety, quality assurance, the management of radioactive waste and radiological protection, and in meeting the associated national regulatory requirements. It recommends how to meet the requirements established in Safety Standards Series No. NS-R-2, Safety of Nuclear Power Plants: Operation (2000). It supersedes Safety Series No. 50-SG-O9 (1984).

Contents: 1. Introduction; 2. Organizational structure; 3. Functions and responsibilities; 4. Interfaces with external organizations; 5. Safety management; 6. Plant operation management programmes; 7. Supporting functions; 8. Communication and liaison.

Chinese Edition (42 pp.; 2005) • ISBN 92-0-516804-1 • STI/PUB/1115 • €14.50
English Edition (53 pp.; 2005) • ISBN 92-0-102301-4 • STI/PUB/1115 • €14.50
French Edition (62 pp.; 2005) • ISBN 92-0-206805-4 • STI/PUB/1115 • €14.50
Russian Edition (69 pp.; 2005) • ISBN 92-0-401604-3 • STI/PUB/1115 • €14.50

Trending of Low Level Events and Near Misses to Enhance Safety Performance in Nuclear Power Plants

IAEA TECDOC Series No. 1477

The number of important and significant events in nuclear power plants (NPPs) is decreasing, and current world industry indicators demonstrate that this has become true throughout the nuclear industry. This is important for the survival and acceptance of the nuclear industry; however, these indicators could hide the existence of a multitude of events which are of lower significance and even near misses (a term from the aviation industry to denote ‘almost accidents’) that have not been captured by the existing detection methods and thresholds. The main objective of this publication is to provide examples, methodologies and suggestions to NPP operators on how to implement a procedure to detect, select and process such events. International experience shows that the number of such events ranges from 2000 to 5000 per operating reactor year. Too many plants do not detect or report these low level

events. These events are the submerged part of the iceberg and must be considered by the operating unit.

**(2005) • ISBN 92-0-112305-1 •
IAEA-TECDOC-1477 • €15.00**

RESEARCH REACTORS

Forthcoming

Decommissioning of Research Reactors: Evolution, State of the Art, Open Issues

Technical Reports Series No. 446

Taking account of work done to date on decommissioning of research reactors, it is timely to provide an up to date basis for ongoing and foreseen activities in this field. The approach taken in this report is to review, from a historical perspective, decommissioning projects either completed in recent years or under way, and to assess progress, remaining issues and new questions. The intention is to facilitate timely, safe and efficient completion of decommissioning projects for research reactors by highlighting state-of-the-art technologies and planning/management methodologies, and by suggesting ways to overcome expected problems. The report is complemented by a CD-ROM providing details on several hundred research reactor decommissioning projects.

**(Forthcoming 2006) • ISBN 92-0-112605-0 •
STI/DOC/010/446 • €37.00**

Research Reactor Utilization, Safety, Decommissioning, Fuel and Waste Management

Proceedings of an International Conference held in Santiago, Chile, 10–14 November 2003

Proceedings Series

This book contains the proceedings of a conference organized by the IAEA and hosted by the Government of Chile through the Atomic Energy Commission of Chile, and was held in Santiago, Chile, 10–14 November 2003. The purpose of the conference was to foster the exchange of information on current research reactor concerns related to safety, operation, utilization, fuel management and decommissioning as well as to provide a forum for reactor operators, designers, managers, users and regulators to share experience, exchange opinions and discuss options and priorities.

**English Edition (717 pp., 235 figs; 2005) • ISBN 92-0-113904-7 •
STI/PUB/1212 • €120.00**

Safety Assessment of Research Reactors and Preparation of the Safety Analysis Report

Safety Guide

Safety Series No. 35-G1

This Safety Guide, a companion document to Safety Series Nos 35-S1 and 35-S2, is part of a set of publications in the IAEA Safety Series dealing with all the important areas of research reactor safety which includes Safety Standards, Safety Guides and Safety Practices. This guide presents guidelines, approved by international consensus, for the preparation, review and assessment of the safety documentation (Safety Series No. 35-S1) and for the preparation of the Safety Analysis Report (SAR) (Safety Series No. 35-S2). In addition, it is most applicable during the design and construction stages of research reactors, as well as during relicensing or reassessment of already existing reactors.

Contents: 1. Introduction; 2. Requirements for safety assessment in the licensing process for a research reactor; 3. Preparation of the safety analysis report; 4. Performance of the review and assessment; Appendix: Contents of a Safety Analysis Report; Annex I: Safety analysis approach and methods; Annex II: Examples of input parameters and initial conditions; Annex III: Examples of items to be considered in the reactor description; Annex IV: Typical sources of radioactive material or radiation fields in a research reactor.

**English Edition (103 pp.; 1994) • ISBN 92-0-104594-8 •
STI/PUB/960 • €29.00**
**French Edition (111 pp.; 2004) • ISBN 92-0-201004-8 •
STI/PUB/960 • €29.00**
**Russian Edition (129 pp.; 2003) • ISBN 92-0-404503-5 •
STI/PUB/960 • €29.00**

Safety Considerations for Research Reactors in Extended Shutdown

IAEA TECDOC Series No. 1387

According to the IAEA Research Reactor Database, 258 research reactors that no longer operate are in some form of shutdown. Many others are facing problems of obsolescence of equipment, lack of experimental programmes, lack of funding for operation and maintenance, loss of expertise and equipment, and the ageing and retirement of staff. The unclear future of these facilities gives rise to safety concerns. The objective of this publication is to state the problem of extended shutdown and its safety implications, including staff issues; review the implications of extended shutdown on reactor components and systems; provide guidance aimed at assisting operating organizations in planning and implementing extended shutdown, and especially the maintenance or replacement of affected systems; assist the regulatory body in determining the requirements that are to be satisfied by an organization that is responsible for a reactor in extended shutdown and for the relicensing of a reactor previously in extended shutdown, and provide guidance for decision makers to assist in the determination of the future of the reactor.

**(2004) • ISBN 92-0-100104-5 •
IAEA-TECDOC-1387 • €15.00**

Safety of New and Existing Research Reactor Facilities in Relation to External Events

Safety Reports Series No. 41

This report provides insights, guidance and a framework for Member States to conduct realistic safety assessments for research reactors in terms of external events. A graded approach to the safety of research reactors is presented based on the radiological hazard that a facility poses to the environment, the public and workers. This report supports the development of site specific guidelines for the actual design and safety assessment. It can also be used as background for the preparation of training material for research reactor staff for a self-assessment of the vulnerability of existing structures to external events.

(99 pp., 5 figs; 2005) • ISBN 92-0-111704-3 • STI/PUB/1209 • €25.00

Safety of Research Reactors

Safety Requirements

Safety Standards Series No. NS-R-4

This Safety Requirements publication establishes requirements for all the important areas of the safety of research reactors, with particular emphasis on requirements for design and operation. It covers the lifetime of research reactor facilities, from site evaluation to design and construction, commissioning, operation, including utilization and modification, and decommissioning.

Contents: 1. Introduction; 2. Safety objectives, concepts and principles; 3. Regulatory supervision; 4. Management and verification of safety; 5. Site evaluation; 6. Design; 7. Operation; 8. Decommissioning; Appendix: Selected postulated initiating events for research reactors; References; Annex I: Selected safety functions for research reactors; Annex II: Operational aspects of research reactors warranting particular attention; Glossary.

(121 pp.; 2005) • ISBN 92-0-115804-1 • STI/PUB/1220 • €24.00

Radiation Sources and Accelerators

Building Competence in Radiation Protection and the Safe Use of Radiation Sources

Safety Guide

Safety Standards Series No. RS-G-1.4

This Safety Guide makes recommendations concerning the building of competence in protection and safety within a national radiation protection infrastructure and provides guidance for setting up the structure for a national strategy. It relates to the training and assessment of qualification of new personnel and the retraining of existing personnel in order to develop and maintain appropriate levels of competence. It provides the necessary guidance to meet the requirements laid down in Safety Series No. 115, International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources (1996).

Contents: 1. Introduction; 2. Responsibilities for building competence in protection and safety; 3. Education, training and work experience; 4. A national strategy for building competence in protection and safety.

Chinese Edition (31 pp., 1 fig.; 2005) • ISBN 92-0-516704-5 • STI/PUB/1108 • €13.00
English Edition (37 pp., 1 fig.; 2001) • ISBN 92-0-100701-9 • STI/PUB/1108 • €13.00
French Edition (42 pp., 1 fig.; 2005) • ISBN 92-0-212003-X • STI/PUB/1108 • €13.00
Russian Edition (45 pp., 1 fig.; 2005) • ISBN 92-0-405805-6 • STI/PUB/1108 • €13.00

Categorization of Radioactive Sources

Safety Guide

Safety Standards Series No. RS-G-1.9

This Safety Guide provides a risk based ranking of radioactive sources and practices in five categories. The categorization system is based on a logical and transparent method that provides the flexibility for it to be applied in a wide range of circumstances. On the basis of this categorization, risk informed decisions can be made in a graded approach to the regulatory control of radioactive sources for the purposes of safety and security.

Contents: 1. Introduction; 2. Categorization scheme; 3. Implementation of the categorization scheme; Appendix I: Categories for sources used in some common practices; Appendix II: Plain language descriptions of the categories; References; Annex I: Rationale and method for the categorization of radioactive sources; Annex II: The D value; Glossary.

(55 pp.; 2005) • ISBN 92-0-103905-0 • STI/PUB/1227 • €18.00

Regulatory Control of Radiation Sources

Safety Guide

Safety Standards Series No. GS-G-1.5

This Safety Guide is intended to assist States in implementing the requirements established in Safety Standards Series No. GS-R-1, Legal and Governmental Infrastructure for Nuclear, Radiation, Radioactive Waste and Transport Safety, for a national regulatory infrastructure to regulate any practice involving radiation sources in medicine, industry, research, agriculture and education. The Safety Guide provides advice on the legislative basis for establishing regulatory bodies, including the effective independence of the regulatory body. It also provides guidance on implementing the

functions and activities of regulatory bodies: the development of regulations and guides on radiation safety; implementation of a system for notification and authorization; carrying out regulatory inspections; taking necessary enforcement actions; and investigating accidents and circumstances potentially giving rise to accidents. The various aspects relating to the regulatory control of consumer products is explained, including justification, optimization of exposure, safety assessment and authorization. Guidance is also provided on the organization and staffing of regulatory bodies.

Contents: 1. Introduction; 2. Legal framework for a regulatory infrastructure; 3. Principal functions and activities of the regulatory body; 4. Regulatory control of the supply of consumer products; 5. Functions of the regulatory body shared with other governmental agencies; 6. Organization and staffing of the regulatory body; 7. Documentation of the functions and activities of the regulatory body; 8. Support services; 9. Quality management for the regulatory system.

(67 pp.; 2004) • ISBN 92-0-105004-6 • STI/PUB/1192 • €25.00

Strengthening Control over Radioactive Sources in Authorized Use and Regaining Control over Orphan Sources: National Strategies

IAEA TECDOC Series No. 1388

The control of radioactive sources is a high visibility and high priority topic in contemporary society. Fatalities from orphan radioactive sources and the possible use of radioactive sources in radiological dispersal devices make it more important than ever that governments know about and have good control over radioactive sources within their territories, especially Category 1, 2 and 3 sources. This publication provides the necessary background and a systematic methodology for governments to evaluate how well they are controlling radioactive sources. Part I of the report provides details of the applications of radioactive sources and Part II describes the process for gathering information, performing an evaluation and then developing a prioritized national strategic action plan. Many examples of events involving sources are given as illustrations of the points discussed.

English Edition (2004) • ISBN 92-0-100304-8 • IAEA-TECDOC-1388 • €15.00
Russian Edition (2005) • ISBN 92-0-409605-5 • IAEA-TECDOC-1388 • €15.00

TRANSPORT OF RADIOACTIVE MATERIAL

Advisory Material for the IAEA Regulations for the Safe Transport of Radioactive Material

Safety Guide

Safety Standards Series No. TS-G-1.1 (ST-2)

This Safety Guide provides recommendations on proven means of achieving and demonstrating compliance with Safety Standards Series No. TS-R-1 (ST-1, Revised), Regulations for the Safe Transport of Radioactive Material – 1996 Edition (Revised), issued in 2000, establishing safety regulations to be applied to the national and international transport of radioactive material. The recommendations apply to all modes of transport of radioactive material, including transport which is incidental to its use. Transport is deemed to comprise all operations and conditions associated with and involved in the movement of radioactive material; these include the design, fabrication and maintenance of packaging, and the preparation, consigning, handling, carriage, storage in transit and receipt at the final destination of packages. This publication supersedes Safety Series No. 7, Explanatory Material for the IAEA Regulations for the Safe Transport of Radioactive Material (1985 Edition) Second Edition (As Amended 1990), and Safety Series No. 37, Advisory Material for the IAEA Regulations for the Safe Transport of Radioactive Material (1985 Edition) Third Edition (As Amended 1990).

English Edition (387 pp., 14 figs; 2005) • ISBN 92-0-111802-3 • STI/PUB/1109 • €48.00
Russian Edition (458 pp., 14 figs; 2005) • ISBN 92-0-406005-0 • STI/PUB/1109 • €48.00

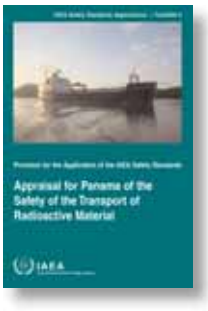
Appraisal for France of the Safety of the Transport of Radioactive Material

IAEA Safety Standards Applications – TranSAS 6

The IAEA has the specific statutory function within the United Nations system of establishing standards of safety for the protection of health against exposure to ionizing radiation. As part of this mandate, the IAEA has issued Regulations for the Safe Transport of Radioactive Material, and has also established the Transport Safety Appraisal Service (TranSAS) to carry out, at the request of States, appraisals of the implementation of these regulations. The IAEA carried out such an appraisal in France in 2004. The appraisal addressed all relevant transport activities in France, both national and international, for all modes of transport, with special emphasis on the maritime transport and air transport of radioactive material.

This report summarizes the findings of the 13 independent experts who participated in the appraisal.

(120 pp., 17 figs; 2004) • ISBN 92-0-111204-1 • STI/PUB/1208 • €23.00

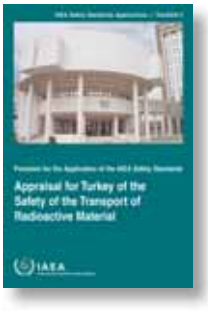


Appraisal for Panama of the Safety of the Transport of Radioactive Material

IAEA Safety Standards Applications – TranSAS 5

The IAEA has the specific statutory function within the United Nations system of establishing standards of safety for the protection of health against exposure to ionizing radiation. As part of this mandate, the IAEA has issued Regulations for the Safe Transport of Radioactive Material, and has also established the Transport Safety Appraisal Service (TranSAS) to carry out, at the request of States, appraisals of the implementation of these regulations. The IAEA carried out such an appraisal in Panama in 2003. The appraisal addressed all relevant transport activities in Panama, both national and international, for all modes of transport, with special emphasis on the regulations and procedures applicable to the Panama Canal Authority with regard to the transport of radioactive material through the Panama Canal. This report summarizes the findings of the ten independent experts who participated in the appraisal.

(86 pp., 3 figs; 2004) • ISBN 92-0-109904-5 • STI/PUB/1204 • €20.00



Appraisal for Turkey of the Safety of the Transport of Radioactive Material

IAEA Safety Standards Applications – TranSAS 4

The IAEA has the specific statutory function within the United Nations system of establishing standards of safety for the protection of health against exposure to ionizing radiation. As part of this mandate, the IAEA has issued Regulations for the Safe Transport of Radioactive Material, and has also established the Transport Safety Appraisal Service (TranSAS) to carry out, at the request of States, appraisals of the implementation of these regulations. The IAEA carried out such an appraisal in Turkey in 2003. The appraisal addressed all relevant transport activities in Turkey, both national and international, for all modes of transport. This report summarizes the findings of the four independent experts who participated in the appraisal.

(58 pp., 1 fig.; 2004) • ISBN 92-0-109804-9 • STI/PUB/1203 • €18.00

Directory of National Competent Authorities' Approval Certificates for Package Design, Special Form Material and Shipment of Radioactive Material

2004 Edition

IAEA TECDOC Series No. 1424

The PACKTRAM database contains administrative and technical information provided annually by the issuing competent authority about package approval certificates. Such data are used mainly by national competent authorities and port and customs officials to assist in regulating radioactive material movements in their country, and also by manufacturers and shippers of radioactive material. The database carries information on extant certificates and those that expired within the last complete calendar year. This is the fifteenth PACKTRAM annual report to be published by the IAEA. It is distributed worldwide mainly to designated competent authorities, as well as to registered interested parties. The database itself is maintained at www.packtram.org and can be accessed by the general public.

(2004) • ISBN 92-0-114404-0 • IAEA-TECDOC-1424 • €15.00

Planning and Preparing for Emergency Response to Transport Accidents Involving Radioactive Material

Safety Guide

Safety Standards Series No. TS-G-1.2 (ST-3)

This Safety Guide provides guidance on various aspects of emergency planning and preparedness for dealing effectively and safely with transport accidents involving radioactive material, including the assignment of responsibilities. It reflects the requirements specified in Safety Standards Series No. TS-R-1 (ST-1, Revised), Regulations for the Safe Transport of Radioactive Material — 1996 Edition (Revised) (2003) and those of Safety Series No. 115, International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources (1996). It supersedes Safety Series No. 87, Emergency Response Planning and Preparedness for Transport Accidents Involving Radioactive Material (1988).

Contents: 1. Introduction; 2. Framework for planning and preparing for response to accidents in the transport of radioactive material transport accidents; 3. Responsibilities for planning and preparing for response to accidents in the transport of radioactive material; 4. Planning for response to accidents in the transport of radioactive material; 5. Preparing for response to accidents in the transport of radioactive material; Appendix I: Features of the transport regulations influencing emergency response to transport accidents; Appendix II: Preliminary emergency response reference matrix; Appendix III: Guide to suitable instrumentation; Appendix IV: Overview of emergency management for a transport accident involving radioactive material; Appendix V: Examples of response to transport accidents; Appendix VI: Example equipment kit for a radiation protection team; References; Annex I: Example of guidance on

emergency response to carriers; Annex II: Emergency response guide.

English Edition (125 pp., 7 figs; 2002) • ISBN 92-0-111602-0 • STI/PUB/1119 • €14.50
Russian Edition (149 pp., 7 figs; 2005) • ISBN 92-0-406105-7 • STI/PUB/1119 • €14.50

Radiological Aspects of Non-fixed Contamination of Packages and Conveyances

IAEA TECDOC Series No. 1449

This publication reports the findings of an international Coordinated Research Project (CRP) organized by the IAEA in which scientists from France, Germany, Japan, UK, USA and the World Nuclear Transport Institute participated. On the basis of extensive studies, the possible radiation exposure that may result due to the presence of non-fixed contamination on packages and conveyances has been estimated. The study reveals that the limits on non-fixed contamination prescribed in the IAEA Regulations for the Safe Transport of Radioactive Material and also adopted by the various other international and national regulations are adequate for ensuring that the potential radiation exposure of workers and public due to the presence of non-fixed contamination is not significant. Related work carried out by the researchers, which is reported in the CD-ROM supplied with this publication, provides useful leads for further work by researchers interested in estimating exposures from non-fixed contamination by a large variety of radionuclides.

(2005) • ISBN 92-0-103105-X • IAEA-TECDOC-1449 • €15.00
CD Edition (2005) • ISBN 92-0-106405-5 • IAEA-TECDOC-CD-1449 • €15.00

Regulations for the Safe Transport of Radioactive Material, 2005 Edition

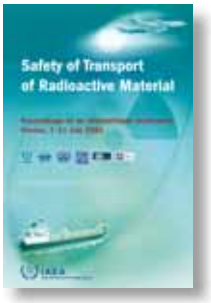
Safety Requirements

Safety Standards Series No. TS-R-1

The purpose of these regulations is to establish standards of safety that provide an acceptable level of control of the radiation hazards to persons, property and the environment that are associated with the transport of radioactive material. These regulations apply to the transport of radioactive material by all modes of transport, including transport that is incidental to the use of the radioactive material. Transport is deemed to comprise all operations and conditions associated with and involved in the movement of radioactive material; these include the design, fabrication and maintenance of packaging, and the preparation, consigning, handling, carriage, storage in transit and receipt at the final destination of packages. Transport includes normal and accident conditions encountered in carriage and in storage during transit.

Contents: Section I: Introduction; Section II: Definitions; Section III: General provisions; Section IV: Activity limits and material restrictions; Section V: Requirements and controls for transport; Section VI: Requirements for radioactive materials and for packagings and packages; Section VII: Text procedures; Section VIII: Approval and administrative requirements; Annex I: Summary of approval and prior notification requirements; Annex II: Conversion factors and prefixes; List of tables.

Chinese Edition (142 pp., 7 figs; 2005) • ISBN 92-0-509105-7 • STI/PUB/1225 • €32.00
English Edition (153 pp., 7 figs; 2005) • ISBN 92-0-103005-3 • STI/PUB/1225 • €32.00
French Edition (157 pp., 7 figs; 2005) • ISBN 92-0-307305-1 • STI/PUB/1225 • €32.00
Russian Edition (162 pp., 7 figs; 2005) • ISBN 92-0-407505-8 • STI/PUB/1225 • €32.00
Spanish Edition (161 pp., 7 figs; 2005) • ISBN 92-0-307405-8 • STI/PUB/1225 • €32.00



Safety of Transport of Radioactive Material

Proceedings of an International Conference in Vienna, Austria, 7–11 July 2003

Proceedings Series

Radioactive material is used throughout the world for many applications that benefit humankind encompassing agriculture, industry, medicine, electric power generation and research. The transport of this material places it outside of controlled facilities, in the public domain, and often entails movement between countries. The IAEA was assigned the task of developing, maintaining and providing the application of safety standards for the transport of radioactive material. This conference was convened to discuss the safety of the international transport of radioactive material. It was co-sponsored by the ICAO, IMO and UPU. These proceedings contain the opening addresses, papers from the background session and other papers presented at the conference, summaries of all discussions, and the summary and findings of the conference president. Contributed papers are provided in a CD-ROM that accompanies this volume.

(319 pp., 19 figs; 2004) • ISBN 92-0-108504-4 • STI/PUB/1200 • €138.00

Waste repositories

Developing Multinational Radioactive Waste Repositories: Infrastructural Framework and Scenarios of Cooperation

IAEA TECDOC Series No. 1413

This publication reviews the possibilities for the realization of multinational repositories and is intended to serve as a reference for Member States potentially interested in multinational repository concepts as hosting, partner or third party countries. The report updates work done in a previous study in 1998 (IAEA-TECDOC-1021) and attempts to define the concepts involved in the creation of multinational repositories, to explore the likely scenarios, to examine the conditions for successful implementation, and to point out the benefits and challenges inherent to multinational repositories. The report also provides

an overview of the past history and current status of multinational cooperations on repositories and related activities.

**(2004) • ISBN 92-0-112204-7 •
IAEA-TECDOC-1413 • €15.00**

Disposal Options for Disused Radioactive Sources

Technical Reports Series No. 436

This report presents a review of relevant information on the various technical factors and issues, as well as approaches and relevant technologies, leading to the identification of potential disposal options for disused radioactive sources. The report attempts to provide a logical 'road map' for the disposal of disused radioactive sources, taking into consideration the high degree of variability in the radiological properties of such types of radioactive waste. The use of borehole or shaft type repositories is highlighted as a potential disposal option, particularly for those countries that have limited resources and are looking for a simple, safe and cost effective solution for the disposal of their radioactive source inventories. The information provided in the report could be adapted or adopted to identify and develop specific disposal options suitable for the type and inventory of radioactive sources kept in storage in a given Member State.

**(51 pp., 14 figs; 2005) • ISBN 92-0-100305-6 •
STI/DOC/010/436 • €27.00**

Safety Assessment Methodologies for Near Surface Disposal Facilities

This publication covers the results of the coordinated research project on the Improvement of Safety Assessment Methodologies for Near Surface Disposal Facilities (ISAM), organized by the IAEA to improve and harmonize the approach to such safety assessment, which has resulted in development of the ISAM project methodology. The ISAM project involved the review and enhancement of post-closure safety assessment methodologies and tools for both existing and proposed near surface radioactive waste disposal facilities. The main objectives of the project were to: (a) provide a critical evaluation of the approaches and tools used in the post-closure safety assessment of proposed and existing near surface radioactive waste disposal facilities; (b) enhance the approaches and tools used; (c) build confidence in the approaches and tools used. In order to help achieve these objectives, the ISAM project paid particular attention to discussing, agreeing and setting down a safety assessment methodology. The ISAM project primarily focused on developing a consensus on the methodological aspects of safety assessment, but also gave considerable attention to illustrating the application of the methodology to three main types of disposal facilities (vault, RADON and borehole type disposal facilities).

**(2004) • ISBN 92-0-104004-0 •
IAEA-ISAM-1 • €45.00**

Surveillance and Monitoring of Near Surface Disposal Facilities for Radioactive Waste

Safety Reports Series No. 35

The publication deals with surveillance and monitoring activities for the purposes of demonstrating the safety of near surface radioactive waste disposal facilities. It covers all phases of facility development from siting through construction and operation to closure. It identifies the activities over which surveillance needs to be exercised and the parameters to be monitored, and provides examples of such programmes for present-day facilities. It also addresses programmes that may be necessary for older facilities which were not built to present-day standards and for which surveillance and monitoring may have to be carried out to identify remedial measures to be taken.

**(75 pp., 4 figs; 2004) • ISBN 92-0-114903-4 •
STI/PUB/1182 • €17.50**

Upgrading of Near Surface Repositories for Radioactive Waste

Technical Reports Series No. 433

This report considers a variety of circumstances that may require corrective actions to be assessed or implemented at near surface disposal facilities. The circumstances leading to the corrective actions, or the corrective actions themselves, may be of either a technical or a non-technical nature. Methodologies that can be employed to implement effective solutions to problems are discussed, including assessment of alternative options prior to selecting corrective actions, and the planning, implementation and verification of the specific measures adopted. Examples are provided of approaches and technologies that may be used to improve repository performance and safety. Information is also provided in the Annex on experience in various Member States with the upgrading of disposal facilities.

**(2005) • ISBN 92-0-112704-9 •
STI/DOC/010/433 • €38.00**

RADIATION PROTECTION

Application of the Concepts of Exclusion, Exemption and Clearance

Safety Guide

Safety Standards Series No. RS-G-1.7

This Safety Guide provides guidance on the application of the concepts of exclusion, exemption and clearance as established in the International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources. The Safety Guide includes specific values for activity concentrations

for both radionuclides of natural origin and those of artificial origin that may be used for bulk amounts of material for the purposes of applying the concepts of exclusion and exemption.

Contents: 1. Introduction; 2. The concepts; 3. Basis for the derivation of activity concentration values; 4. Values of activity concentration; 5. Application of the values.

(29 pp.; 2004) • ISBN 92-0-109404-3 • STI/PUB/1202 • €16.00

Assessment of Occupational Exposure due to External Sources of Radiation

Safety Guide

Safety Standards Series No. RS-G-1.3

The present Safety Guide addresses the assessment of exposure to external sources of radiation in the workplace and the monitoring of workers and the workplace in such situations. It also reflects the major changes over the past decade in international practice in external dose assessment. It further provides the necessary guidance to meet the requirements as laid down in Safety Series No. 115, International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources (1996).

Contents: 1. Introduction; 2. Dosimetric quantities; 3. Monitoring programmes; 4. Dosimetric specifications; 5. Type testing; 6. Pre-use and periodic testing; 7. Performance testing; 8. Dose record keeping and reporting; 9. Quality assurance; Appendix: Monitoring for skin contamination and assessment of skin dose; References; Annex I: Summary of recommended radiation weighting factors and Q–L relationships; Annex II: Instrumentation for individual monitoring; Annex III: Instrumentation for workplace monitoring; Annex IV: Reference conditions and standard test conditions; Annex V: Data relevant to type testing of personal dosimeters and area monitors in terms of the operational quantities; Annex VI: Examples of IEC standards on radiation monitoring equipment.

English Edition (89 pp., 5 figs; 2004) • ISBN 92-0-101799-5 • STI/PUB/1076 • €14.50
French Edition (95 pp., 5 figs; 2004) • ISBN 92-0-215503-8 • STI/PUB/1076 • €14.50
Spanish Edition (95 pp., 5 figs; 2004) • ISBN 92-0-300704-0 • STI/PUB/1076 • €14.50

Assessment of Occupational Exposure due to Intakes of Radionuclides

Safety Guide

Safety Standards Series No. RS-G-1.2

The present Safety Guide addresses the assessment of exposure due to intakes of radionuclides in the workplace and reflects the major changes which have occurred in international practice in internal dose assessment over the past decade. The report further provides the necessary guidance to meet the requirements as laid down in Safety Series No. 115, International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources (1996).

Contents: 1. Introduction; 2. Dosimetric quantities; 3. Monitoring programmes; 4. Direct methods; 5. Indirect methods; 6. Biokinetic models for internal dosimetry; 7. Interpretation of measurements; 8. Dose record keeping and reporting; 9. Quality assurance; Appendix I: Suggested criteria for individual monitoring; Appendix II: Detection limits for measurement methods; References; Annex I: Basic data.

English Edition (85 pp., 7 figs; 1999) • ISBN 92-0-101999-8 • STI/PUB/1077 • €14.50
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Spanish Edition (91 pp., 7 figs; 2004) • ISBN 92-0-306704-3 • STI/PUB/1077 • €14.50

Building Competence in Radiation Protection and the Safe Use of Radiation Sources

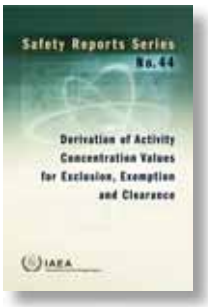
Safety Guide

Safety Standards Series No. RS-G-1.4

This Safety Guide makes recommendations concerning the building of competence in protection and safety within a national radiation protection infrastructure and provides guidance for setting up the structure for a national strategy. It relates to the training and assessment of qualification of new personnel and the retraining of existing personnel in order to develop and maintain appropriate levels of competence. It provides the necessary guidance to meet the requirements laid down in Safety Series No. 115, International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources (1996).

Contents: 1. Introduction; 2. Responsibilities for building competence in protection and safety; 3. Education, training and work experience; 4. A national strategy for building competence in protection and safety.

Chinese Edition (31 pp., 1 fig.; 2005) • ISBN 92-0-516704-5 • STI/PUB/1108 • €13.00
English Edition (37 pp., 1fig.; 2001) • ISBN 92-0-100701-9 • STI/PUB/1108 • €13.00
French Edition (42 pp., 1 fig.; 2005) • ISBN 92-0-212003-X • STI/PUB/1108 • €13.00
Russian Edition (45 pp., 1 fig.; 2005) • ISBN 92-0-405805-6 • STI/PUB/1108 • €13.00



Derivation of Activity Concentration Values for Exclusion, Exemption and Clearance

Safety Reports Series No. 44

The present Safety Report has been prepared to support Safety Guide RS-G-1.7, Application of the Concepts of Exclusion, Exemption and Clearance. The information provided in this publication can be applied to all commodities other than foodstuffs and drinking water. In order to comply with the request relating to foodstuffs, the Codex Alimentarius Commission of the FAO of the United Nations and the WHO has been requested to review its radiological criteria for foodstuffs. This Safety Report provides the basis for the activity concentration levels given in the related Safety Guide.

It presents the detailed scenario descriptions and parameters that were used.

(61 pp., 2 figs; 2005) • ISBN 92-0-113104-6 • STI/PUB/1213 • €34.00

Environmental and Source Monitoring for Purposes of Radiation Protection

Safety Guide

Safety Standards Series No. RS-G-1.8

The purpose of this Safety Guide is to provide international guidance, consistent with contemporary radiation protection principles and IAEA safety requirements, on the strategy of monitoring in relation to: (a) control of radionuclide discharges under practice conditions, and (b) intervention, such as in cases of nuclear or radiological emergencies or past contamination of areas with long lived radionuclides. Three categories of monitoring are discussed: monitoring at the source of the discharge (source monitoring), monitoring in the environment (environmental monitoring) and monitoring of individual exposures in emergencies (individual monitoring). The Safety Guide also provides general guidance on assessment of the doses to critical groups of the population due to the presence of radioactive materials or radiation fields in the environment both from routine operation of nuclear and other related facilities (practice) and from nuclear or radiological emergencies and past contamination of areas with long lived radionuclides (intervention). The dose assessments are based on the results of source monitoring, environmental monitoring, individual monitoring, or their combinations. This Safety Guide is primarily intended for use by national regulatory bodies and other agencies involved in national systems of radiation monitoring, as well as by operators of nuclear installations and other facilities where natural or human made radionuclides are treated and monitored.

Contents: 1. Introduction; 2. Meeting regulatory requirements for monitoring in practices and interventions; 3. Responsibilities for monitoring; 4. Generic aspects of monitoring programmes; 5. Programmes for monitoring in practices and interventions; 6. Technical conditions for monitoring procedures; 7. Considerations in dose assessment; 8. Interpretation of monitoring results; 9. Quality assurance; 10. Recording of results; 11. Education and training; References; Glossary.

(119 pp., 2 figs; 2005) • ISBN 92-0-113404-5 • STI/PUB/1216 • €26.00

Forthcoming

Management of Long Term Radiological Liabilities: Stewardship Challenges

Technical Reports Series No. 450

Radioactively contaminated sites often cannot be remediated to residual levels of contamination that are not of concern and released for unrestricted use. Residual contamination, buried wastes and other hazards may remain after cleanup is complete for several reasons: technical limitations, economic feasibility, worker health and safety issues, or prevention of collateral environmental impacts. An optimization between social and economic cost and level of protection has to be found. Hence, maintenance of institutional control is likely to be required for very long periods of time. The present publication discusses the relevant issues and approaches to tackle the conceptual, management and technical problems of maintaining institutional control over possibly hundreds or even thousands of years. These provisions and processes for maintaining institutional control over prolonged periods of time and to manage the radiological liabilities are often referred to as ‘stewardship’.

(Forthcoming 2006) • ISBN 92-0-101806-1 • STI/DOC/010/450 • €48.00

Methods for Assessing Occupational Radiation Doses due to Intakes of Radionuclides

Safety Reports Series No. 37

Radioactive material is used in many human activities, and whenever unsealed radioactive sources are present intakes of radionuclides by workers can occur. Intakes can occur by a number of routes, and the monitoring of workers and the workplace is an integral part of any occupational radiation protection programme. This report contains practical advice on the interpretation of such monitoring results and the assessment of committed effective doses to workers. A CD-ROM of tables is included.

(115 pp., 5 figs; 2004) • ISBN 92-0-103904-2 • STI/PUB/1190 • €28.00

Naturally Occurring Radioactive Materials (NORM IV)

Proceedings of an International Conference held in Szczyrk, Poland, 17–31 May 2004

IAEA TECDOC Series No. 1472

In line with the IAEA’s safety related programme objective to foster information exchange, this publication is aimed at disseminating important new information on exposure to natural sources to a wide spectrum of technical and regulatory personnel working in this area. Although natural sources of radiation are not usually of regulatory concern, some exposures to radon and naturally occurring radioactive material (NORM) may warrant consideration as to whether controls should be applied. More and more countries are regulating exposures to natural sources, and the body of radiological data on such exposures is growing rapidly. This international conference, NORM IV, is the fourth in a series dating back to 1997, and also follows on from an international symposium held in Rio de Janeiro in 1999 (the proceedings of which were published as IAEA-TECDOC-1271). Among the topics addressed at NORM IV were exposure to radionuclides of natural origin in mining and other industrial operations involving NORM (including

environmental impacts), standards and regulations, and measurement techniques.

**(2005) • ISBN 92-0-110305-0 •
IAEA-TECDOC-1472 • €15.00**

Occupational Radiation Protection

Safety Guide

Safety Standards Series No. RS-G-1.1

The present Safety Guide provides general guidance on the establishment of an effective radiation protection programme for occupational exposure, appropriate for the sources of radiation likely to be encountered in a range of industries, medical institutions, educational and research establishments and nuclear fuel cycle facilities. This Safety Guide further provides the necessary guidance to meet the requirements as laid down in Safety Series No. 115, International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources (1996).

Contents: 1. Introduction; 2. Framework for occupational radiation protection; 3. Dose limitation; 4. Optimization of radiation protection for practices; 5. Radiation protection programmes; 6. Intervention in emergencies; 7. Health surveillance.

**English Edition (73 pp., 2 figs; 1999) • ISBN 92-0-102299-9 •
STI/PUB/1081 • €14.50**
**French Edition (81 pp., 2 figs; 2004) • ISBN 92-0-200804-3 •
STI/PUB/1081 • €14.50**
**Spanish Edition (79 pp., 2 figs; 2004) • ISBN 92-0-300604-4 •
STI/PUB/1081 • €14.50**

Occupational Radiation Protection in the Mining and Processing of Raw Materials

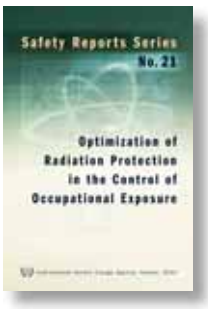
Safety Guide

Safety Standards Series No. RS-G-1.6

This Safety Guide, which is jointly sponsored by the IAEA and the ILO, supersedes Safety Series No. 26, Radiation Protection of Workers in the Mining and Milling of Radioactive Ores (1983 Edition). Safety Series No. 26 dealt mainly with activities involving uranium or thorium ores. This Safety Guide updates the previous guidance material and extends its coverage to include activities involving all raw materials for which radiation protection measures need to be considered, as well as including additional guidance on authorization of mining and processing activities, inspection and compliance. The main purpose of this Safety Guide is to provide practical guidance on meeting the requirements of the Basic Safety Standards as they relate to the radiation protection of workers in the mining and processing of raw materials, and thus to facilitate the preparation and adoption, by Member States, of national and local regulations rules and work procedures in this area of industrial activity. This Safety Guide is aimed at regulatory bodies, operators of mines and mineral processing facilities, health and safety committees, workers and their representatives, and health and safety professionals.

Contents: 1. Introduction; 2. Fulfilment of requirements and discharge of responsibilities; 3. Dose limitation; 4. Radiation protection programme; 5. Engineering and administrative protection measures; 6. Health surveillance; Appendix I: Responsibilities of employers and workers; Appendix II: Dose coefficients for radionuclides of different lung absorption types; Appendix III: General guidance on the radiation protection programme; Appendix IV: Radiation monitoring techniques; Appendix V: Protective respiratory equipment; Appendix VI: General guidance on health surveillance; Annex: Relationships between gross alpha activity and committed effective dose for the inhalation of ore dust containing uranium or thorium; Glossary.

**(95 pp.; 2004) • ISBN 92-0-115003-2 •
STI/PUB/1183 • €21.00**



Optimization of Radiation Protection in the Control of Occupational Exposure

Safety Reports Series No. 21

This Safety Report provides practical information on the application of the principle of the optimization of radiation protection in the workplace. It emphasizes the importance of integrating radiation protection into the work management system and of the involvement of management and workers alike in setting up and implementing a radiation protection system.

Contents: 1. Introduction; 2. Optimization process; 3. Assessment of exposure situations; 4. Means of reducing exposure; 5. Defining and implementing an ALARA plan; 6. Conclusions; Annex I: Decision aiding techniques; Annex II: ALARA checklists; Annex III: Monetary value of the unit collective dose.

**English Edition (66 pp., 3 figs; 2002) • ISBN 92-0-110302-6 •
STI/PUB/1118 • €19.00**
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STI/PUB/1118 • €19.00**
**Spanish Edition (76 pp., 3 figs; 2004) • ISBN 92-0-302504-9 •
STI/PUB/1118 • €19.00**

Optimization of the Radiological Protection of Patients Undergoing Radiography, Fluoroscopy and Computed Tomography

IAEA TECDOC Series No. 1423

National surveys in the UK and USA have indicated that there are large variations in patient doses for routine radiographic examinations, sometimes as high as 20 times or more. This indicates that variations in developing countries, where there may also be older machines or poor maintenance facilities, should be a matter of concern. This publication contains the results of a coordinated research project carried out in countries in Eastern Europe, Africa and Asia. Considerable variations were observed in general radiography. The experience with optimization indicated significant reductions in patient dose with acceptable image quality consistent with the clinical purpose

of the examination. The methodology, based on patient dose measurements, comparison with reference values, assessment of image quality, the introduction of quality control (QC) and corrective actions, wherever needed, and re-evaluation of patient doses and image quality, has demonstrated its effectiveness for the optimization of radiation protection programmes. This publication also contains the results of a situation analysis on patient doses and QC status in fluoroscopy and in computed tomography.

**(2004) • ISBN 92-0-113504-1 •
IAEA-TECDOC-1423 • €15.00**

Optimization of the Radiological Protection of Patients: Image Quality and Dose in Mammography (Coordinated Research in Europe)

IAEA TECDOC Series No. 1447

In view of the vast potential of mammography as an imaging modality to achieve early detection of breast cancer, and the recommendations of various national and international organizations to achieve optimization in mammography, the IAEA initiated a coordinated research project in 1999. The project was confined to six countries in Eastern Europe. The purpose was to access the situation with regard to image quality and patient dose, identify corrective actions needed to achieve optimization, implement corrective actions and evaluate the impact. Useful observations were made, and ultimately it was possible to achieve, on average, a 25% reduction in dose while maintaining image quality. It is hoped that this publication will prove useful to Member States in setting up programmes for optimization of radiological protection in mammography.

**(2005) • ISBN 92-0-102305-7 •
IAEA-TECDOC-1447 • €15.00**

Radiation Protection in the Design of Radiotherapy Facilities

Safety Reports Series No. 47

This Safety Report provides practical guidance regarding the design and shielding of radiotherapy facilities. Methods for determining the necessary structural shielding for external beam units (^{60}Co units, linear accelerators, superficial and orthovoltage units, and simulators) as well as brachytherapy units are described. Data used for determining the structural shielding necessary for all types of radiotherapy facilities are reproduced in this report and example calculations are provided for each type of facility. In addition, specific design features that could be incorporated into radiotherapy facilities, including those related to the security of radioactive sources, are discussed. This report is intended to be used primarily by radiological physicists in the planning and design of new radiotherapy facilities and in the remodelling of existing facilities. Sections of the report will also be of interest to architects, civil engineers, hospital administrators and others who are concerned with the design of radiotherapy facilities. In addition, the guidance in the report will be useful to regulatory personnel responsible for the licensing and inspection of these facilities.

**(2006) • ISBN 92-0-100505-9 •
STI/PUB/1223 • €29.00**

Radiological Protection for Medical Exposure to Ionizing Radiation

Safety Guide

Safety Standards Series No. RS-G-1.5

This Safety Guide provides recommendations on how safety requirements may be fulfilled for the protection of patients and visitors against exposure to ionizing radiation in medical practice. Recommendations cover the establishment of guidance levels for diagnostic medical exposures, acceptance testing processes for radiation equipment, calibration of radiotherapy units and reporting of accidental medical exposures.

Contents: 1. Introduction; 2. Regulatory programme for radiological protection for medical exposure; 3. Specific aspects of radiological protection for medical exposure in diagnostic and interventional radiology; 4. Specific aspects of radiological protection for medical exposure in nuclear medicine; 5. Specific aspects of radiological protection for medical exposure in radiotherapy; Annex I: General requirements; Annex II: Medical exposure; Annex III: Schedule II. Dose limits. Dose limitation for comforters and visitors of patients; Annex IV: Schedule III. Guidance levels of dose, dose rate and activity for medical exposure; Glossary.

**Chinese Edition (65 pp.; 2005) • ISBN 92-0-516604-9 •
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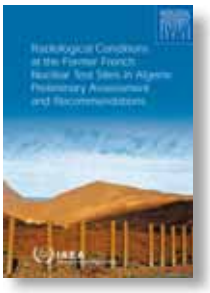
STI/PUB/1117 • €14.50
French Edition (89 pp.; 2004) • ISBN 92-0-202204-6 •
STI/PUB/1117 • €14.50
Russian Edition (99 pp.; 2004) • ISBN 92-0-402104-7 •
STI/PUB/1117 • €14.50**



Radiological Conditions at the Former French Nuclear Test Sites in Algeria: Preliminary Assessment and Recommendations

Radiological Assessment Reports

There are various locations around the world that have been affected by radioactive residues. Some of these residues are the result of past peaceful activities, while others result from military activities, including residues from the testing of nuclear weapons. Stimulated by concern about the state of the environment, movement away from military nuclear activities and improved opportunities for international cooperation, attention in many countries has turned to assessing and, where necessary, remediating areas affected by radioactive residues. Representatives of the

Algerian government requested the IAEA to carry out a study of the radiological situation at the former French nuclear test sites in Algeria. The findings of this assessment are summarized in this report.

(60 pp., 27 figs; 2005) • ISBN 92-0-113304-9 • STI/PUB/1215 • €30.00

Forthcoming

Regulatory and Management Approaches for the Control of Environmental Residues Containing Naturally Occurring Radioactive Material (NORM)

IAEA TECDOC Series No. 1484

This publication contains the papers presented and the ensuing discussions from the technical meeting on 'Regulatory and Management Approaches for the Control of Environmental Residues containing Naturally Occurring Radioactive Materials (NORM)' and in addition some papers from a similar meeting held in Vienna in 2002. All the papers present an overview of the current NORM residue regulation and management situation in a number of Member States. The subsequent discussions from the 2004 meeting are summarized, and the report goes on to list the meeting's recommendations for actions that need to be taken to improve guidance on future management of residues containing NORM.

(Forthcoming 2006) • ISBN 92-0-113305-7 • IAEA-TECDOC-1484 • €15.00

Testing of Environmental Transfer Models Using Data from the Remediation of a Radium Extraction Site

IAEA BIOMASS-7

This publication has been produced by the Remediation Working Group of the BIOMASS project. The main aim of this group was to test the accuracy of predictions of environmental assessment models that form part of the assessment of the radiological impact of remediation decisions. Two scenarios were constructed and applied based on the contamination around the site of a former radium extraction plant in Olen, Belgium, which arose due to the discharge of liquid effluents into a local brook — waste disposal practices and the use of waste material as a road surfacing material. This group considered the situation in an area of approximately 100 ha, contaminated as a result of the frequent flooding of a local river and the dredging of bed sediment out of the river onto the river banks. The scenarios were designed to allow modellers to consider the impact of possible future remediation actions, based on input data for a real site. Differences between model predictions were mainly due to differences in user interpretation of the scenario description. The main sources of uncertainty were the radium distribution in the root zone before deep ploughing and the effectiveness of deep ploughing. The report is intended for use by experts in environmental remediation assessment.

(2004) • ISBN 92-0-109103-6 • IAEA-BIOMASS-7 • €15.00

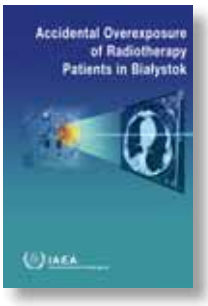
Accident Response

Accident Analysis for Nuclear Power Plants with Graphite Moderated Boiling Water RBMK Reactors

Safety Reports Series No. 43

Accident analysis is an important tool for confirming the adequacy and efficiency of provisions within the defence in depth concept for the safety of nuclear power plants. In 2002, the IAEA published Safety Reports Series No. 23 on Accident Analysis for Nuclear Power Plants, containing general rules and practical guidance for performing accident analysis applicable to any reactor design. The specific features of individual reactor types are taken into account in separate Safety Reports. The current report provides additional guidance with respect to the specific design features of the graphite moderated boiling water reactors with pressurized channels known as RBMKs. In particular, guidance is provided regarding categorization of initiating events, selection of acceptance criteria, and initial and boundary conditions. Specific suggestions are offered for analysis of different groups of initiating events. The report is intended primarily for analysts coordinating, performing or reviewing computational analyses of transients and accidents for nuclear power plants with RBMKs, on both the utility and regulatory sides.

(59 pp., 9 figs; 2005) • ISBN 92-0-112804-5 • STI/PUB/1211 • €38.00



Accidental Overexposure of Radiotherapy Patients in Bialystok

An accidental overexposure occurred in the Bialystok Oncology Centre which affected five patients undergoing radiotherapy. This report gives an account of the event, the subsequent dose assessment and the clinical consequences for the patients. It also discusses the lessons learned and provides recommendations for preventing similar events from occurring in future. As such the report is likely to be of use to the manufacturers and users of accelerators and to national bodies.

(103 pp., 38 figs; 2004) • ISBN 92-0-114203-X • STI/PUB/1180 • €24.00

Forthcoming

Development and Review of Plant Specific Emergency Operating Procedures

Safety Reports Series No. 48

Emergency operating procedures (EOPs) are essential for maintaining the fundamental safety functions and for preventing core damage during both design basis accidents and beyond design basis accidents in nuclear power plants (NPPs). This publication is applicable for all reactor technologies and comprehensively deals with all aspects of the development, implementation and review of EOPs using state-of-the-art experience. The primary objective of this publication is to provide guidance and to be used as a reference for teams of experts in charge of the development or review of EOPs at specific NPPs.

(Forthcoming 2006) • ISBN 92-0-103705-8 • STI/PUB/1226 • €32.00

Development of an Extended Framework for Emergency Response Criteria: Interim Report for Comments

IAEA TECDOC Series No. 1432

This publication proposes for widespread comment an extension of the existing emergency response guidance. It addresses actions based on facility conditions; preventing deterministic effects from intake; individual decontamination; immediate medical treatment; long term medical follow-up; medical consultation, especially for pregnant women following an exposure during an emergency; and implementation of protective actions under difficult conditions. This guidance also includes a plain language explanation designed to assist decision makers when making and communicating their final decision on actions to be taken, and the public. This will form the basis for future international guidance. In addition, a revised and expanded technical basis for response to nuclear and radiological emergencies is presented that is based on an examination of the latest data. This includes: (a) proposed thresholds for severe deterministic health effects for the full spectrum of important radionuclides; (b) a consensus on the insights that can be drawn from the current knowledge of the development of stochastic health effects; and (c) epidemiological and statistical considerations.

(2005) • ISBN 92-0-100205-X • IAEA-TECDOC-1432 • €15.00

Planning and Preparing for Emergency Response to Transport Accidents Involving Radioactive Material

Safety Guide

Safety Standards Series No. TS-G-1.2 (ST-3)

This Safety Guide provides guidance on various aspects of emergency planning and preparedness for dealing effectively and safely with transport accidents involving radioactive material, including the assignment of responsibilities. It reflects the requirements specified in Safety Standards Series No. TS-R-1 (ST-1, Revised), Regulations for the Safe Transport of Radioactive Material — 1996 Edition (Revised) (2003) and those of Safety Series No. 115, International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources (1996). It supersedes Safety Series No. 87, Emergency Response Planning and Preparedness for Transport Accidents Involving Radioactive Material (1988).

Contents: 1. Introduction; 2. Framework for planning and preparing for response to accidents in the transport of radioactive material transport accidents; 3. Responsibilities for planning and preparing for response to accidents in the transport of radioactive material; 4. Planning for response to accidents in the transport of radioactive material; 5. Preparing for response to accidents in the transport of radioactive material; Appendix I: Features of the transport regulations influencing emergency response to transport accidents; Appendix II: Preliminary emergency response reference matrix; Appendix III: Guide to suitable instrumentation; Appendix IV: Overview of emergency management for a transport accident involving radioactive material; Appendix V: Examples of response to transport accidents; Appendix VI: Example equipment kit for a radiation protection team; References; Annex I: Example of guidance on emergency response to carriers; Annex II: Emergency response guide.

English Edition (125 pp., 7 figs; 2002) • ISBN 92-0-111602-0 • STI/PUB/1119 • €14.50
Russian Edition (149 pp., 7 figs; 2005) • ISBN 92-0-406105-7 • STI/PUB/1119 • €14.50

Preparedness and Response for a Nuclear or Radiological Emergency

Safety Requirements

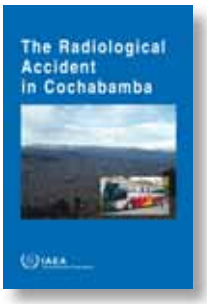
Safety Standards Series No. GS-R-2

This Safety Requirements publication establishes the requirements for preparedness and response for a nuclear or radiological emergency. It expands on, complements and organizes the requirements relating to emergency management established in Safety Series No. 120, Radiation Protection and the Safety of Radiation Sources (1996), and No. 115, International Basic Safety Standards for Protection against

Ionizing Radiation and for the Safety of Radiation Sources (1996).

Contents: 1. Introduction; 2. Principles and objectives; 3. General requirements; 4. Functional requirements; 5. Requirements for infrastructure; References; Annex I: Requirements on protection for workers undertaking an intervention; Annex II: Dose levels at which intervention is expected to be undertaken under any circumstances; Annex III: Guidelines for intervention levels and action levels in emergency exposure situations.

Chinese Edition (2005) • ISBN 92-0-513605-0 • STI/PUB/1133 • €20.50
English Edition (72 pp.; 2005) • ISBN 92-0-116702-4 • STI/PUB/1133 • €20.50
French Edition (84 pp.; 2004) • ISBN 92-0-200904-X • STI/PUB/1133 • €20.50
Russian Edition (92 pp.; 2004) • ISBN 92-0-410204-7 • STI/PUB/1133 • €20.50
Spanish Edition (86 pp.; 2004) • ISBN 92-0-311904-3 • STI/PUB/1133 • €20.50



The Radiological Accident in Cochabamba

In April 2002 an accident involving an industrial radiography source containing ^{192}Ir occurred in Cochabamba, Bolivia, some 500 km from the capital, La Paz. The source, in a remote exposure container, remained exposed within a guide tube, although this was not known at the time. The container, the guide tube and other equipment were transported from Cochabamba to La Paz as cargo on a passenger bus. This bus had a full load of passengers for most of the eight hour journey. The equipment was subsequently collected by employees of the company concerned and transferred by taxi to the company's shielded facility. This publication gives an account of the event, the doses received and the medical assessment. It also presents information relevant to national authorities and regulatory organizations, emergency planners and a broad range of specialists, including physicists, radiation protection officers and medical specialists. It is hoped that dissemination of the information contained in the report will help reduce the likelihood of similar accidents occurring in future or, if they do occur, help mitigate their consequences.

(55 pp., 20 figs; 2004) • ISBN 92-0-107604-5 • STI/PUB/1199 • €19.00

RADIOACTIVE WASTE MANAGEMENT

Decommissioning of Medical, Industrial and Research Facilities

Safety Guide

Safety Standards Series No. WS-G-2.2

This Safety Guide addresses the subject of how to meet the requirements for the decommissioning of medical, industrial and research facilities where radioactive materials and sources are produced, received, used and stored, as laid down in the Safety Requirements publication, Safety Standards Series No. WS-R-2, Predisposal Management of Radioactive Waste, Including Decommissioning. It provides guidance to national authorities and operating organizations, particularly to those in developing countries (as such facilities are predominant in these countries), on the planning and safe management of the decommissioning of such facilities.

Contents: 1. Introduction; 2. Key issues specific to decommissioning; 3. Decommissioning options; 4. Facilitating decommissioning; 5. Planning and safety assessment for decommissioning; 6. Critical tasks of decommissioning; 7. Management during decommissioning; 8. Completion of decommissioning; References; Annex I: Example of the contents of a decommissioning plan; Annex II: Safety assessment specific for decommissioning; Annex III: Example of the contents of a final radiation survey report.

Chinese Edition (33 pp., 2 figs; 2005) • ISBN 92-0-516504-2 • STI/PUB/1078 • €13.00
English Edition (37 pp., 2 figs; 2005) • ISBN 92-0-102099-6 • STI/PUB/1078 • €13.00
French Edition (37 pp., 2 figs; 2004) • ISBN 92-0-215404-X • STI/PUB/1078 • €13.00
Russian Edition (39 pp., 2 figs; 2005) • ISBN 92-0-404005-X • STI/PUB/1078 • €13.00

Decommissioning of Nuclear Fuel Cycle Facilities

Safety Guide

Safety Standards Series No. WS-G-2.4

This Safety Guide sets out recommendations relating to the decommissioning of nuclear fuel cycle facilities. The guidance provided is derived from the basic principles for radioactive waste management set out in the Safety Requirements publication, Safety Standards Series No. WS-R-2, Predisposal Management of Radioactive Waste, Including Decommissioning (2000), and in Safety Series No. 111-F, The Principles of Radioactive Waste Management: A Safety Fundamental (1995).

Contents: 1. Introduction; 2. Key issues specific to decommissioning; 3. Selection of a decommissioning option; 4. Facilitating decommissioning; 5. Planning and safety assessment for decommissioning; 6. Critical decommissioning tasks; 7. Management during decommissioning; 8. Completion of decommissioning; Annex: Example of the contents of the final radiological survey report.

Chinese Edition (29 pp.; 2005) • ISBN 92-0-517304-5 • STI/PUB/1110 • €13.00
English Edition (37 pp.; 2004) • ISBN 92-0-101001-X • STI/PUB/1110 • €13.00
French Edition (41 pp.; 2004) • ISBN 92-0-215604-2 • STI/PUB/1110 • €13.00
Russian Edition (40 pp.; 2005) • ISBN 92-0-406905-8 • STI/PUB/1110 • €13.00

Decommissioning of Nuclear Power Plants and Research Reactors

Safety Guide

Safety Standards Series No. WS-G-2.1

This Safety Guide addresses the subject of how to meet the requirements for decommissioning of nuclear power plants and research reactors laid down in the Safety Requirements publication, Safety Standards Series No. WS-R-2, Predisposal Management of Radioactive Waste, Including Decommissioning. It provides guidance to national authorities and operating organizations on the planning and safe management of the decommissioning of such installations.

Contents: 1. Introduction; 2. Key issues specific to decommissioning; 3. Selection of a decommissioning option; 4. Facilitating decommissioning; 5. Planning and safety assessment for decommissioning; 6. Critical tasks of decommissioning; 7. Management during decommissioning; 8. Completion of decommissioning; References; Annex I: Example of the contents of a final radiological survey report; Annex II: Example of documented plans and management systems for implementation of decommissioning.

English Edition (41 pp.; 1999) • ISBN 92-0-102599-8 • STI/PUB/1079 • €14.50
French Edition (46 pp.; 2004) • ISBN 92-0-211903-1 • STI/PUB/1079 • €14.50

Forthcoming

Geological Disposal of Radioactive Waste

Safety Requirements

Safety Standards Series No. WS-R-4

This Safety Requirements publication is concerned with providing protection for people and the environment from the hazards associated with waste management activities related to disposal, i.e. hazards that could arise during the operational period and following closure. It sets out the protection objectives and criteria for geological disposal and establishes the requirements that must be met to ensure the safety of this disposal option, consistent with the established principles of safety for radioactive waste management. It is intended for use by those involved in radioactive waste management and in making decisions in relation to the development, operation and closure of geological disposal facilities, especially those concerned with the related regulatory aspects.

(Forthcoming 2006) • ISBN 92-0-105705-9 • STI/PUB/1231 • €18.00

Improvements of Radioactive Waste Management at WWER Nuclear Power Plants

The focus of this report is on the low and intermediate level radioactive wastes generated and managed during the normal operating life of WWER nuclear power plants. It identifies mechanisms for reducing the generation and disposal volumes of radioactive waste at WWER reactors, and compares the waste management approaches of western PWR and WWER reactors to identify reasons why PWRs currently have lower waste generation, storage, and disposal volumes. Examining historical trends in plant design and waste management approaches, it seeks to identify those changes which contribute most significantly to today's differences between PWRs and WWERs in generation and disposal volumes. The report determines the role of waste storage in promoting implementation of improved or advanced waste minimization technologies and approaches, and proposes recommendations for improving WWER waste minimization.

(Forthcoming 2006) • ISBN 92-0-103006-1 • IAEA-TECDOC-1492 • €15.00

Management of Radioactive Waste from the Mining and Milling of Ores

Safety Standards Series No. WS-G-1.2

Safety Guide

This Safety Guide provides recommendations and guidance on the safe management of radioactive waste resulting from the mining and milling of ores, with the purpose of protecting workers, the public and the environment from the consequences of these activities. It supplements Safety Standards Series No. WS-R-1, Near Surface Disposal of Radioactive Waste (1999), and supersedes Safety Series No. 85, Safe Management of Wastes from the Mining and Milling of Uranium and Thorium Ores (1987).

Contents: 1. Introduction; 2. Administrative, legal and regulatory framework; 3. Protection of human health and the environment; 4. Strategy for waste management; 5. Safety considerations in different phases of operations; 6. Safety assessment; 7. Quality assurance; 8. Monitoring and surveillance; 9. Institutional control for the post-closure phase.

English Edition (39 pp., 2 figs; 2002) • ISBN 92-0-115802-5 • STI/PUB/1134 • €13.50
Russian Edition (47 pp., 2 figs; 2005) • ISBN 92-0-404104-8 • STI/PUB/1134 • €13.50

Natural Activity Concentrations and Fluxes as Indicators for the Safety Assessment of Radioactive Waste Disposal

IAEA TECDOC Series No. 1464

This report presents the findings of the IAEA Coordinated Research Project entitled "Natural Safety Indicators (Concentrations and Fluxes)", the objective of which was to contribute to the assessment of the long term safety of radioactive waste disposal by means of additional safety indicators based on the observation of natural systems. The participation of countries from around the world has meant that the distribution of naturally occurring radionuclides on local, regional and global scales is now better understood. This has enabled the project to define ways in which these abundances may be used to set criteria against which the potential releases from a repository may be evaluated. This report also contains the developing views of experts within the international community and should be of use to those engaged in producing national and international standards and guidance in this area.

(2005) • ISBN 92-0-109805-7 • IAEA-TECDOC-1464 • €15.00

Near Surface Disposal of Radioactive Waste

Safety Requirements

Safety Standards Series No. WS-R-1

This publication sets out the basic safety requirements related to the disposal of radioactive wastes in near surface repositories. As a Safety Requirements publication it is supported by a number of associated Safety Guides which provide guidance on the implementation of the requirements. Its principles are derived from the Safety Fundamentals publication, Safety Series No. 111-F, The Principles of Radioactive Waste Management. It includes requirements for the protection of human health, requirements for the assessment procedures needed to ensure that safety is achieved, and technical requirements for waste acceptance and for siting, design, construction, operation and closure of the repository as well as for the post-closure phase.

Contents: 1. Introduction; 2. Requirements for the protection of human health and the environment; 3. Safety assessment and compliance with safety requirements; 4. Organizational and technical safety requirements; 5. Waste acceptance requirements; 6. Characteristics of an acceptable site; 7. Design of disposal facilities; 8. Construction; 9. Operation; 10. Closure; 11. Post-closure phase; 12. Quality assurance; Annex: Dose and risk criteria for the post-closure phase.

Chinese Edition (25 pp.; 2005) • ISBN 92-0-517404-1 • STI/PUB/1073 • €12.50
English Edition (29 pp.; 1999) • ISBN 92-0-101099-0 • STI/PUB/1073 • €12.50
French Edition (35 pp.; 1999) • ISBN 92-0-204105-9 • STI/PUB/1073 • €12.50
Russian Edition (38 pp.; 2004) • ISBN 92-0-404603-1 • STI/PUB/1073 • €12.50
Spanish Edition (34 pp.; 2004) • ISBN 92-0-308004-X • STI/PUB/1073 • €12.50

Predisposal Management of High Level Radioactive Waste

Safety Guide

Safety Standards Series No. WS-G-2.6

This Safety Guide provides regulatory bodies and the operators that generate and manage radioactive waste with recommendations on how to meet the principles and requirements established for the predisposal management of high level waste.

Contents: 1. Introduction; 2. Protection of human health and the environment; 3. Roles and responsibilities; 4. General safety considerations; 5. Safety features for the predisposal management; 6. Record keeping and reporting; 7. Safety assessment; 8. Quality assurance; Annex I: Practical steps in the predisposal management of HLW; Annex II: Site conditions, processes and events for consideration in a safety assessment (external natural phenomena); Annex III: Site conditions, processes and events for consideration in a safety assessment (external human induced phenomena); Annex IV: Postulated initiating events for consideration in a safety assessment (internal phenomena).

English Edition (59 pp.; 2003) • ISBN 92-0-102503-3 • STI/PUB/1151 • €17.50
Russian Edition (64 pp.; 2005) • ISBN 92-0-412905-0 • STI/PUB/1089 • €17.50

Predisposal Management of Radioactive Waste, Including Decommissioning

Safety Requirements

Safety Standards Series No. WS-R-2

This publication establishes safety requirements relating to the predisposal management of radioactive waste arising from: the operation and decommissioning of nuclear facilities; the application of radionuclides in industry, medicine and research; the processing of raw materials containing naturally occurring radionuclides; and the cleanup of contaminated sites. Safety requirements for the relevant aspects of the decommissioning of nuclear facilities are established. The book includes provisions required to bring radioactive waste into a state suitable for storage or disposal in designated facilities and to ensure the safety of the facilities. Relevant requirements and associated responsibilities for the protection of human health and the environment are included. The safety requirements are established on the basis of principles set out in the Safety Fundamentals publication, The Principles of Radioactive Waste Management (Safety Series No. 111-F, 1995).

Contents: 1. Introduction; 2. Protection of human health and the environment; 3. Responsibilities associated with predisposal management of radioactive waste, including decommissioning; 4. Interdependence; 5. Elements of predisposal management of radioactive waste; 6. Decommissioning; 7. Safety of facilities; Glossary.

Chinese Edition (21 pp.; 2005) • ISBN 92-0-517204-9 • STI/PUB/1089 • €11.00
English Edition (26 pp.; 2000) • ISBN 92-0-100300-5 • STI/PUB/1089 • €11.00
French Edition (33 pp.; 2004) • ISBN 92-0-202704-8 • STI/PUB/1089 • €11.00
Russian Edition (33 pp.; 2003) • ISBN 92-0-404703-8 • STI/PUB/1089 • €11.00
Spanish Edition (29 pp.; 2004) • ISBN 92-0-310804-1 • STI/PUB/1089 • €11.00

Records for Radioactive Waste Management up to Repository Closure: Managing the Primary Level Information (PLI) Set

IAEA TECDOC Series No. 1398

The objective of this publication is to highlight the importance of the early establishment of a comprehensive records system to manage primary level information (PLI) as an integrated set of information, not merely as a collection of information, throughout all the phases of radioactive waste management. The information presented in this publication will assist Member States in ensuring that waste and repository records, relevant for retention after repository closure, are generated, identified, reviewed and actively managed during pre-closure phases so that they are available and useable at the appropriate time. This publication addresses the establishment and management of

the PLI set up to the point of closure of a repository. Specifically, it (1) describes the importance of establishing a coordinated, integrated and well-managed PLI set, (2) provides a basic overview of the components of a PLI set, and (3) provides general guidance on the management of and responsibility for the PLI set.

**(2004) • ISBN 92-0-107104-3 •
IAEA-TECDOC-1398 • €15.00**

Forthcoming

Release of Sites from Regulatory Control upon Termination of Practices

Safety Guide

Safety Standards Series

An increasing number of nuclear facilities are coming to the end of their useful lives and are being or are going to be decommissioned with a view to removing the sites from regulatory control. In many cases, decommissioning activities include the decontamination of land, buildings and other structures such as underground pipes and tanks, or ponds, at the site that became contaminated as a result of an authorized practice. The objective of this Safety Guide is to provide guidance to the regulatory body and operators for the release of sites or parts of sites from regulatory control after a practice has been terminated. Such release may include cleanup of contaminated sites, and this Safety Guide also aims to provide guidance in this area.

**(Forthcoming 2006) • ISBN 92-0-101606-9 •
STI/PUB/1244 • €27.00**

Safety Assessment for Near Surface Disposal of Radioactive Waste

Safety Guide

Safety Standards Series No. WS-G-1.1

This Safety Guide provides recommendations on how to meet the requirements related to safety assessment in the Safety Requirements publication, Safety Standards Series No. WS-R-1, Near Surface Disposal of Radioactive Waste (1999). It addresses the subject of safety assessment for near surface disposal of radioactive waste and provides guidance on approaches to performing safety assessments in the context of near surface repositories.

Contents: 1. Introduction; 2. General considerations for safety assessment; 3. Guidelines for safety assessment; 4. Confidence building.

**English Edition (28 pp., 1 fig.; 1999) • ISBN 92-0-101299-3 •
STI/PUB/1075 • €11.50**
**French Edition (39 pp., 1 fig.; 2004) • ISBN 92-0-201104-4 •
STI/PUB/1075 • €11.50**
**Spanish Edition (37 pp., 1 fig.; 2004) • ISBN 92-0-302604-5 •
STI/PUB/1075 • €11.50**

Regulatory Control of Radioactive Discharges to the Environment

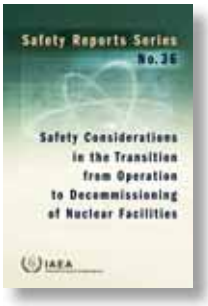
Safety Guide

Safety Standards Series No. WS-G-2.3

This Safety Guide makes recommendations concerning the regulatory process for controlling the discharge of liquid and gaseous effluents to the environment from normal controlled operations of practices in which radioactive material is used. It provides guidance on how to meet the requirements established in the Safety Requirements publication, Safety Standards Series No. WS-R-2, Predisposal Management of Radioactive Waste, Including Decommissioning (2000). It expands on and interprets the principles stated in the Safety Fundamentals publications: Safety Series No. 111-F, The Principles of Radioactive Waste Management (1995), and Safety Series No. 120, Radiation Protection and the Safety of Radiation Sources (1996). It also elaborates on how to fulfil the requirements established in Safety Series No. 115, International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources (1996), and Safety Standards No. GS-R-1, Legal and Governmental Infrastructure for Nuclear, Radiation, Radioactive Waste and Transport Safety (2000).

Contents: 1. Introduction; 2. General responsibilities; 3. Authorization of discharges for a new practice or source; 4. Responsibilities in operation; 5. Existing practices; Appendix: Generic upper value for a dose constraint for members of the public; Annex: Basic radiological protection concepts relevant to this Safety Guide.

**Chinese Edition (38 pp., 3 figs; 2005) • ISBN 92-0-516404-6 •
STI/PUB/1088 • €14.50**
**English Edition (43 pp., 3 figs; 2000) • ISBN 92-0-101000-1 •
STI/PUB/1088 • €14.50**
**French Edition (49 pp., 3 figs; 2005) • ISBN 92-0-215004-4 •
STI/PUB/1088 • €14.50**
**Russian Edition (53 pp., 3 figs; 2005) • ISBN 92-0-406205-3 •
STI/PUB/1088 • €14.50**



Safety Considerations in the Transition from Operation to Decommissioning of Nuclear Facilities

Safety Reports Series No. 36

A growing number of nuclear facilities around the world are being shut down for various reasons. The transition period between operations and implementation of the decommissioning strategy includes some routine operations and others that may be specific to the transition stage. These transitional operations are undertaken following procedures authorized by the regulatory body. In this period, a number of modifications, both technical and organizational, are required to adjust the facility to new objectives and requirements. This Safety Report provides information regarding the safety concerns associated with the transition period and suggests solutions for managing them. It addresses issues that are

generically applicable to any nuclear facility and those that are specific to various types of nuclear facility.

(38 pp., 1 fig.; 2004) • ISBN 92-0-115103-9 • STI/PUB/1184 • €16.00

Standard Format and Content for Safety Related Decommissioning Documents

Safety Reports Series No. 45

This report provides information on the content and format for decommissioning plans and supporting safety related documents. Its scope includes information that is relevant to all types of nuclear facilities, ranging from nuclear power plants and reprocessing facilities to university laboratories and manufacturing plants. The report will be of interest to decommissioning planning engineers, project managers and operations managers.

(2005) • ISBN 92-0-113204-2 • STI/PUB/1214 • €22.00

SAFETY ANALYSIS

Dispersion of Radioactive Material in Air and Water and Consideration of Population Distribution in Site Evaluation for Nuclear Power Plants

Safety Guide

Safety Standards Series No. NS-G-3.2

This Safety Guide deals with consideration of the potential effects of a nuclear power plant on the environment and of the population distribution in the surrounding area in site evaluation for a nuclear power plant. It supplements Safety Standard No. NS-R-3, Site Evaluation for Nuclear Installations, which supersedes Safety Series No. 50-C-S (Rev. 1), Code on the Safety of Nuclear Power Plants: Siting (1988). The present Guide supersedes Safety Series: No. 50-SG-S3, Atmospheric Dispersion in Nuclear Power Plant Siting (1980); No. 50-SG-S4, Site Selection and Evaluation for Nuclear Power Plants with Respect to Population Distribution (1980); No. 50-SG-S-6, Hydrological Dispersion of Radioactive Material in Relation to Nuclear Power Plant Siting (1985); and No. 50-SG-S7, Nuclear Power Plant Siting: Hydrogeological Aspects (1984).

Contents: 1. Introduction; 2. Transport and diffusion of effluents discharged into the atmosphere; 3. Transport and diffusion of effluents discharged into the hydrosphere; 4. Uses of land and water in the region of the site; 5. Population distribution; 6. Consideration of the feasibility of an emergency plan; 7. Quality assurance programme.

English Edition (32 pp.; 2002) • ISBN 92-0-110102-3 • STI/PUB/1122 • €11.50
Russian Edition (41 pp.; 2004) • ISBN 92-0-404304-0 • STI/PUB/1122 • €11.50

External Human Induced Events in Site Evaluation for Nuclear Power Plants

Safety Guide

Safety Standards Series No. NS-G-3.1

This Safety Guide recommends actions, conditions and procedures and provides guidance for fulfilling the requirements of Safety Standards Series No. NS-R-3, Site Evaluation for Nuclear Installations, in relation to external human induced events when conducting a site evaluation for a nuclear power plant. The present Guide supersedes Safety Series No. 50-SG-S5, External Man-induced Events in Relation to Nuclear Power Plant Siting (1981).

Contents: 1. Introduction; 2. General approach to site evaluation in relation to external human induced events; 3. Data collection and investigations; 4. Screening and evaluation procedures; 5. Aircraft crashes; 6. Release of hazardous fluids; 7. Explosions; 8. Other external human induced events; 9. Administrative aspects.

Chinese Edition (forthcoming 2006) • ISBN 92-0-514205-0 • STI/PUB/1126 • €14.50
English Edition (49 pp., 1 fig.; 2004) • ISBN 92-0-111202-5 • STI/PUB/1126 • €14.50
Russian Edition (61 pp., 1 fig.; 2004) • ISBN 92-0-402304-X • STI/PUB/1126 • €14.50

Format and Content of the Safety Analysis Report for Nuclear Power Plants

Safety Guide

Safety Standards Series No. GS-G-4.1

This Safety Guide provides recommendations and guidance on the possible format and content of Safety Analysis Reports (SARs) to be developed in support of requests to regulatory bodies for authorization to construct and/or to operate a nuclear power plant. As such, this Safety Guide recommends how to meet the requirements for preparation of adequate safety demonstrations as established in Safety Standards Series No. GS-R-1, Safety Requirements on Legal and Governmental Infrastructure for Nuclear, Radiation, Radioactive Waste and Transport Safety, and complements Safety Guide No. NS-G-1.2, Safety Assessment and Verification of Nuclear Power Plants.

Contents: 1. Introduction; 2. General considerations; 3. Format and content of a SAR; Chapter I: Introduction; Chapter II: General plant description; Chapter III: Management of safety; Chapter IV: Site evaluation; Chapter V: General design aspects; Chapter VI: Description and conformance to the design of plant systems; Chapter VII: Safety analyses; Chapter VIII: Commissioning; Chapter IX: Operational aspects; Chapter X: Operational limits and conditions; Chapter XI: Radiation protection; Chapter XII: Emergency preparedness; Chapter XIII: Environmental aspects; Chapter XIV: Radioactive waste

management; Chapter XV: Decommissioning and end of life aspects; 4. Review and updating of the SAR; Glossary.

English Edition (81 pp.; 2004) • ISBN 92-0-115203-5 • STI/PUB/1185 • €22.00

Intercomparison and Validation of Computer Codes for Thermohydraulic Safety Analysis of Heavy Water Reactors

IAEA TECDOC Series No. 1395

Intercomparison and validation of computer codes used in different countries for thermohydraulics safety analysis of heavy water reactors (HWRs) enhances confidence in the predictions made by these codes. A set of reliable experimental data is necessary for conducting such intercomparison and validation exercises. Experimental results from a large loss of coolant accident (LOCA) test simulating HWR LOCA behaviour that was conducted by Atomic Energy of Canada Ltd (AECL) was selected for this validation project. This report provides a comparison of the results obtained from six participating countries, utilizing four different computer codes. General conclusions are reached and recommendations made.

(2004) • ISBN 92-0-106004-1 • IAEA-TECDOC-1395 • €15.00

Maintenance, Surveillance and In-service Inspection in Nuclear Power Plants

Safety Guide

Safety Standards Series No. NS-G-2.6

This Safety Guide provides recommendations and guidance for effective maintenance, surveillance and in-service inspection to ensure that the levels of reliability and availability of all plant structures, systems and components meet the assumptions and intent of the design. It supplements Section 6 of Safety Standards Series No. NS-R-2, Safety of Nuclear Power Plants: Operation (2000). It supersedes the following Safety Series publications: No. 50-SG-O2, In-service Inspection for Nuclear Power Plants (1980), No. 50-SG-O7, Maintenance of Nuclear Power Plants (1990), No. 50-SG-O8, Surveillance of Items Important to Safety in Nuclear Power Plants.

Contents: 1. Introduction; 2. Maintenance, surveillance and in-service inspection and their interrelationship; 3. Functions, responsibilities and interfaces; 4. Organizational aspects; 5. Implementation of the MS&I programme; 6. Analysis of results and feedback of experience; 7. Areas to which special considerations apply; 8. Additional considerations specific to maintenance; 9. Additional considerations specific to surveillance; 10. Additional considerations specific to in-service inspection.

English Edition (74 pp.; 2002) • ISBN 92-0-115702-9 • STI/PUB/1136 • €20.50
Russian Edition (91 pp.; 2005) • ISBN 92-0-406505-2 • STI/PUB/1136 • €20.50

Operational Limits and Conditions and Operating Procedures for Nuclear Power Plants

Safety Guide

Safety Standards Series No. NS-G-2.2

This Safety Guide provides guidance on the development, content and use of operational limits and conditions (limits on plant operating parameters) and operating procedures that affect them. It recommends how to meet the requirements established in Safety Standards Series No. NS-R-2, Safety of Nuclear Power Plants: Operation (2000), setting out the responsibilities of the operating organization in setting, modifying and documenting operational limits and conditions and ensuring compliance with them. It supersedes Safety Series No. 50-SG-O3, Operational Limits and Conditions for Nuclear Power Plants (1979).

Contents: 1. Introduction; 2. Safety objective; 3. The concept of operational limits and conditions and their development; 4. Safety limits; 5. Limiting safety system settings; 6. Limits and conditions for normal operation; 7. Surveillance requirements; 8. Operating procedures; 9. Development of operating procedures; 10. Compliance with operational limits and conditions and operating procedures; Appendix I: Selection of limits and conditions for normal operation; Appendix II: Development of operating procedures (outlines); Annex: Example to explain some terms used; Glossary.

Chinese Edition (forthcoming 2006) • ISBN 92-0-514105-4 • STI/PUB/1100 • €14.50
English Edition (41 pp., 2 figs; 2000) • ISBN 92-0-102000-7 • STI/PUB/1100 • €14.50
French Edition (47 pp., 2 figs; 2005) • ISBN 92-0-207205-1 • STI/PUB/1100 • €14.50
Russian Edition (45 pp., 2 figs; 2004) • ISBN 92-0-401704-X • STI/PUB/1100 • €14.50

Precursor Analyses – The Use of Deterministic and PSA Based Methods in the Event Investigation Process at Nuclear Power Plants

IAEA TECDOC Series No. 1417

This publication outlines the methodology that is used for evaluation of the safety significance of unusual events in nuclear power plants. It describes a synergistic process that makes more effective use of operating experience event information by combining the insights and knowledge gained from two approaches, traditional deterministic root cause event investigation and PSA-based event analysis. The precursor analysis described in this publication enables better determination of the safety significance of events, so that

adequate corrective measures can be better planned and utilized.

**(2004) • ISBN 92-0-111604-7 •
IAEA-TECDOC-1417 • €15.00**

Safety Assessment and Verification for Nuclear Power Plants

Safety Guide

Safety Standards Series No. NS-G-1.2

This Safety Guide provides recommendations to the designers of a nuclear power plant for a comprehensive safety assessment in the initial design process and for modifications to the design, as well as recommendations to the operating organization for independent verification of the safety assessment for new nuclear power plants. The guidance can also be applied to safety reviews for existing plants. The methods and recommendations can be used by regulatory bodies for the conduct of the regulatory review and assessment. The Safety Guide recommends how to meet the requirements established in Safety Standards Series No. NS-R-1, The Safety of Nuclear Power Plants: Design (2000). It supersedes Safety Series No. 50-SG-D11 (1986). Guidance is also provided for Contracting Parties to the Convention on Nuclear Safety in meeting their obligations under Article 14 on Assessment and Verification of Safety.

Contents: 1. Introduction; 2. Safety assessment, safety analysis and independent verification; 3. Engineering aspects important to safety; 4. Safety analysis; 5. Independent verification.

**Chinese Edition (forthcoming 2006) • ISBN 92-0-513805-3 •
STI/PUB/1112 • €14.50**
**English Edition (83 pp., 1 fig.; 2004) • ISBN 92-0-403004-6 •
STI/PUB/1112 • €14.50**
**French Edition (62 pp., 1 fig.; 2004) • ISBN 92-0-206705-8 •
STI/PUB/1112 • €14.50**
**Russian Edition (99 pp., 1 fig.; 2004) • ISBN 92-0-403004-6 •
STI/PUB/1112 • €14.50**

Software for Computer Based Systems Important to Safety in Nuclear Power Plants

Safety Guide

Safety Standards Series No. NS-G-1.1

This Safety Guide provides guidance on the collection of evidence and preparation of documentation to be used in the demonstration of safety and reliability of the software for computer based systems important to safety in nuclear power plants for all phases of the system life cycle. It recommends how to meet the requirements established in Safety Standards Series No. NS-R-1, The Safety of Nuclear Power Plants: Design: Safety Requirements (2000).

Contents: 1. Introduction; 2. Technical considerations for computer based systems; 3. Application of requirements for management of safety to computer based systems; 4. Project planning; 5. Computer system requirements; 6. Computer system design; 7. Software requirements; 8. Software design; 9. Software implementation; 10. Verification and analysis; 11. Computer system integration; 12. Validation of computer systems; 13. Installation and commissioning; 14. Operation; 15. Post-delivery modifications; Annex: Use and validation of pre-existing software; Glossary.

**Chinese Edition (forthcoming 2006) • ISBN 92-0-513705-7 •
STI/PUB/1095 • €14.50**
**English Edition (89 pp., 2 figs; 2000) • ISBN 92-0-101800-2 •
STI/PUB/1095 • €14.50**
**French Edition (95 pp., 2 figs; 2004) • ISBN 92-0-202004-3 •
STI/PUB/1095 • €14.50**

LEGAL AND GOVERNMENTAL ASPECTS

Documentation for Use in Regulating Nuclear Facilities

Safety Guide

Safety Standards Series No. GS-G-1.4

This Safety Guide provides recommendations for regulatory bodies and operators on how to meet the requirements in respect of documentation for use in regulating nuclear facilities established in Safety Standards Series No. GS-R-1, Legal and Governmental Infrastructure for Nuclear, Radiation, Radioactive Waste and Transport Safety (2000). It supersedes Safety Series No. 50-SG-G8, Licences for Nuclear Power Plants: Content, Format and Legal Considerations: Safety Guide (1982), and Safety Series No. 50-SG-G9, Regulations and Guides for Nuclear Power Plants: Safety Guide (1984).

Contents: 1. Introduction; 2. Overview of documentation; 3. Regulations and guides; 4. Documents to be produced by the operator; 5. Documents produced for a particular facility by the regulatory body; Appendix: The authorization process.

**Chinese Edition (34 pp.; 2003) • ISBN 92-0-502705-7 •
STI/PUB/1132 • €14.00**
**English Edition (42 pp.; 2002) • ISBN 92-0-113702-8 •
STI/PUB/1132 • €14.00**
**French Edition (47 pp.; 2004) • ISBN 92-0-214604-7 •
STI/PUB/1132 • €14.00**
**Russian Edition (54 pp.; 2004) • ISBN 92-0-401304-4 •
STI/PUB/1132 • €14.00**

Legal and Governmental Infrastructure for Nuclear, Radiation, Radioactive Waste and Transport Safety

Safety Requirements

Safety Standards Series No. GS-R-1

This Safety Requirements publication establishes the requirements for the

legal and governmental infrastructure in respect of a range of facilities and activities, including nuclear facilities, sources of ionizing radiation, management of radioactive waste and transport of radioactive material. It covers development of the legal framework for establishing a regulatory body and other actions to achieve effective regulatory control. The publication addresses all phases of the life cycle of facilities or the duration of activities and any subsequent period of institutional control until there is no significant residual radiation hazard. For a facility, these phases usually include siting, design, construction, commissioning, operation and decommissioning (or close-out or closure). Other responsibilities are also covered, such as those for developing the necessary support for safety, involvement in securing third party liability and emergency preparedness. It accompanies Safety Series No. 115, International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources (1996), and Safety Standards Series No. TS-R-1 (ST-1, Revised), Regulations for the Safe Transport of Radioactive Material — 1996 Edition (Revised): Safety Requirements. It supersedes both Safety Series No. 50-C-G (Rev. 1), Code on the Safety of Nuclear Power Plants: Governmental Organization (1988), and Safety Series No.111-S-1, Establishing a National System for Radioactive Waste Management (1995).

Contents: 1. Introduction; 2. Legislative and governmental responsibilities; 3. Responsibilities and functions of the regulatory body; 4. Organization of the regulatory body; 5. Activities of the regulatory body; 6. Specific infrastructure; Appendix: Review and assessment during the life cycle of a nuclear power plant; Glossary.

Chinese Edition (26 pp.; 2000) • ISBN 92-0-513402-3 • STI/PUB/1093 • €11.50
English Edition (30 pp.; 2000) • ISBN 92-0-100800-7 • STI/PUB/1093 • €11.50
French Edition (34 pp.; 2004) • ISBN 92-0-100800-7 • STI/PUB/1093 • €11.50
Russian Edition (36 pp.; 2003) • ISBN 92-0-404803-4 • STI/PUB/1093 • €11.50
Spanish Edition (32 pp.; 2004) • ISBN 92-0-311804-7 • STI/PUB/1093 • €11.50

National Infrastructures for Radiation Safety: Towards Effective and Sustainable Systems

Proceedings of an International Conference in Rabat, Morocco, 1–5 September 2003

Proceedings Series

This conference reviewed the overall situation with respect to the development of radiation safety and security infrastructures both in IAEA Member States and in countries that are not IAEA Member States. It highlighted the need for complete and effective radiation safety and security infrastructures that are sustainable. The conference findings and recommendations are included in these proceedings, along with the keynote speeches, rapporteurs' summaries of contributed papers and the discussions. The contributed papers and oral presentations are available on a CD that is attached to the back of this volume.

(449 pp., 14 figs; 2004) • ISBN 92-0-105404-1 • STI/PUB/1193 • €120.00

Organization and Staffing of the Regulatory Body for Nuclear Facilities

Safety Guide

Safety Standards Series No. GS-G-1.1

This Safety Guide provides recommendations on the appropriate management system, organization and staffing of the regulatory body responsible for the regulation of nuclear facilities in order to comply with the requirements of Safety Standards Series No. GS-R-1, Legal and Governmental Infrastructure for Nuclear, Radiation, Radioactive Waste and Transport Safety (2000). It supersedes Safety Series No. 50-SG-G1, Qualifications and Training of Staff of the Regulatory Body for Nuclear Power Plants: A Safety Guide (1979).

Contents: 1. Introduction; 2. Regulatory independence and funding of the regulatory body; 3. Organization of the regulatory body; 4. Staffing; 5. Training of staff; Appendix: Basic elements of a regulatory training programme.

Chinese Edition (25 pp.; 2005) • ISBN 92-0-517104-2 • STI/PUB/1129 • €11.50
English Edition (31 pp.; 2002) • ISBN 92-0-114002-9 • STI/PUB/1129 • €11.50
French Edition (37 pp.; 2004) • ISBN 92-0-215304-3 • STI/PUB/1129 • €11.50
Russian Edition (42 pp.; 2004) • ISBN 92-0-401404-0 • STI/PUB/1129 • €11.50

Regulatory Inspection of Nuclear Facilities and Enforcement by the Regulatory Body

Safety Guide

Safety Standards Series No. GS-G-1.3

This Safety Guide provides recommendations for regulatory bodies on how to meet the requirements in respect of the inspection of nuclear facilities, regulatory enforcement and related matters established in Safety Standards Series No. GS-R-1, Legal and Governmental Infrastructure for Nuclear, Radiation, Radioactive Waste and Transport Safety (2000). It supersedes Safety Series No. 50-SG-G4 (Rev. 1), Inspection and Enforcement by the Regulatory Body for Nuclear Power Plants: Safety Guide (1996).

Contents: 1. Introduction; 2. Objectives of regulatory inspection and enforcement; 3. Management of inspection; 4. Performance of regulatory inspections; 5. Regulatory enforcement;

6. Assessment of inspection and enforcement activities; Appendix: Inspection areas for nuclear facilities.

English Edition (46 pp.; 2002) • ISBN 92-0-114102-5 • STI/PUB/1130 • €15.00
French Edition (53 pp.; 20023) • ISBN 92-0-215504-6 • STI/PUB/1130 • €15.00
Russian Edition (60 pp.; 2004) • ISBN 92-0-401204-8 • STI/PUB/1130 • €15.00

Review and Assessment of Nuclear Facilities by the Regulatory Body

Safety Guide

Safety Standards Series No. GS-G-1.2

This Safety Guide provides recommendations on how to satisfy the requirements established in Safety Standards Series No. GS-R-1, Legal and Governmental Infrastructure for Nuclear, Radiation, Radioactive Waste and Transport Safety (2000), concerning the responsibilities and functions of the regulatory body in the regulation of nuclear facilities. It provides recommendations on regulatory review and assessment of the various safety related submissions (on siting, design, construction, commissioning, operation and decommissioning or closure of a nuclear facility) to determine whether a facility complies with the applicable safety objectives and requirements. This Safety Guide supersedes Safety Series No. 50-SG-G3, Conduct of a Regulatory Review and Assessment During the Licensing Process for Nuclear Power Plants: Safety Guide (1980).

Contents: 1. Introduction; 2. Review and assessment process; 3. Performance of the review and assessment process; 4. Monitoring of the review and assessment process; Appendix: Topics to be covered by review and assessment.

Chinese Edition (38 pp.; 2005) • ISBN 92-0-517004-6 • STI/PUB/1128 • €15.00
English Edition (46 pp.; 2002) • ISBN 92-0-111702-7 • STI/PUB/1128 • €15.00
French Edition (54 pp.; 2004) • ISBN 92-0-201005-6 • STI/PUB/1128 • €15.00
Russian Edition (60 pp.; 2004) • ISBN 92-0-405103-5 • STI/PUB/1128 • €15.00

Risk Informed Regulation of Nuclear Facilities: Overview of the Current Status

IAEA TECDOC Series No. 1436

This report provides guidance on the use of risk information by regulatory bodies as part of an integrated decision making process. This addresses the way in which risk information is being used in decisions about safety issues at nuclear plants, sometimes referred to as risk informed decision making, and how risk information is being used by regulatory bodies as an input into the activities that they carry out, sometimes referred to as risk informed regulation.

(2005) • ISBN 92-0-100105-3 • IAEA-TECDOC-1436 • €15.00

Nuclear Power

Country Nuclear Power Profiles – 2004 Edition

This publication compiles background information on the status and development of nuclear power programmes in countries having operating nuclear plants and/or plants under construction as of 1 January 2004, and in countries actively engaged in planning such a programme. It presents historical information on energy supply and demand; reviews the organizational and industrial aspects of nuclear power programmes in participating countries for the same period; and provides information about the relevant legislative, regulatory and international framework in each country. Topics such as reactor safety, nuclear fuel cycle, radioactive waste management and research programmes are for the most part not discussed in detail. Statistical data about nuclear plant operations, population, energy and electricity use are largely drawn from the PRIS and EEDB sources as of the end of 2004 and 2002, respectively.

CD Edition (2005) • ISBN 92-0-114505-5 • IAEA-CNPP/2004/CD • €95.00
(2004) • ISBN 92-0-106904-9 • IAEA-CNPP/2003/P • €95.00
CD Edition (2004) • ISBN 92-0-104604-9 • IAEA-CNPP/2003/CD • €95.00

Energy Indicators for Sustainable Development: Guidelines and Methodologies

This publication presents a set of energy indicators for sustainable development and is a versatile analytical tool for countries to track their progress on energy for sustainable development. The thematic framework, guidelines, methodologies and energy indicators set out in this publication reflect the expertise of five international agencies and organizations (International Atomic Energy Agency, United Nations Department of Economic and Social Affairs, International Energy Agency, Eurostat and European Environment Agency) recognized worldwide as leaders in energy and environmental statistics and analysis. General guidelines and specific methodology sheets for 30 energy indicators are outlined in this report for statisticians, analysts, policy makers and academics to use in their efforts to analyse the effects of energy policies on the social, economic and environmental dimensions of sustainable development.

(161 pp., 1 fig.; 2005) • ISBN 92-0-116204-9 • STI/PUB/1222 • €35.00

Methodology for the Assessment of Innovative Nuclear Reactors and Fuel Cycles

Report of Phase 1B (first part) of the International Project on Innovative Nuclear Reactors and Fuel Cycles (INPRO)

IAEA TECDOC Series No. 1434

The main objectives of INPRO are to: help ensure that nuclear energy is available to contribute towards fulfilling energy needs in the 21st century in a sustainable manner; and bring together both technology holders and technology users to consider jointly the international and national actions required to achieve desired innovations in nuclear reactors and fuel cycles. Within INPRO the future energy demand and supply was explored and several scenarios were identified. The following requirement for energy supply will play a crucial role: sustainability of the way the energy supply will be realized. Fulfilling the growing need for energy in developing countries is also an important issue. On the basis of scenarios for the next fifty years, requirements for the different aspects of the future of nuclear energy systems, such as those on economics, environment, safety, waste, proliferation resistance and infrastructure, have been identified as well as a methodology developed to assess innovative nuclear systems and fuel cycles. On the basis of this assessment, the need for innovations in existing nuclear technology, to be achieved via research, development and demonstration, can be defined. To facilitate the deployment of innovative nuclear systems, different aspects of the infrastructure, technical as well as institutional, also have been reviewed, and recommendations for changes are made to anticipate the main developments worldwide, such as ongoing globalization.

(2004) • ISBN 92-0-116304-5 • IAEA-TECDOC-1434 • €15.00

Nuclear Power for the 21st Century

Proceedings of an International Ministerial Conference held in Paris, 21–22 March 2005

The International Ministerial Conference on Nuclear Energy in the 21st Century was organized by the IAEA, in cooperation with the Organisation for Economic Cooperation and Development (OECD) and the Nuclear Energy Agency (OECD/NEA), and was hosted by the Government of France. The broad strategic objectives of the conference were to facilitate a discussion on the issue of nuclear energy and society, involving ministers, experts and decision makers, which would review the role of nuclear power and define the potential benefits (energy security, sustainability and improved environmental protection) that expanding nuclear power offers to meet the increasing energy needs of the world. This was encouraged by recent indications by a number of Member States regarding their future increased use of nuclear power.

(2005) • ISBN 92-0-109505-8 • CN-122/CD • €15.00

Nuclear Power Reactors in the World April 2005

Reference Data Series No. 2

This is the twenty-fifth edition of Reference Data Series No. 2, which presents the most recent reactor data available to the IAEA. It contains summarized information as of the end of 2004 on: (1) power reactors operating or under construction, and shut down; and (2) performance data on reactors operating in the IAEA Member States, as reported to the IAEA. The information is collected by the IAEA through designated national correspondents in the Member States. The replies are used to maintain the IAEA's Power Reactor Information System (PRIS).

(77 pp., 6 figs; 2005) • ISBN 92-0-104205-1 • IAEA-RDS-2/25 • €12.00
26th Edition (forthcoming 2006) • IAEA-RDS-2/26 • €12.00

The Role of Nuclear Power and Nuclear Propulsion in the Peaceful Exploration of Space

This publication provides details of a variety of radioisotope power systems, shows in what circumstances they surpass other power systems, and provides the history of the space missions in which they have been employed. The book also summarizes the use of on-board reactors and the testing done on reactor rocket thrusters as well as providing a review of current technology, a consideration of future applications and a bibliography of further information on space nuclear technology. This publication also identifies those R&D areas where space related nuclear power systems can be of practical relevance to efforts in innovative reactor and fuel cycle technology development.

(133 pp., 57 figs; 2005) • ISBN 92-0-107404-2 • STI/PUB/1197 • €35.00

Nuclear Power Planning and Economics

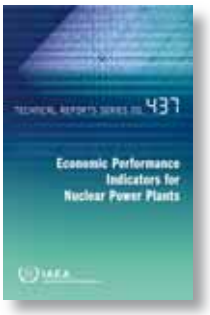
Comparative Assessment of Energy Options and Strategies in Mexico until 2025

IAEA TECDOC Series No. 1469

The IAEA offers its Member States a comprehensive programme of technical assistance and cooperation, which covers many diverse areas related to peaceful uses of nuclear energy. In the area of energy planning, the IAEA provides assistance to Member States for strengthening national capabilities for elaborating sustainable patterns of energy supply and use. This publication is a successful example of implementing an energy planning project in Mexico. It can serve as a guideline for designing and implementing similar projects in other countries, addressing the economic, social and environmental issues of energy sector development.

(2005) • ISBN 92-0-111105-3 • IAEA-TECDOC-1469 • €15.00

Forthcoming



Economic Performance Indicators for Nuclear Power Plants

Technical Reports Series No. 437

From a global perspective, it is clear that there is no single group of key economic and financial measures that are applicable and useful for all countries and regions. The extent to which deregulation and privatization is occurring varies considerably around the world, with some countries continuing to foster regulated monopolies or provide government subsidies for power generation, while in others, retail and wholesale electricity is sold in truly open market, competitive situations. Consequently, the requirement for key measures of financial and economic success for the nuclear power industry will continue to vary from one region or country to another. The primary purpose of this report is to identify and define a number of economic performance measures for use at nuclear power plants operating in deregulated, competitive electricity markets. The report outlines recent changes in the regulatory environments surrounding the financial operation of electric utilities, and in particular discusses the implications of deregulation and competition on gauging the economic performance and financial health of a nuclear power enterprise. It presents and discusses a general definition and classification of nuclear economic indicators, within the context of regulation, competition and the economic requirements of constructing, operating and decommissioning nuclear power plants. The economic indicators selected are a reflection of the diversity of requirements and are intended to be applicable to different regions worldwide. In using these indicators, individual countries and Member States should select from the list those economic measures that are best suited to their specific applications and financial requirements.

(Forthcoming 2006) • ISBN 92-0-100905-4 • STI/DOC/010/437 • €40.00

Energy and Nuclear Power Planning Study for Armenia

IAEA TECDOC Series No. 1404

This report describes the outcome of a successfully completed National Technical Cooperation Project, ARM/0/004, entitled Energy and Nuclear Power Planning Study (ENPP) for Armenia, covering the period up to 2020. The main objectives of the project were to contribute to the development of a national energy master plan and assess the future role of nuclear power in Armenia by providing proven methodologies and building institutional capacities for analysing different energy options, and to perform an ENPP study. Assisted by the IAEA, a team of local experts conducted the study over a period of two years.

The national team conducted a very detailed analysis of the energy issues, and constructed and evaluated various scenarios for future development of the energy sector in Armenia, using the IAEA's energy planning models. Finally, recommendations on future energy projects and policy were prepared which were used by the national authorities in the formulation of the ENPP for Armenia.

**(2004) • ISBN 92-0-109204-0 •
IAEA-TECDOC-1404 • €15.00**

Energy, Electricity and Nuclear Power Estimates for the Period up to 2030

Reference Data Series No. 1

This annual publication contains estimates of energy, electricity and nuclear power trends up to the year 2030, using a variety of sources, such as the IAEA's Power Reactor Information System and data prepared by the United Nations.

**(53 pp., 10 figs; 2005) • ISBN 92-0-108705-5 •
IAEA-RDS-1/25 • €9.00
2006 Edition (forthcoming) •
IAEA-RDS-1/26 • €9.00**

Energy Supply Options for Lithuania

IAEA TECDOC Series No. 1408

This publication reports on the comprehensive study of Lithuania's future energy supply strategies taking into consideration necessary measures being implemented in the energy sector in accordance with the accession to full membership of the European Union. Within this context, the study investigates the future development of the Lithuanian electricity/heat supply sector and the impacts on energy supply security and environmental effects of a closure of the Ignalina nuclear power plant by 2009, a condition stipulated by the European Union. The publication describes the application of the IAEA energy models: the Model for Analysis of Energy Demand (MAED) and the Model for Energy Supply Strategy Alternatives and their General Environmental Impacts (MESSAGE), in the context of the Lithuanian energy system, in order to assess the financial, economic and environmental implications of the various development scenarios during the period up to 2025. As a result, a set of future development strategies has been analysed, prioritized and ranked according to their performance indicators with respect to investment requirements, air emission burden and fuel import dependence. For each proposed strategy, a list of best candidate projects for future electricity/heat supply systems has been identified for consideration by policy makers.

**(2004) • ISBN 92-0-110004-3 •
IAEA-TECDOC-1408 • €15.00**

Financial Aspects of Decommissioning

IAEA TECDOC Series No. 1476

Estimating decommissioning costs and collecting the necessary funds for the eventual decommissioning of nuclear facilities is a prerequisite for safe, timely and cost effective decommissioning. The report identifies the types of costs that should be considered when developing a cost estimate and provides information on the collection and management of the funds. It also provides a discussion of the social impacts of decommissioning and how decommissioning can affect the surrounding communities.

**(2005) • ISBN 92-0-110905-9 •
IAEA-TECDOC-1476 • €15.00**

Forthcoming

Indicators for Management of Planned Outages in Nuclear Power Plants

IAEA TECDOC Series No. 1490

Planned outages are a main contributor to nuclear power plant (NPP) unavailability, risk and cost. Effective management of planned outages is a key factor for improvement of NPP safety, availability and competitiveness. To support outage management an outage monitoring system is implemented that follows all the fundamental and critical activities and deadlines in each phase of the outage. The IAEA has produced this publication on indicators for planned outage monitoring as a complement to a series of technical publications related to practices regarding outage management and cost effective maintenance. The aim of this publication is to provide guidelines for outage monitoring systems, examples of specific outage indicators and good practices in outage monitoring. This publication outlines a set of outage indicators that could be considered by operators of NPPs when establishing or revising their own specific outage indicator systems.

**(Forthcoming 2006) • ISBN 92-0-102706-0 •
IAEA-TECDOC-1490 • €15.00**

Management of Life Cycle and Ageing at Nuclear Power Plants: Improved I&C Maintenance

IAEA TECDOC Series No. 1402

The goal of this publication is to provide the latest information on ageing, obsolescence and performance monitoring of those items of Instrumentation and Control (I&C) equipment that are classified as safety equipment and/or safety related equipment, are operated in harsh environments in NPPs, and are important to plant life extension not only for normal operation but also, and more importantly, for post-accident service. In achieving this goal, this publication identifies the key I&C components of interest that are expected to function well throughout the life of a plant, including the extended life.

**(2004) • ISBN 92-0-108804-3 •
IAEA-TECDOC-1402 • €15.00**

Forthcoming

Management Strategies for Nuclear Power Plant Outages

Technical Reports Series No. 449

More competitive energy markets have significant implications for nuclear power plant (NPP) operations, including among

others the need for more efficient use of resources and more effective management of plant activities such as on-line maintenance and outages. Outage management is a key factor for safe, reliable and economic NPP performance. It involves many aspects: plant policy, coordination of available resources, nuclear safety, regulatory and technical requirements, and all activities and work hazards, before and during the outage. The IAEA has produced this report on NPP outage management strategies as both a summary and an update to a series of technical publications related to practices regarding outage management and cost effective maintenance. The aim of this report is to identify good practices in outage management: outage planning and preparation, outage execution and post-outage review. This report aims to communicate these practices in a way that can be used by operating organizations and regulatory bodies in Member States.

(Forthcoming 2006) • ISBN 92-0-101706-5 • STI/DOC/010/449 • €27.00

Optimization of the Coupling of Nuclear Reactors and Desalination Systems

IAEA TECDOC Series No. 1444

This publication presents the results of an IAEA Coordinated Research Project (CRP) on Optimization of the Coupling of Nuclear Reactors and Desalination Systems. The overall scope of the CRP was to encompass research and development projects focused on optimized coupling of nuclear and desalination systems in the following areas: nuclear reactor design intended for coupling with desalination systems; optimization of thermal coupling of nuclear steam supply systems and desalination systems; performance improvement of desalination systems for coupling; and advanced desalination technologies for nuclear desalination. A total of nine nuclear reactors were examined for optimal coupling with desalination systems within this CRP. They are all of the water cooled reactor type and are in various degrees of development. The commercial seawater desalination processes which are proven and reliable for large scale production of desalted water are multi-stage flash (MSF) and multi-effect distillation (MED) for distillation processes and reverse osmosis (RO) for membrane processes, as well as hybrid technologies such as MSF-RO and MED-RO. Different coupling options between the above nuclear and desalination technologies have been investigated within the CRP and were optimized with respect to safety, operational flexibility, reliability/availability and economics.

(2005) • ISBN 92-0-102505-X • IAEA-TECDOC-1444 • €15.00

Planning, Managing and Organizing the Decommissioning of Nuclear Facilities: Lessons Learned

IAEA TECDOC Series No. 1394

This publication is intended to encourage the development and improvement of decommissioning planning and management techniques with the focus on organizational aspects, reduce the duplication of efforts by different parties through transfer of experience and know-how, and provide useful results for those Member States planning or implementing decommissioning projects. In general it can be stated that any decommissioning project can be completed without any deleterious effects on the safety of the workforce and the public or any identifiable impact on the environment. However, timeliness and cost effectiveness are not always optimal. It has been noted on several occasions that the major weakness in decommissioning projects (as well as in other industrial projects) is often not the lack of technologies, but rather poor planning and management. This publication is intended to stimulate awareness of the need for early and efficient planning and to foster developments in management and organization in association with planned or ongoing decommissioning projects. A companion report on Organization and Management for Decommissioning of Large Nuclear Facilities was published by the IAEA in 2000 (Technical Reports Series No. 399) which provides generic guidance on organizational and management aspects. This publication is complementary to the existing publication in that it highlights practical experience – in particular, typical issues, evidence of poor management, undue delays and lack of timely funding – and distils lessons learned from this experience.

(2004) • ISBN 92-0-104404-6 • IAEA-TECDOC-1394 • €15.00

Radiation Protection Aspects in the Design of Nuclear Power Plants

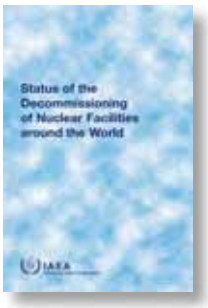
Safety Guide

Safety Standards Series No. NS-G-1.13

Prepared as part of the IAEA's programme on safety standards for nuclear power plants (NPPs), this Safety Guide deals with the provisions that should be made in the design of NPPs to protect site personnel, the public and environment against radiological hazards in operational states, decommissioning and accident conditions, including severe accidents. It also provides recommendations for ensuring radiation protection in the design of new NPPs, design modifications to operating plants, and safety reviews of operating NPPs. Comprehensive annexes provide additional information on the subjects addressed in this Safety Guide.

Contents: 1. Introduction; 2. Safety objectives, dose limitation and optimization; 3. Radiation protection aspects in design; 4. Protection of site personnel in operational states and during decommissioning; 5. Protection of the public during plant operation and decommissioning; 6. Guidelines for estimating radiation dose rates during plant operation and decommissioning; 7. Monitoring for radiation protection during plant operation and decommissioning; 8. Process radiation monitoring; 9. Auxiliary facilities; 10. Protection of site personnel under accident conditions; 11. Protection of the public under accident conditions; 12. Radiation and contamination monitoring under accident conditions; References; Annex I: Application of the optimization principle; Annex II: Sources of radiation during normal operation and decommissioning; Annex III: Sources of radiation under accident conditions; Annex IV: Example of zoning for design purposes; Glossary;

(115 pp., 4 figs; 2005) • ISBN 92-0-107905-2 • STI/PUB/1233 • €22.00



Status of the Decommissioning of Nuclear Facilities around the World

This book reviews and summarizes the decommissioning activities that have been performed to date, those that are currently under way and those that will need to be performed in the future. The aim of the book is to quantify the level of effort that will be required on the part of the industry in order to safely perform the necessary decommissioning activities. The book will be of interest to regulators, engineers and planners as a basis for developing a regulatory infrastructure and implementing a decommissioning programme. A CD-ROM is included which gives details of the location, type and status of nuclear power plants, research reactors, fuel cycle facilities and particle accelerators, along with relevant associated data.

(27 pp., 1 fig.; 2004) • ISBN 92-0-108704-7 • STI/PUB/1201 • €32.00

The Power Reactor Information System (PRIS) and its Extension to Non-electrical Applications, Decommissioning and Delayed Projects Information

Technical Reports Series No. 428

The IAEA's Power Reactor Information System (PRIS) contains detailed information on nuclear power plants worldwide since they started commercial operation. It covers a broad range of information, including reactor design characteristics, plant general specifications, operating experience data and non-electrical applications of nuclear power plants such as steam production and desalination. This report describes all the elements of PRIS and explains the rules, coding, terminology and definitions used in the system.

(112 pp., 13 figs; 2005) • ISBN 92-0-104704-5 • STI/DOC/010/428 • €28.00

Nuclear Power Operations

Design of Emergency Power Systems for Nuclear Power Plants

Safety Guide

Safety Standards Series No. NS-G-1.8

This Safety Guide was prepared under the IAEA safety standards programme for nuclear power plants (NPPs). The basic requirements for the design of safety systems for NPPs are provided in Safety Standards Series No. NS-R-1: Safety of NPPs: Design. This Safety Guide describes how the revised basic requirements should be met for the design of emergency power supply systems for NPPs. This publication is a revision of Safety Series No. 50-SG-D7, Emergency Power Systems at NPPs. It takes account of developments in the design of emergency power supply systems in NPPs since 1991 and includes recommendations and guidance on non-electrical power sources. This Safety Guide was prepared through three technical meetings and extensive review of experts from 21 countries over a period of four years.

Contents: 1. Introduction; 2. General design basis for EPSs; 3. General recommendations on design; 4. Recommendations on the design of systems and features; 5. Design provisions for the inspection, testing and maintenance of the EPSs; 6. Confirmation of the design; Appendix: Guidance on on-site and off-site power; Glossary.

English Edition (61 pp., 5 figs; 2004) • ISBN 92-0-103504-7 • STI/PUB/1188 • €20.00

Design of the Reactor Coolant System and Associated Systems in Nuclear Power Plants

Safety Guide

Safety Standards Series No. NS-G-1.9

This publication is a revision and combination of two previous Safety Guides: Safety Series No. 50-SG-D6, Ultimate Heat Sink and Directly Associated Heat Transport Systems for Nuclear Power Plants (1981), and Safety Series No. 50-SG-D13, Reactor Coolant and Associated Systems in Nuclear Power Plants (1986). The revision takes account of developments in the design of the reactor coolant and associated systems in nuclear power plants since the earlier Safety Guides were published. The other objectives of the revision are to ensure consistency with the Requirements for Design, issued in 2000, and to update the technical content. In addition, an appendix on pressurized heavy water reactors has been included.

Contents: 1. Introduction; 2. Extent of the RCS and associated systems; 3. General considerations in design; 4. Specific considerations in design; Appendix: The RCS and associated systems in pressure tube heavy water reactors; Annex I: Main components of the RCS; Annex II; Diagrams of the RCS and associated systems; Annex III: Safety classification and safety class interface devices for fluid systems.

(79 pp., 4 figs; 2004) • ISBN 92-0-103404-0 • STI/PUB/1187 • €18.00

Forthcoming

Development and Review of Plant Specific Emergency Operating Procedures

Safety Reports Series No. 48

Emergency operating procedures (EOPs) are essential for maintaining the fundamental safety functions and for preventing core damage during both design basis accidents and beyond design basis accidents in nuclear power plants (NPPs). This publication is applicable for all reactor technologies and comprehensively deals with all aspects of the development, implementation and review of EOPs using state-of-the-art experience. The primary objective of this publication is to provide guidance and to be used as a reference for teams of experts in charge of the development or review of EOPs at specific NPPs.

(Forthcoming 2006) • ISBN 92-0-103705-8 • STI/PUB/1226 • €32.00

Fire Safety in the Operation of Nuclear Power Plants

Safety Guide

Safety Standards Series No. NS-G-2.1

This Safety Guide provides recommendations on how to meet the requirements for achieving and maintaining fire safety in the management and operation of a nuclear power plant throughout its lifetime, covering topics including fire prevention, control of combustible materials and ignition sources, manual fire fighting, training and quality assurance. The requirements for fire safety are established in Safety Standards Series No. NS-R-2, Safety of Nuclear Power Plants: Operation (2000). The publication is intended for plant managers, operators, safety assessors and regulators. Recommendations are made concerning organization and responsibilities, periodic updating of the fire hazard analysis, modifications relating to fire safety, inspection, maintenance and testing of fire safety features, records and documentation, the adoption of a formal policy for fire safety, and specific responsibilities and authorities of staff in relation to fire safety.

Contents: 1. Introduction; 2. Application of defence in depth; 3. Organization and responsibilities; 4. Periodic updating of the fire hazard analysis; 5. Impacts of plant modifications on fire safety; 6. Control of combustible materials and ignition sources; 7. Inspection, maintenance and testing of fire protection measures; 8. Manual fire fighting capability; 9. Training of plant personnel; 10. Quality assurance for matters relating to fire safety; Annex: Fire protection measures for inclusion in the inspection, maintenance and testing programme; Glossary.

Chinese Edition (2005) • 92-0-514005-8 • STI/PUB/1091 • €12.50
English Edition (34 pp.; 2000) • ISBN 92-0-100900-3 • STI/PUB/1091 • €12.50
French Edition (41 pp.; 2004) • ISBN 92-0-201904-5 • STI/PUB/1091 • €12.50
Russian Edition (43 pp.; 2004) • ISBN 92-0-401504-7 • STI/PUB/1091 • €12.50

Format and Content of the Safety Analysis Report for Nuclear Power Plants

Safety Guide

Safety Standards Series No. GS-G-4.1

This Safety Guide provides recommendations and guidance on the possible format and content of Safety Analysis Reports (SARs) to be developed in support of requests to regulatory bodies for authorization to construct and/or to operate a nuclear power plant. As such, this Safety Guide recommends how to meet the requirements for preparation of adequate safety demonstrations as established in Safety Standards Series No. GS-R-1, Safety Requirements on Legal and Governmental Infrastructure for Nuclear, Radiation, Radioactive Waste and Transport Safety, and complements Safety Guide No. NS-G-1.2, Safety Assessment and Verification of Nuclear Power Plants.

Contents: 1. Introduction; 2. General considerations; 3. Format and content of a SAR; Chapter I: Introduction; Chapter II: General plant description; Chapter III: Management of safety; Chapter IV: Site evaluation; Chapter V: General design aspects; Chapter VI: Description and conformance to the design of plant systems; Chapter VII: Safety analyses; Chapter VIII: Commissioning; Chapter IX: Operational aspects; Chapter X: Operational limits and conditions; Chapter XI: Radiation protection; Chapter XII: Emergency preparedness; Chapter XIII: Environmental aspects; Chapter XIV: Radioactive waste management; Chapter XV: Decommissioning and end of life aspects; 4. Review and updating of the SAR; Glossary.

(81 pp.; 2004) • ISBN 92-0-115203-5 • STI/PUB/1185 • €22.00

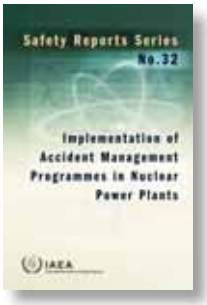
Guidelines for Application of the Master Curve Approach to Reactor Pressure Vessel Integrity in Nuclear Power Plants

Technical Reports Series No. 429

The master curve approach for assessing the fracture toughness of a sampled irradiated material has been gaining acceptance around the world. This direct measurement approach is preferred over the correlative and indirect methods used in the past to assess irradiated reactor pressure vessel (RPV) integrity. The master curve methodology already has been or is being assimilated into the ASME Boiler and Pressure Vessel Code, ASTM standards, USNRC regulations, German regulations (KTA 3203) and IAEA PTS guidelines for WWER reactors, as well as the VERLIFE “Unified Procedure for WWER Component Lifetime Assessment” and other industry guidance documents governing RPV integrity analysis. As this report was prepared using the results of many research projects and experiments,

these guidelines for application will be used for a long time to evaluate and assess the residual life of RPVs.

**(105 pp., 41 fig.; 2005) • ISBN 92-0-112104-0 •
STI/DOC/010/429 • €39.00**



Implementation of Accident Management Programmes in Nuclear Power Plants

Safety Reports Series No. 32

This publication provides a description of the elements which should be addressed by the team responsible for the preparation, development and implementation of a plant specific accident management programme at a nuclear power plant. The issues addressed include formation of the team, selection of accident management strategies, safety analyses required, evaluation of the performance of plant systems, development of accident management procedures and guidelines, staffing and qualification of accident management personnel, and training needs. The report is intended to facilitate the work to be done by nuclear power plant operators, utilities and their technical support organizations, but it can also be used for the preparation of relevant national regulatory requirements.

**(121 pp., 16 figs; 2004) • ISBN 92-0-113803-2 •
STI/PUB/1167 • €28.00**

International Outage Coding System for Nuclear Power Plants

IAEA TECDOC Series No. 1393

This publication summarizes the results of a Coordinated Research Project (CRP) to develop a general, internationally applicable system of coding nuclear power plant outages, providing worldwide nuclear utilities with a standardized tool for reporting outage information. The publication provides information for transformation of the historical outage data into the new coding system, taking into consideration the existing systems for coding nuclear power plant events (WANO, IAEA-IRS and IAEA PRIS) but avoiding duplication of efforts.

**(2004) • ISBN 92-0-116003-8 •
IAEA-TECDOC-1393 • €15.00**

Modifications to Nuclear Power Plants

Safety Guide

Safety Standards Series No. NS-G-2.3

This Safety Guide provides recommendations and guidance on controlling activities relating to modifications to nuclear power plants so as to reduce risk and to ensure that the configuration of the plant is under control at all times, and that the modified configuration conforms to the approved basis for granting an operation licence. The recommendations cover the whole process from conception to completion for modifications to structures, systems and components, operational limits and conditions, procedures and software, and the management systems and tools for plant operation. The Safety Guide recommends how to meet the requirements established in Safety Standards Series No. NS-R-2, The Safety of Nuclear Power Plants: Operation (2000).

Contents: 1. Introduction; 2. General; 3. Roles and responsibilities; 4. Modifications relating to plant configuration; 5. Modifications to management systems; 6. Temporary modifications; 7. Implementation of modifications relating to plant configuration; 8. Implementation of organizational changes; 9. Quality assurance; 10. Training; 11. Management of documentation.

**Chinese Edition (27 pp., 1 fig.; 2005) • ISBN 92-0-516904-8 •
STI/PUB/1111 • €12.50**
**English Edition (33 pp., 1 fig.; 2001) • ISBN 92-0-101501-1 •
STI/PUB/1111 • €12.50**
**French Edition (41 pp., 1 fig.; 2005) • ISBN 92-0-202804-4 •
STI/PUB/1111 • €12.50**
**Russian Edition (41 pp., 1 fig.; 2004) • ISBN 92-0-402904-8 •
STI/PUB/1111 • €12.50**

Operating Experience with Nuclear Power Stations in Member States in 2004

Operating Experience

This report is the thirty-sixth in the IAEA's series of annual reports on operating experience with nuclear power stations in Member States. It is a direct output from the IAEA's Power Reactor Information System (PRIS) and contains data on electricity production, overall plant operating performance and plant outage during 2004 for individual plants. In addition to annual performance data and outage information, the report contains a historical summary of performance and outages during the lifetime of individual plants and figures illustrating worldwide performance and statistical data.

**(2005) • ISBN 92-0-114304-4 •
STI/PUB/1237 • €170.50**

Operational and Decommissioning Experience with Fast Reactors

IAEA TECDOC Series No. 1405

Given the present slowdown in many Member States of fast reactor technology development, and the concomitant retirement of many of the developers of this technology, data retrieval and knowledge preservation efforts in this area are particularly important. Operational experience constitutes an important aspect of any fast reactor knowledge base. It is within this context that the IAEA convened a Topical Technical Meeting on Feedback from Operational and Decommissioning Experience with Fast Reactors. The present publication presents the proceedings of this meeting, which was held from 11 to 15 March 2002 at CEA, Cadarache, France.

**(2004) • ISBN 92-0-107804-8 •
IAEA-TECDOC-1405 • €15.00**

Operational Limits and Conditions and Operating Procedures for Nuclear Power Plants

Safety Guide

Safety Standards Series No. NS-G-2.2

This Safety Guide provides guidance on the development, content and use of operational limits and conditions (limits on plant operating parameters) and operating procedures that affect them. It recommends how to meet the requirements established in Safety Standards Series No. NS-R-2, Safety of Nuclear Power Plants: Operation (2000), setting out the responsibilities of the operating organization in setting, modifying and documenting operational limits and conditions and ensuring compliance with them. It supersedes Safety Series No. 50-SG-O3, Operational Limits and Conditions for Nuclear Power Plants (1979).

Contents: 1. Introduction; 2. Safety objective; 3. The concept of operational limits and conditions and their development; 4. Safety limits; 5. Limiting safety system settings; 6. Limits and conditions for normal operation; 7. Surveillance requirements; 8. Operating procedures; 9. Development of operating procedures; 10. Compliance with operational limits and conditions and operating procedures; Appendix I: Selection of limits and conditions for normal operation; Appendix II: Development of operating procedures (outlines); Annex: Example to explain some terms used; Glossary.

Chinese Edition (forthcoming 2006) • ISBN 92-0-514105-4 • STI/PUB/1100 • €14.50
English Edition (41 pp., 2 figs; 2000) • ISBN 92-0-102000-7 • STI/PUB/1100 • €14.50
French Edition (47 pp., 2 figs; 2000) • ISBN 92-0-207205-1 • STI/PUB/1100 • €14.50
Russian Edition (45 pp., 2 figs; 2004) • ISBN 92-0-401704-X • STI/PUB/1100 • €14.50

Protection against Internal Hazards other than Fires and Explosions in the Design of Nuclear Power Plants

Safety Guide

Safety Standards Series No. NS-G-1.11

The publication is a revision of the former safety standards given in Safety Series No. 50-SG-D4, dealing with protection against missiles and their consequences for the safety of nuclear power plants. This revised publication also includes other internal hazards: collapses and falling objects, pipe whips, jet effects and flooding.

Contents: 1. Introduction; 2. General considerations; 3. Review of internal hazards.

English Edition (43 pp.; 2004) • ISBN 92-0-104904-8 • STI/PUB/1191 • €20.00

Safety of Nuclear Power Plants: Operation

Safety Requirements

Safety Standards Series No. NS-R-2

This Safety Requirements publication establishes the requirements to be met to ensure the safe operation of nuclear power plants. This publication supersedes Safety Series No. 50-C-O (Rev. 1), Code on the Safety of Nuclear Power Plants: Operation (1988). It restructures the code in the light of the Safety Fundamentals publication, Safety Series No. 110, The Safety of Nuclear Installations (1993), and Safety Series No. 115, International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources (1996). It introduces new topics to reflect current international practices, new concepts and technical developments.

Contents: 1. Introduction; 2. Operating organization; 3. Qualification and training of personnel; 4. Commissioning programme for the plant; 5. Plant operations; 6. Maintenance, testing, surveillance and inspection of structures, systems and components important to safety; 7. Plant modifications; 8. Radiation protection and radioactive waste management; 9. Records and reports; 10. Periodic safety review; 11. Decommissioning; Glossary.

Chinese Edition (24 pp.; 2005) • ISBN 92-0-517604-4 • STI/PUB/1096 • €11.50
English Edition (31 pp.; 2004) • ISBN 92-0-100700-0 • STI/PUB/1096 • €11.50
French Edition (37 pp.; 2004) • ISBN 92-0-215204-7 • STI/PUB/1096 • €11.50
Russian Edition (41 pp.; 2004) • ISBN 92-0-404903-0 • STI/PUB/1096 • €11.50
Spanish Edition (35 pp.; 2004) • ISBN 92-0-309504-7 • STI/PUB/1096 • €11.50

Software for Computer Based Systems Important to Safety in Nuclear Power Plants

Safety Guide

Safety Standards Series No. NS-G-1.1

This Safety Guide provides guidance on the collection of evidence and preparation of documentation to be used in the demonstration of safety and reliability of the software for computer based systems important to safety in nuclear power plants for all phases of the system life cycle. It recommends how to meet the requirements established in Safety Standards Series No. NS-R-1, The Safety of Nuclear Power Plants: Design: Safety Requirements (2000).

Contents: 1. Introduction; 2. Technical considerations for computer based systems; 3. Application of requirements for management of safety to computer based systems; 4. Project planning; 5. Computer system requirements; 6. Computer system design; 7. Software requirements; 8. Software design; 9. Software implementation; 10. Verification and analysis;

11. Computer system integration; 12. Validation of computer systems; 13. Installation and commissioning; 14. Operation; 15. Post-delivery modifications; Annex: Use and validation of pre-existing software; Glossary.

Chinese Edition (forthcoming 2006) • ISBN 92-0-513705-7 • STI/PUB/1095 • €14.50
English Edition (89 pp., 2 figs; 2000) • ISBN 92-0-101800-2 • STI/PUB/1095 • €14.50
French Edition (95 pp., 2 figs; 2004) • ISBN 92-0-202004-3 • STI/PUB/1095 • €14.50

The Operating Organization for Nuclear Power Plants

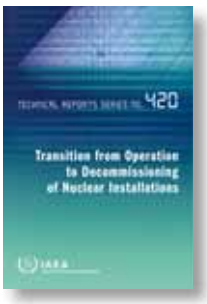
Safety Guide

Safety Standards Series No. NS-G-2.4

This Safety Guide provides recommendations on setting up an operating organization for nuclear power plants so as to facilitate their safe operation, and on the organizational elements necessary for a strong safety culture and an international level of performance. The Safety Guide highlights the important elements of effective management in relation to nuclear safety, quality assurance, the management of radioactive waste and radiological protection, and in meeting the associated national regulatory requirements. It recommends how to meet the requirements established in Safety Standards Series No. NS-R-2, Safety of Nuclear Power Plants: Operation (2000). It supersedes Safety Series No. 50-SG-O9 (1984).

Contents: 1. Introduction; 2. Organizational structure; 3. Functions and responsibilities; 4. Interfaces with external organizations; 5. Safety management; 6. Plant operation management programmes; 7. Supporting functions; 8. Communication and liaison.

Chinese Edition (42 pp.; 2005) • ISBN 92-0-516804-1 • STI/PUB/1115 • €14.50
English Edition (53 pp.; 2005) • ISBN 92-0-102301-4 • STI/PUB/1115 • €14.50
French Edition (62 pp.; 2005) • ISBN 92-0-206805-4 • STI/PUB/1115 • €14.50
Russian Edition (69 pp.; 2005) • ISBN 92-0-401604-3 • STI/PUB/1115 • €14.50



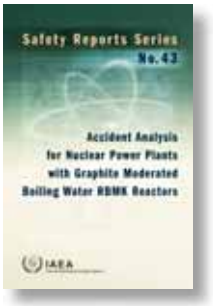
Transition from Operation to Decommissioning of Nuclear Installations

Technical Reports Series No. 420

The transition period between operation of an installation and implementation of the decommissioning strategy is a critical one. In this period, a number of modifications, both technical and organizational, are needed to adjust a plant to meet new objectives and requirements. It is essential that detailed planning for decommissioning begin in good time during plant operation and that preparatory actions for implementation of the decommissioning strategy be initiated immediately after permanent shutdown. This ensures a gradual transition and minimizes uncontrolled loss of resources. The purpose of this report is to highlight technical, management and organizational issues during the transition period, to provide guidance to minimize delays and undue costs, to optimize personnel and other resources, and to initiate preparatory activities for decommissioning in a planned, timely and cost effective manner.

(221 pp., 54 figs; 2004) • ISBN 92-0-114103-3 • STI/DOC/010/420 • €39.00

REACTOR TECHNOLOGY



Accident Analysis for Nuclear Power Plants with Graphite Moderated Boiling Water RBMK Reactors

Safety Reports Series No. 43

Accident analysis is an important tool for confirming the adequacy and efficiency of provisions within the defence in depth concept for the safety of nuclear power plants. In 2002, the IAEA published Safety Reports Series No. 23 on Accident Analysis for Nuclear Power Plants, containing general rules and practical guidance for performing accident analysis applicable to any reactor design. The specific features of individual reactor types are taken into account in separate Safety Reports. The current report provides additional guidance with respect to the specific design features of the graphite moderated boiling water reactors with pressurized channels known as RBMKs. In particular, guidance is provided regarding categorization of initiating events, selection of acceptance criteria, and initial and boundary conditions. Specific suggestions are offered for analysis of different groups of initiating events. The report is intended primarily for analysts coordinating, performing or reviewing computational analyses of transients and accidents for nuclear power plants with RBMKs, on both the utility and regulatory sides.

(59 pp., 9 figs; 2005) • ISBN 92-0-112804-5 • STI/PUB/1211 • €38.00

Assessment and Management of Ageing of Major Nuclear Power Plant Components Important to Safety: BWR Pressure Vessel Internals

IAEA TECDOC Series No. 1471

The objective of this report is to identify significant ageing mechanisms and degradation locations, as well as to document current practices for the assessment and management of the ageing of boiling water reactor (BWR) pressure vessel internals (RPVIs). The report emphasizes safety aspects and also provides information on current inspections as well as on

monitoring and mitigation practices for managing ageing of BWR RPVs.

**(2005) • ISBN 92-0-109205-9 •
IAEA-TECDOC-1471 • €15.00**

Assessment and Management of Ageing of Major Nuclear Power Plant Components Important to Safety: BWR Pressure Vessels

IAEA TECDOC Series No. 1470

The objective of this report is to identify significant ageing mechanisms and degradation locations, as well as to document current practices for the assessment and management of the ageing of boiling water reactor (BWR) pressure vessels (RPVs). The report emphasizes safety aspects and also provides information on current inspections as well as on monitoring and mitigation practices for managing ageing of BWR RPVs.

**(2005) • ISBN 92-0-109305-5 •
IAEA-TECDOC-1470 • €15.00**

Construction and Commissioning Experience of Evolutionary Water Cooled Nuclear Power Plants

IAEA TECDOC Series No. 1390

This publication is intended to provide an overview of the most advanced technologies, methods and processes used in the construction and commissioning of recent water cooled nuclear power plants. Information from the following recent nuclear projects has been collected and analysed: Qinshan III Units 1&2 and Lingao Units 1&2 in China, Kashiwazaki-Kariwa Units 6&7 in Japan, Yonggwang Units 5&6 in the Republic of Korea, and Tarapur Units 5&6 in India. To facilitate the readers' understanding, for each of the construction and commissioning activities reviewed, the publication presents background information, a brief description of the scope, generic good practices and specific examples selected from the collected data. The presentation is focused more on new developments than on providing a full review of all the issues related to construction and commissioning. The main focus of the publication is on-site construction, with only general considerations given to construction activities at manufacturers.

**(2004) • ISBN 92-0-103804-6 •
IAEA-TECDOC-1390 • €15.00**

Delayed Hydride Cracking in Zirconium Alloys in Pressure Tube Nuclear Reactors

IAEA TECDOC Series No. 1410

This report describes all of the research work undertaken as part of the IAEA coordinated research project on hydrogen and hydride induced degradation of the mechanical and physical properties of zirconium based alloys, and includes a review of the state of the art in understanding crack propagation by delayed hydride cracking (DHC), and details of the experimental procedures that have produced the most consistent set of DHC rates reported in an international round-robin exercise to this date.

**(2004) • ISBN 92-0-110504-5 •
IAEA-TECDOC-1410 • €15.00**

Design of the Reactor Core for Nuclear Power Plants

Safety Guide

Safety Standards Series No. NS-G-1.12

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 reactor cores 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. Qualification and testing; 5. Quality assurance in design; Appendix I: Reactivity coefficients; Appendix II: Fuel pellet–cladding interaction; Appendix III: Design considerations for core management; Appendix IV: High burnup fuel cores; Appendix V: Mixed oxide fuel cores; References; Glossary.

**(59 pp.; 2005) • ISBN 92-0-116004-6 •
STI/PUB/1221 • €23.00**

Innovative Small and Medium Sized Reactors: Design Features, Safety Approaches and R&D Trends

IAEA TECDOC Series No. 1451

Design and technology development for small and medium sized reactors (SMRs) is ongoing in many countries, and there are growing expectations of increased support from the IAEA to interested Member States in the definition of common technology and infrastructure development needs and in the coordination of international R&D efforts for such reactors. This publication presents a variety of innovative water cooled, gas cooled, liquid metal cooled and non-conventional SMR designs developed worldwide, and examines the technology and infrastructure development needs that may be common to several concepts or lines of such reactors. This publication also gives an updated definition of small reactors without on-site refuelling and a preliminary review of the passive safety design options for SMRs.

**(2005) • ISBN 92-0-103205-6 •
IAEA-TECDOC-1451 • €15.00**

Managing Modernization of Nuclear Power Plant Instrumentation and Control Systems

IAEA TECDOC Series No. 1389

The scope of this publication covers all of the management activities related to modernization of I&C systems in nuclear power plants, including the evaluation of all I&C systems to determine which can be successfully maintained and which need to be modernized. It also includes large, comprehensive modernization programmes that will modernize a large number of I&C systems, small modernization programmes that will modernize a very few I&C systems, and all of the possibilities in-between. The scope covers highly integrated systems and projects as well as stand-alone systems and projects.

**(2004) • ISBN 92-0-116103-4 •
IAEA-TECDOC-1389 • €15.00**

Primary Coolant Pipe Rupture Event in Liquid Metal Cooled Reactors

IAEA TECDOC Series No. 1406

The objectives of this publication are to review the safety philosophy for the primary coolant pipe (PCP) rupture event in pool type liquid metal fast reactors (LMFRs), to assess the structural reliability of the PCP and the probability of rupture under different conditions (with/without in-service inspection), to review the classification of the PCP rupture event in the design basis/beyond design basis categories and discuss the applicable design safety limits, to assess the need for consequential analysis such as pipe whip effects, primary pump seizure and multiple pipe rupture, and, last but not least, to present the results of analyses of the event per se for flows and/or temperatures and improved design concepts for minimizing the consequences to the core.

**(2004) • ISBN 92-0-109104-4 •
IAEA-TECDOC-1406 • €15.00**

Status of Advanced Light Water Reactor Designs 2004

IAEA TECDOC Series No. 1391

The report is intended to be a source of reference information for interested organizations and individuals, among them decision makers in countries considering implementation of nuclear power programmes. Furthermore, the report is addressed to government officials with an appropriate technical background and to research institutes of countries with existing nuclear programmes that wish to be informed about the global status of advanced light water reactor designs in order to plan their nuclear power programmes, including both research and development efforts and means for meeting future energy needs. The report is also intended to provide the public with unbiased information on nuclear power.

**(2004) • ISBN 92-0-104804-1 •
IAEA-TECDOC-1391 • €15.00
CD Edition (2004) • ISBN 92-0-109704-2 •
IAEA-TECDOC-CD-1391 • €15.00**

Structural Behaviour of Fuel Assemblies for Water Cooled Reactors

IAEA TECDOC Series No. 1454

This publication, the proceedings of a meeting, covers topics including the impact of hydraulic loadings on fuel assembly (FA) performance, FA bow and control rod drop kinetics, vibrations and rod-to-grid wear and fretting, and evaluation and modelling of accident (mainly seismic) conditions. These proceedings are presented as a book with an attached CD-ROM. The first part of the CD-ROM repeats the papers presented at the meeting and the second part the Appendix with the original slides (in PowerPoint) converted into pdf format.

**(2005) • ISBN 92-0-105105-0 •
IAEA-TECDOC-1454 • €15.00**

QUALITY ASSURANCE

Application of Surveillance Programme Results to Reactor Pressure Vessel Integrity Assessment

IAEA TECDOC Series No. 1435

This publication has been developed under the Coordinated Research Project (CRP) entitled: Surveillance Programme Results Application to Reactor Pressure Vessel Integrity Assessment. This publication provides a summary of master curve fracture toughness test results on small surveillance type specimens of the IAEA reference material JRQ and other national steels from numerous laboratories around the world. These results were a key ingredient used in the development of the guidance given in IAEA Technical Reports Series No. 429, Guidelines for Application of the Master Curve Approach to Reactor Pressure Vessel Integrity. This publication has been written to allow utility engineers and scientists to directly measure fracture toughness and apply the results using the master curve approach for RPV structural integrity assessment.

**(2005) • ISBN 92-0-101605-0 •
IAEA-TECDOC-1435 • €15.00**

Effects of Nickel on Irradiation Embrittlement of Light Water Reactor Pressure Vessel Steels

IAEA TECDOC Series No. 1441

The goal of this publication is to investigate and understand the mechanism of the deterioration effect in radiation embrittlement of reactor pressure vessel steels of Ni–Cr–Mo–V or Mn–Ni–Cr–Mo types with a high nickel content (>1.5 wt%) in nuclear power plants. Eleven institutes from eight countries and the European Union participated in the Coordinated Research Project (CRP) entitled Mechanism of Nickel Effect in Radiation Embrittlement of RPV Material, and six institutes conducted the irradiation experiments with the CRP materials. In addition to the irradiation and testing of those materials, irradiation experiments with various national steels were conducted. This publication provides the results of all the data obtained by the participants. It is generally accepted that the presence of nickel in RPV steels

increases its sensitivity to neutron induced embrittlement even at low phosphorus and copper concentrations.

**(2005) • ISBN 92-0-103305-2 •
IAEA-TECDOC-1441 • €15.00**

Guidelines for Prediction of Irradiation Embrittlement of Operating WWER-440 Reactor Pressure Vessels

IAEA TECDOC Series No. 1442

The IAEA International Database on RPV Materials (IDRPVM) is used for prediction and analysis of radiation embrittlement of WWER-440 reactor pressure vessel (RPV) materials. These guidelines will be used for assessment of irradiation embrittlement of RPV ferritic materials as a result of degradation during operation. Two approaches, i.e. transition temperatures based on Charpy impact notch toughness as well as those based on static fracture toughness tests, are used to develop the prediction formulas for radiation embrittlement of RPVs of WWER-440 nuclear power plants.

**(2005) • ISBN 92-0-105605-2 •
IAEA-TECDOC-1442 • €15.00**

Improvement of In-service Inspection in Nuclear Power Plants

IAEA TECDOC Series No. 1400

This publication describes strategies for improving the effectiveness of in-service inspection (ISI). The role of ISI in maintaining or improving safety and the relationship of ISI improvement to cost are examined. The strategies for improving ISI effectiveness discussed in this publication consider the entire framework of ISI, including effective selection of the proper scope of inspection and the effectiveness of non-destructive examination as demonstrated through inspection qualification programmes. Improving the effectiveness of ISI in an economical and organized way requires adoption of a strategy that meets the specific objectives of each plant owner. Several such strategies are considered.

**(2004) • ISBN 92-0-108104-9 •
IAEA-TECDOC-1400 • €15.00**

Safety Culture in the Maintenance of Nuclear Power Plants

Safety Reports Series No. 42

Building upon earlier IAEA publications on this topic, this Safety Report reviews how challenges to the maintenance of nuclear power plants can affect safety culture. It also highlights indications of a weakening safety culture. The challenges described are in areas such as maintenance management, human resources management, plant condition assessment and the business environment. The steps that some Member States have taken to address safety culture aspects are detailed and singled out as good practices, with a view to disseminating and exchanging experiences and lessons learned.

**(49 pp.; 2005) • ISBN 92-0-112404-X •
STI/PUB/1210 • €22.00**

QUALIFICATION AND TRAINING OF PERSONNEL

Forthcoming

Competency Assessments for Nuclear Industry Personnel

The nuclear industry expends significant resources conducting competency assessments. Competency assessments are used for employee selection, trainee assessment, qualification, re-qualification and authorization. This publication focuses on the competency assessments used for measuring the knowledge, skills and attitudes of personnel as the result of training. Other uses of competency assessments are also briefly discussed. Ineffective testing methods and procedures, or inappropriate interpretation of test results, can have significant effects on both human performance and nuclear safety. Test development requires unique skills, and training and experience are needed to develop and improve these skills. Test item and examination development, use, interpretation of results, and examination refinement should be part of an ongoing systematic process. Testing, and particularly the results of testing, can also be used for trainee motivation, instructional improvement and programme evaluation. In addition, testing can also be used to provide teaching and feedback. For some users, this publication will provide a review of the ideas and principles of competency assessments with which they are already familiar; for others it will present new concepts. While not intended to provide in-depth coverage of assessment theory, this publication should provide developers, instructors and assessors with a foundation on which to develop sound assessments.

**(Forthcoming 2006) • ISBN 92-0-110105-8 •
STI/PUB/1236 • €46.00**

Development of Instructors for Nuclear Power Plant Personnel Training

IAEA TECDOC Series No. 1392

The quality of nuclear power plant (NPP) personnel training is strongly dependent upon the availability of competent instructors. This book is published as a follow-up to Technical Reports Series No. 380, Nuclear Power Plant Personnel Training and its Evaluation, A Guidebook, to provide further details concerning the development of instructors for NPP personnel training. This publication has been developed and published to provide practical guidance on various aspects of instructor selection, development and deployment, by quoting actual examples from various countries and operating organizations.

**(2004) • ISBN 92-0-105204-9 •
IAEA-TECDOC-1392 • €15.00**

Human Performance Improvement in Organizations: Potential Application for the Nuclear Industry

IAEA TECDOC Series No. 1479

This publication is primarily intended for managers and specialists in nuclear facility operating organizations working in the area of human performance improvement. It is intended to provide them with practical information they can use to improve human performance in their organizations. While some of the information provided in this publication is based upon the experience of nuclear facility operating organizations, most of it comes from human performance improvement initiatives in non-nuclear organizations and industries. The nuclear industry has a long tradition of sharing good management practices in order to foster continuous improvement. However, it is not always realized that many of the practices that are now well established initially came from non-nuclear industries and were subsequently adapted for application to nuclear power plant operating organizations. There is, therefore, good reason to periodically review non-nuclear industry practices for ideas that might have direct or indirect application to the nuclear industry in order to potentially gain benefits such as the following: new approaches to certain problem areas, insights into new or impending challenges, improvements in existing practices, benchmarking of opportunities, development of learning organizations and avoidance of collective blind spots.

**(2005) • ISBN 92-0-111505-9 •
IAEA-TECDOC-1479 • €15.00**

Forthcoming

Managing Nuclear Knowledge: Strategies and Human Resource Development

Proceedings of the International Conference held in Saclay, France, 7–10 September 2004

Proceedings Series

This conference provided a forum for professionals and decision makers in the nuclear sector, comprising industry, governments and academia as well as professionals in the knowledge management and information technology sectors. The goals of the conference were: to exchange information and share experience on nuclear knowledge management, comprising strategies, information management and human resource development, and to identify lessons learned and to embark on the development of new initiatives and concepts for nuclear knowledge management in IAEA Member States. Keynote papers delivered by leading experts in the field, industrial leaders and governmental officials covered important aspects of nuclear knowledge management, and the sessions were devoted to covering managing and preserving nuclear knowledge; managing nuclear information; human resources for the nuclear sector; and networking education and training.

**(Forthcoming 2006) • ISBN 92-0-110005-1 •
STI/PUB/1235 • €80.00**

Organization and Staffing of the Regulatory Body for Nuclear Facilities

Safety Guide

Safety Standards Series No. GS-G-1.1

This Safety Guide provides recommendations on the appropriate management system, organization and staffing of the regulatory body responsible for the regulation of nuclear facilities in order to comply with the requirements of Safety Standards Series No. GS-R-1, Legal and Governmental Infrastructure for Nuclear, Radiation, Radioactive Waste and Transport Safety (2000). It supersedes Safety Series No. 50-SG-G1, Qualifications and Training of Staff of the Regulatory Body for Nuclear Power Plants: A Safety Guide (1979).

Contents: 1. Introduction; 2. Regulatory independence and funding of the regulatory body; 3. Organization of the regulatory body; 4. Staffing; 5. Training of staff; Appendix: Basic elements of a regulatory training programme.

**Chinese Edition (25 pp.; 2005) • ISBN 92-0-517104-2 •
STI/PUB/1129 • €11.50
English Edition (31 pp.; 2002) • ISBN 92-0-114002-9 •
STI/PUB/1129 • €11.50
French Edition (37 pp.; 2004) • ISBN 92-0-215304-3 •
STI/PUB/1129 • €11.50
Russian Edition (42 pp.; 2004) • ISBN 92-0-401404-0 •
STI/PUB/1129 • €11.50**

Overview of Training Methodology for Accident Management at Nuclear Power Plants

IAEA TECDOC Series No. 1440

Many Member States operating nuclear power plants (NPPs) are at present developing accident management programmes (AMPs) aimed at the prevention and mitigation of severe accidents. Such developments are in compliance with the revised set of IAEA Safety Standards Series and, in particular, with the Safety Requirements on Design, on Operation, and on Preparedness and Response for a Nuclear and Radiological Emergency. Adequate training represents an essential component for the qualification of AM personnel and for the successful implementation of AMP. Available tools and support material, applicable to the training of the staff involved in AM, are discussed in greater detail in the present publication. Many examples of such tools and materials are provided in the appendices. The report is intended to facilitate the work to be performed by NPP operators, utilities and their technical support organizations.

**(2005) • ISBN 92-0-101805-3 •
IAEA-TECDOC-1440 • €15.00**

Recruitment, Qualification and Training of Personnel for Nuclear Power Plants

Safety Standards Series No. NS-G-2.8

Safety Guide

This Safety Guide provides recommendations on the recruitment, selection, qualification, training and authorization of personnel working in all safety related functions and at all levels of nuclear power plants. It supplements Safety Standards Series No. NS-R-2, Safety of Nuclear Power Plants: Operation (2000), and is related to Safety Standards Series No. NS-G-2.4, The Operating Organization for Nuclear Power Plants: Safety Guide. It supersedes Safety Series No. 50-SG-O1 (Rev. 1), Staffing of Nuclear Power Plants and the Recruitment, Training and Authorization of Operating Personnel (1991).

Contents: 1. Introduction; 2. Recruitment and selection; 3. Competence and qualification; 4. Training policy; 5. Training programmes; 6. Training facilities and materials; 7. Authorization; Appendix I: Attitudes and skills for safety culture; Appendix II: Aspects of safety culture in individuals.

English Edition (2002) • ISBN 92-0-117902-2 • STI/PUB/1140 • €15.50
Russian Edition (2005) • ISBN 92-0-411805-9 • STI/PUB/1140 • €15.50

The Nuclear Power Industry's Ageing Workforce: Transfer of Knowledge to the Next Generation

IAEA TECDOC Series No. 1399

This publication provides information on experiences gained in retaining the knowledge needed to design, operate and maintain nuclear power plants (NPPs) in IAEA Member States in the context of the ageing of the nuclear workforce. Information is provided on effective methods for transfer of knowledge in NPP operating organizations, along with selected examples of proven management strategies and initiatives. Awareness and use of this information can assist NPP operating organizations in dealing with the challenges posed by retirement of the current NPP workforce and recruitment of new personnel.

(2004) • ISBN 92-0-107704-1 • IAEA-TECDOC-1399 • €15.00

Use of Control Room Simulators for Training of Nuclear Power Plant Personnel

IAEA TECDOC Series No. 1411

Safety analysis and operational experience consistently indicate that human error is the greatest contributor to the risk of a severe accident in a nuclear power plant. Subsequent to the Three Mile Island accident, major changes were made internationally to reduce the potential for human error through improved procedures, information presentation and training of operators. The use of full scope simulators in the training of operators is an essential element of these efforts to reduce human error. In cases where a 'replica' plant-referenced full scope simulator is not available, it may be necessary for operators to receive their training with a computer simulation or to travel to another plant that is similar to their plant that has a simulator. This publication has been developed and published to provide information and practical guidance on various aspects of the use of control room simulators, by quoting actual examples from various Member States.

(2004) • ISBN 92-0-110604-1 • IAEA-TECDOC-1411 • €15.00

External Human Induced Events in Site Evaluation for Nuclear Power Plants

Safety Guide

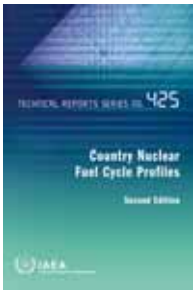
Safety Standards Series No. NS-G-3.1

This Safety Guide recommends actions, conditions and procedures and provides guidance for fulfilling the requirements of Safety Standards Series No. NS-R-3, Site Evaluation for Nuclear Installations, in relation to external human induced events when conducting a site evaluation for a nuclear power plant. The present Guide supersedes Safety Series No. 50-SG-S5, External Man-induced Events in Relation to Nuclear Power Plant Siting (1981).

Contents: 1. Introduction; 2. General approach to site evaluation in relation to external human induced events; 3. Data collection and investigations; 4. Screening and evaluation procedures; 5. Aircraft crashes; 6. Release of hazardous fluids; 7. Explosions; 8. Other external human induced events; 9. Administrative aspects.

Chinese Edition (forthcoming 2006) • ISBN 92-0-514205-0 • STI/PUB/1126 • €14.50
English Edition (49 pp., 1 fig.; 2002) • ISBN 92-0-111202-5 • STI/PUB/1126 • €14.50
Russian Edition (61 pp., 1 fig.; 2004) • ISBN 92-0-402304-X • STI/PUB/1126 • €14.50

Nuclear Fuel Cycle and Waste Management



Country Nuclear Fuel Cycle Profiles – Second Edition

Technical Reports Series No. 425

In recent years, activities related to the nuclear fuel cycle have expanded globally. In addition, the complexity of the nuclear fuel cycle market has increased with the emergence of new providers of fuel cycle services. In this context, a need was perceived for a compilation of country profiles on nuclear fuel cycle activities in a form which could be easily understood both by experts and by the public, and which should lead to a greater understanding of these activities worldwide. Furthermore, such information would improve the transparency of nuclear energy development in general. The second edition represents the status of the nuclear fuel cycle at the end of 2002 and consists of two parts: the first part is a review of worldwide activities related to the nuclear fuel cycle; the second comprises the country profiles, reflecting each country's status with regard to nuclear fuel cycle activities. The second part incorporates a graphical representation of material flow in the nuclear fuel cycle of each country.

(91 pp., 32 figs; 2005) • ISBN 92-0-114803-8 • STI/DOC/010/425 • €22.50

Innovative Technologies for Nuclear Fuel Cycles and Nuclear Power

C&S Papers Series No. 24

The International Atomic Energy Agency, in cooperation with the World Nuclear Association, the World Energy Council, the International Science and Technology Center and the Electric Utilities Cost Group, organized the International Conference on Innovative Technologies for Nuclear Fuel Cycles and Nuclear Power, held in Vienna from 23 to 26 June 2003. The main objectives of the Conference were to facilitate exchange of information between senior experts and policy makers from Member States and international organizations on important aspects of the development of innovative technologies for future generations of nuclear power reactors and fuel cycles; to create an understanding of the social, environmental and economic conditions that would facilitate innovative and sustainable nuclear technologies; and to identify opportunities for collaborative work between Member States and international organizations and programmes. In addition to 21 oral presentations and 26 poster presentations of accepted papers, talks on specific topics were given by 21 invited speakers from 11 Member States. All relevant aspects of innovative technologies for nuclear fuel cycles and nuclear power were discussed in an open, frank and objective manner. This publication includes an executive summary of the conference and the papers presented.

(2004) • ISBN 92-0-110704-8 • IAEA-CSP-24/P • €15.00

Methodology for the Assessment of Innovative Nuclear Reactors and Fuel Cycles

Report of Phase 1B (first part) of the International Project on Innovative Nuclear Reactors and Fuel Cycles (INPRO)

IAEA TECDOC Series No. 1434

The main objectives of INPRO are to: help ensure that nuclear energy is available to contribute towards fulfilling energy needs in the 21st century in a sustainable manner; and bring together both technology holders and technology users to consider jointly the international and national actions required to achieve desired innovations in nuclear reactors and fuel cycles. Within INPRO the future energy demand and supply was explored and several scenarios were identified. The following requirement for energy supply will play a crucial role: sustainability of the way the energy supply will be realized. Fulfilling the growing need for energy in developing countries is also an important issue. On the basis of scenarios for the next fifty years, requirements for the different aspects of the future of nuclear energy systems, such as those on economics, environment, safety, waste, proliferation resistance and infrastructure, have been identified as well as a methodology developed to assess innovative nuclear systems and fuel cycles. On the basis of this assessment, the need for innovations in existing nuclear technology, to be achieved via research, development and demonstration, can be defined. To facilitate the deployment of innovative nuclear systems, different aspects of the infrastructure, technical as well as institutional, also have been reviewed, and recommendations for changes are made to anticipate the main developments worldwide, such as ongoing globalization.

(2004) • ISBN 92-0-116304-5 • IAEA-TECDOC-1434 • €15.00

Research Reactor Utilization, Safety, Decommissioning, Fuel and Waste Management

Proceedings of an International Conference held in Santiago, Chile, 10–14 November 2003

Proceedings Series

This book contains the proceedings of a conference organized by the IAEA and hosted by the Government of Chile through the Atomic Energy Commission of Chile, and was held in Santiago, Chile, 10–14 November 2003. The purpose of the conference was to foster the exchange of information on current research reactor concerns related to safety, operation, utilization, fuel management and decommissioning as well as to provide a forum for reactor operators, designers, managers, users and regulators to share experience, exchange opinions and discuss options and priorities.

English Edition (717 pp., 235 figs; 2005) • ISBN 92-0-113904-7 • STI/PUB/1212 • €120.00

Selection of Decommissioning Strategies: Issues and Factors

IAEA TECDOC Series No. 1478

When selecting a proper decommissioning strategy in a specific facility, a range of general and site specific factors needs to be considered. These factors include cost, health and safety issues and environmental (HSE) impact, availability of resources, stakeholder involvement, etc. In some cases the lack of a single key resource could result in the elimination of some decommissioning strategies. Good practice may not always be achieved in Member States due to constraints or overruling factors such as a lack of funds or a lack of waste management infrastructure. Constraints or overruling factors are often attributable to inadequate decommissioning planning. This in turn may be due to inadequate legal and regulatory frameworks. Some relevant constraints and conditions have been evaluated. The objective of the evaluation is to identify key issues and to provide recommendations to Member States in which these constraints and factors prevail, to promote actions in support of good decommissioning practice.

(2005) • ISBN 92-0-111705-1 •
IAEA-TECDOC-1478 • €15.00

Thorium Fuel Cycle – Potential Benefits and Challenges

IAEA TECDOC Series No. 1450

There has been significant interest among Member States in developing advanced and innovative technologies for safe, proliferation resistant and economically efficient nuclear fuel cycles, while minimizing waste and environmental impacts. This publication provides a critical review of the thorium fuel cycle: potential benefits and challenges in the thorium fuel cycle, mainly based on the latest developments at the front end of the fuel cycle, applying thorium fuel cycle options, and at the back end of the thorium fuel cycle. The aim is to address the benefits and challenges faced at the front and back ends of the thorium fuel cycle, highlighting fuel fabrication, reprocessing and waste management. In addition, this publication provides an insight into the reasons for renewed interest in the thorium fuel cycle, different implementation scenarios and options for the thorium cycle and an update of the information base on thorium fuels and fuel cycles.

(2005) • ISBN 92-0-103405-9 •
IAEA-TECDOC-1450 • €15.00

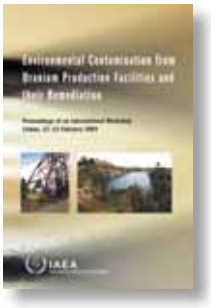
URANIUM ORE PROCESSING

Developments in Uranium Resources, Production, Demand and the Environment

IAEA TECDOC Series No. 1425

Globalization has led to a growth in importance of the uranium production industries of the world's developing countries. Uranium supply from these countries could be increasingly important in satisfying worldwide reactor requirements over time. Along with the increasing contribution to worldwide uranium supply, the environmental impact of uranium production in developing countries has come under increasing scrutiny from the nuclear power industry, the end users of this supply, and from communities affected by uranium mining and processing. The papers presented at the meeting on Developments in Uranium Resources, Production, Demand and the Environment provide an important overview of uranium production operations and of their environmental consequences in developing countries, as well as offering insight into future production plans and potential.

(2005) • ISBN 92-0-112904-1 •
IAEA-TECDOC-1425 • €15.00



Environmental Contamination from Uranium Production Facilities and their Remediation

Proceedings of an International Workshop held in Lisbon, Portugal, February 2004

Proceedings Series

The legacies of past uranium mining and milling continue to be of concern and require assessment and remedial action. This problem has been recognized in many parts of the world over the past three decades, but has received increased attention since the end of the Cold War. Considerable effort and resources have been expended in dealing with this legacy. However, it has to be noted that the search for uranium has covered almost all countries on the globe. The result in some countries is a legacy of numerous small scale mines and mills. For economic and other reasons, including less stringent environmental standards and awareness at the time, these operations may not have been properly closed out and made safe. The remediation strategies and techniques developed by major problem holders, such as the USA and Germany, would often be out of scale for the problems in other countries. Therefore an international workshop was organized in Lisbon from 11 to 13 February 2004 as a forum for the exchange of views and experiences of countries with smaller scale uranium mining legacies.

(262 pp., 64 figs; 2005) • ISBN 92-0-104305-8 •
STI/PUB/1228 • €80.00

Recent Developments in Uranium Resources and Production with Emphasis on In Situ Leach Mining

IAEA TECDOC Series No. 1396

In situ leach (ISL) mining of uranium involves injecting mild acidic or alkaline chemicals through surface boreholes into permeable, uranium-bearing sandstones. The chemicals dissolve the uranium, and the uranium-bearing solutions are pumped to the surface through a second set of boreholes. ISL mining of uranium totalled 6410 tonnes of uranium in 2002, and accounted for 18% of worldwide uranium production. Seven countries reported ISL production in 2002, and other countries are considering the potential for developing an ISL capability, as

ISL has economic and environmental advantages for producing uranium from carefully selected deposits. This publication contains 26 papers on various aspects of ISL mining including the geology of ISL-amenable sandstone deposits, case histories of ISL production using leaching solutions of varying chemistry and finally post-mining rehabilitation of ISL projects. The papers were presented at a meeting held in Beijing, China, in 2002, attended by 59 scientists from 18 countries and one international organization (OECD/NEA). Attendees at the meeting also toured one of China's ISL operations, a description of which is included in this publication.

**(2004) • ISBN 92-0-103104-1 •
IAEA-TECDOC-1396 • €15.00**

Treatment of Liquid Effluent from Uranium Mines and Mills

IAEA TECDOC Series No. 1419

Treatment and control of the liquid effluents produced during uranium mining and milling operations is an integral part of environmental project management. Research has continued to add to the large body of science that has been built up around the treatment of radioactive and non-radioactive effluents to minimize their long term environmental impact. The objective of the meetings on which this publication is based was to exchange information on active effluent treatment technologies that have application during operations and passive treatment techniques such as constructed wetlands and use of microorganisms that are applicable during project reclamation and long term care and maintenance. The papers included in this publication describe effluent treatment case histories from active uranium mining and processing operations. There are also papers that describe effluent treatment research on both active and passive systems that have potential application under a wide range of operating and post-operational conditions.

**(2004) • ISBN 92-0-112304-3 •
IAEA-TECDOC-1419 • €15.00**

Fuel Fabrication and Performance

Advanced Fuel Pellet Materials and Designs for Water Cooled Reactors

IAEA TECDOC Series No. 1416

This report presents the proceedings of the Technical Meeting on Improved Fuel Pellet Materials and Designs held in Brussels, Belgium, in October 2003. The meeting focused on fabrication and design tools to influence, to some extent, and ensure desirable in-pile fuel properties. Emphasis was placed on the analysis of fuel characteristics at high burnup, including thermal behaviour, fission gas retention and release, pellet–cladding interaction and pellet–cladding mechanical interaction. Specific features of large grain size UO_2, MOX and urania-gadolinia fuels with and without additives were considered in detail. A CD-ROM is also included.

**(2004) • ISBN 92-0-111404-4 •
IAEA-TECDOC-1416 • €15.00**

Structural Behaviour of Fuel Assemblies for Water Cooled Reactors

IAEA TECDOC Series No. 1454

This publication, the proceedings of a meeting, covers topics including the impact of hydraulic loadings on fuel assembly (FA) performance, FA bow and control rod drop kinetics, vibrations and rod-to-grid wear and fretting, and evaluation and modelling of accident (mainly seismic) conditions. These proceedings are presented as a book with an attached CD-ROM. The first part of the CD-ROM repeats the papers presented at the meeting and the second part the Appendix with the original slides (in PowerPoint) converted into pdf format.

**(2005) • ISBN 92-0-105105-0 •
IAEA-TECDOC-1454 • €15.00**

Spent Fuel Management

Forthcoming

Geological Disposal of Radioactive Waste

Safety Requirements

Safety Standards Series No. WS-R-4

This Safety Requirements publication is concerned with providing protection for people and the environment from the hazards associated with waste management activities related to disposal, i.e. hazards that could arise during the operational period and following closure. It sets out the protection objectives and criteria for geological disposal and establishes the requirements that must be met to ensure the safety of this disposal option, consistent with the established principles of safety for radioactive waste management. It is intended for use by those involved in radioactive waste management and in making decisions in relation to the development, operation and closure of geological disposal facilities, especially those concerned with the related regulatory aspects.

**(Forthcoming 2006) • ISBN 92-0-105705-9 •
STI/PUB/1231 • €18.00**

Management of High Enriched Uranium for Peaceful Purposes: Status and Trends

IAEA TECDOC Series No. 1452

Arms control agreements between some Nuclear Weapon States have led to the dismantling of many of the nuclear weapons in their military stockpiles, which in turn have produced stockpiles of excess weapons-grade high enriched uranium (HEU) from the dismantled weapons. Considering the proliferation potential of HEU, the management, control and disposition of this fissile material has become a primary focus of nuclear non-proliferation efforts worldwide. To lessen the

proliferation threat of excess HEU stockpiles, the USA agreed to purchase several tonnes of excess Russian HEU down-blended to low enriched uranium (LEU). Proliferation concerns about HEU have also resulted in a global effort to convert research reactors from HEU to LEU fuel and to minimize civilian use of HEU. This publication addresses HEU management declared excesses, non-proliferation programmes and options for the use of HEU stockpiles, including disposition programmes. Also addressed are the influence of LEU derived from surplus HEU on the global market for uranium, technical issues associated with utilization and the disposition of HEU.

**(2005) • ISBN 92-0-105405-X •
IAEA-TECDOC-1452 • €15.00**

Remote Technology Applications in Spent Fuel Management

IAEA TECDOC Series No. 1433

This publication provides an overview of remote technology applications to spent fuel management within the scope of the fuel cycle back end. Remote systems technology has been extensively applied to a variety of work in spent fuel management facilities with such benefits as dose reduction to workers, enhancement of operational performance or reliability and saving of labour costs. In recognition of the beneficial applications of remote technology in spent fuel management, the IAEA has provided information on the state-of-art developments and practices.

**(2005) • ISBN 92-0-101405-8 •
IAEA-TECDOC-1433 • €15.00**

Status and Trends in Spent Fuel Reprocessing

IAEA TECDOC Series No. 1467

The management of spent fuel arising from nuclear power production is a crucial issue for the sustainable development of nuclear energy. The IAEA has issued several publications in the past that provide technical information on the global status and trends in spent fuel reprocessing and associated topics, and one reason for this present publication is to provide an update of this information which has mostly focused on the conventional technology applied in the industry. However, the scope of this publication has been significantly expanded in an attempt to make it more comprehensive and by including a section on emerging technologies applicable to future innovative nuclear systems, as are being addressed in such international initiatives as INPRO, Gen IV and MICANET. In an effort to be informative, this publication attempts to provide a state-of-the-art review of these technologies, and to identify major issues associated with reprocessing as an option for spent fuel management. It does not, however, provide any detailed information on some of the related issues such as safety or safeguards, which are addressed in other relevant publications.

**(2005) • ISBN 92-0-108805-1 •
IAEA-TECDOC-1467 • €15.00**

Technical, Economic and Institutional Aspects of Regional Spent Fuel Storage Facilities

IAEA TECDOC Series No. 1482

A particular challenge facing countries with small nuclear programmes is the preparation for extended interim storage and then disposal of their spent nuclear fuel. The costs and complications of providing for away-from-reactor storage facilities and/or geological repositories for relatively small amounts of spent fuel may be prohibitively high, motivating interest in regional solutions. This publication addresses the technical, economic and institutional aspects of regional spent fuel storage facilities and is based on the results of a series of meetings on this topic with participants from IAEA Member States.

**(2005) • ISBN 92-0-112505-4 •
IAEA-TECDOC-1482 • €15.00**

**CD Edition (2006) • ISBN 92-0-114605-1 •
IAEA-TECDOC-CD-1482 • €15.00**

Forthcoming

Understanding and Managing Ageing of Material in Spent Fuel Storage Facilities

Technical Reports Series No. 443

This report results from a Coordinated Research Project on “Ageing of Materials in Spent Fuel Storage Facilities”. It includes sections on the status of understanding ageing of selected materials and on management of ageing. The management of ageing is of key importance in many countries for the owners and operators of many facilities, including power reactors. There is a large measure of agreement on the general approach, which is summarized in this report. The report also includes a brief section on specific approaches in the context of fuel storage facilities and some specific recommendations. Moreover, the content has been broadened to be relevant to those who may be in the early stages of setting up ageing management programmes either for new or for older fuel storage facilities. The report differentiates between the ageing of fuel materials from research reactors and civil reactors. However, there is no such selectivity with regard to the materials of fuel storage facilities.

**(Forthcoming 2006) • ISBN 92-0-105205-7 •
STI/DOC/010/443 • €29.00**

WWER-440 Fuel Rod Experiments under Simulated Dry Storage Conditions

IAEA TECDOC Series No. 1385

There is significant interest in Member States operating WWER reactors in obtaining information about the highest allowable cladding temperatures for spent fuel assemblies in dry storage facilities. Therefore, special efforts have been made to simulate dry storage tests with WWER-440 fuel rods at the State Scientific Centre of the Russian Federation, Scientific Research Institute for Nuclear Reactors (RIIAR) in Dimitrovgrad, using extra-budgetary funds supplied by the Government of Japan, leading to publication of the results in this publication. The aim is to provide an insight into the maximum spent fuel cladding

temperature at the beginning of placement in a dry storage facility, in the context of the pre-cooling time. This publication contains the results of pre-characterization of the rods, descriptions of the tests and the results of characterizations in the two principal temperature regimes.

(2004) • ISBN 92-0-103704-X • IAEA-TECDOC-1385 • €15.00

WASTE MANAGEMENT

Forthcoming

Applicability of Monitored Natural Attenuation at Radioactively Contaminated Sites

Technical Reports Series No. 445

This report discusses in detail the necessary prerequisites, processes involved and applicability of 'non-intervention' as a strategy for dealing with radioactive contamination. Particular emphasis is placed on modelling tools as an integral element of monitored natural attenuation (MNA). It provides a comprehensive critique of the applicability of MNA and explores its limits. While MNA is de facto relied upon in many instances where a contamination cannot be completely removed to an engineered repository, it is emphasized that 'non-intervention' is not equivalent to a 'do nothing' option. In order to rely on MNA safely, a thorough understanding of the site and the migration behaviour of the contaminants in the given environment is needed, which is gained by a comprehensive site investigation. This report complements other recent reports on remediation techniques and strategies with a less invasive concept.

(Forthcoming 2006) • ISBN 92-0-111905-4 • STI/DOC/010/445 • €31.00

Application of Membrane Technologies for Liquid Radioactive Waste Processing

Technical Reports Series No. 431

Membrane separation processes have made impressive progress since the first synthesis of membranes almost 40 years ago. This progress was driven by strong technological needs and commercial expectations. As a result the range of successful applications of membranes and membrane processes is continuously broadening. In addition, increasing application of membrane processes and technologies lies in the increasing variations of the nature and characteristics of commercial membranes and membrane apparatus. The objective of the report is to review the information on application of membrane technologies in the processing of liquid radioactive waste. The report covers the various types of membranes, equipment design, range of applications, operational experience and the performance characteristics of different membrane processes. The report aims to provide Member States with basic information on the applicability and limitations of membrane separation technologies for processing liquid radioactive waste streams.

(145 pp., 53 figs; 2004) • ISBN 92-0-106804-2 • STI/DOC/010/431 • €32.00

Anthropogenic Analogues for Geological Disposal of High Level and Long Lived Waste

IAEA TECDOC Series No. 1481

This report presents a brief overview of recent developments in evaluating the long term performance of selected human made materials (copper based metals, glasses and concrete). It summarizes the results of several studies which contribute to the information base on anthropogenic analogues. Although the primary intention was to promote development of an engineered system of geological repositories, some data are relevant to the performance of barriers considered when designing near surface disposal facilities. It is also expected that the published results may provide other workers in the field with an insight into the potential of the studied materials for their long term uses in constructions long term and for their exposure to extreme environmental conditions.

(2005) • ISBN 92-0-113105-4 • IAEA-TECDOC-1481 • €15.00

Forthcoming

Decommissioning of Research Reactors: Evolution, State of the Art, Open Issues

Technical Reports Series No. 446

Taking account of work done to date on decommissioning of research reactors, it is timely to provide an up to date basis for ongoing and foreseen activities in this field. The approach taken in this report is to review, from a historical perspective, decommissioning projects either completed in recent years or under way, and to assess progress, remaining issues and new questions. The intention is to facilitate timely, safe and efficient completion of decommissioning projects for research reactors by highlighting state-of-the-art technologies and planning/management methodologies, and by suggesting ways to overcome expected problems. The report is complemented by a CD-ROM providing details on several hundred research reactor decommissioning projects.

(Forthcoming 2006) • ISBN 92-0-112605-0 • STI/DOC/010/446 • €37.00

Forthcoming

Decommissioning of Underground Structures, Systems and Components of Nuclear Installations

Technical Reports Series No. 439

Among the facilities needing attention in decommissioning are underground facilities. These require special consideration and are the subject of this report. Firstly, due to their poor accessibility, there are significant difficulties in physical and radiological characterization, deployment of decontamination techniques, and physical disassembly and removal. Secondly, these types of components are present in a large number of nuclear installations. However, early nuclear design and construction practices often did not consider or incorporate eventual decommissioning requirements in their design considerations and these requirements were not commonly enforced in the early nuclear era. This is also true for those

facilities situated in countries that do not have sufficient experience/expertise in performing decommissioning. Thirdly, a comprehensive assessment of the literature on nuclear decommissioning of underground components shows that this subject has not yet received any systematic coverage, despite the technical difficulties that have been encountered in actual projects to date. In fact, the literature on this subject is comprised of rather sporadic case histories. This report is intended to draw attention to a neglected field and to collate and condense sporadic information into an overview of important factors and practical guidance.

(Forthcoming 2006) • ISBN 92-0-104405-4 • STI/DOC/010/439 • €53.00

Developing Multinational Radioactive Waste Repositories: Infrastructural Framework and Scenarios of Cooperation

IAEA TECDOC Series No. 1413

This publication reviews the possibilities for the realization of multinational repositories and is intended to serve as a reference for Member States potentially interested in multinational repository concepts as hosting, partner or third party countries. The report updates work done in a previous study in 1998 (IAEA-TECDOC-1021) and attempts to define the concepts involved in the creation of multinational repositories, to explore the likely scenarios, to examine the conditions for successful implementation, and to point out the benefits and challenges inherent to multinational repositories. The report also provides an overview of the past history and the current status of multinational cooperations on repositories and related activities.

(2004) • ISBN 92-0-112204-7 • IAEA-TECDOC-1413 • €15.00

Dismantling of Contaminated Stacks at Nuclear Facilities

Technical Reports Series No. 440

Nearly all nuclear installations utilize stacks to discharge ventilation air as well as gases and fumes from contaminated areas. Over a service lifetime that can span decades, stacks may become contaminated as the result of deposition of radioactive substances, such as aerosols on stack surfaces. In the longer term, this is a serious decommissioning issue. This contamination may be difficult to remove, depending on the operating conditions and the chemical–physical environments over time. In addition, the physical logistics of stack dismantling may be complex, for example the difficulty in severing concrete high above the ground. Relevant aspects include project planning and management, decontamination and dismantling, and the management and disposal of wastes. Although more than 40 previous IAEA reports have been published in the field of decommissioning, none focus on this subject. It can be assumed that generic decontamination and dismantling technologies would also apply to these bulky components, but such an approach disregards a number of specific physical and radiological characteristics that make stack decommissioning a unique project.

(155 pp., 68 figs; 2005) • ISBN 92-0-104505-0 • STI/DOC/010/440 • €38.00

Disposal of Low Activity Radioactive Waste

Proceedings of an International Symposium held in Córdoba, Spain, 13–17 December 2004

Proceedings Series

Low activity waste constitutes the largest proportion, by mass and volume, of all radioactive waste. The topical issues addressed by the symposium were: policies and strategies for low activity radioactive waste; very low activity radioactive waste; low activity radioactive waste from decommissioning; long lived low activity radioactive waste and other materials; and unique low activity radioactive waste. These proceedings include the keynote addresses, papers on topical issues, records of panel discussions, Chairs' summaries of the five topical sessions, the symposium Chair's general summary and symposium findings. A CD containing the contributed papers and a list of participants of the symposium is included.

(478 pp., 66 figs; 2005) • ISBN 92-0-102905-5 • STI/PUB/1224 • €110.00

Disposal Options for Disused Radioactive Sources

Technical Reports Series No. 436

This report presents a review of relevant information on the various technical factors and issues, as well as approaches and relevant technologies, leading to the identification of potential disposal options for disused radioactive sources. The report attempts to provide a logical "road map" for the disposal of disused radioactive sources, taking into consideration the high degree of variability in the radiological properties of such types of radioactive waste. The use of borehole or shaft type repositories is highlighted as a potential disposal option, particularly for those countries that have limited resources and are looking for a simple, safe and cost effective solution for the disposal of their radioactive source inventories. The information provided in the report could be adapted or adopted to identify and develop specific disposal options suitable for the type and inventory of radioactive sources kept in storage in a given Member State.

(51 pp., 14 figs; 2005) • ISBN 92-0-100305-6 • STI/DOC/010/436 • €27.00

Near Surface Disposal of Radioactive Waste

Safety Requirements

Safety Standards Series No. WS-R-1

This publication sets out the basic safety requirements related to the disposal of radioactive wastes in near surface repositories. As a Safety Requirements publication it is supported by a number of associated Safety Guides which provide guidance on the implementation of the requirements. Its principles are derived from the Safety Fundamentals publication, Safety Series No. 111-F, The Principles of Radioactive Waste Management. It includes requirements for the protection of human health, requirements for the assessment procedures needed to ensure that safety is achieved, and technical requirements for waste acceptance and for siting, design, construction, operation and closure of the repository as well as for the post-closure phase.

Contents: 1. Introduction; 2. Requirements for the protection of human health and the environment; 3. Safety assessment and compliance with safety requirements; 4. Organizational and technical safety requirements; 5. Waste acceptance requirements; 6. Characteristics of an acceptable site; 7. Design of disposal facilities; 8. Construction; 9. Operation; 10. Closure; 11. Post-closure phase; 12. Quality assurance; Annex: Dose and risk criteria for the post-closure phase.

Chinese Edition (25 pp.; 2005) • ISBN 92-0-517404-1 • STI/PUB/1073 • €12.50
English Edition (29 pp.; 1999) • ISBN 92-0-101099-0 • STI/PUB/1073 • €12.50
French Edition (35 pp.; 1999) • ISBN 92-0-204105-9 • STI/PUB/1073 • €12.50
Russian Edition (38 pp.; 2004) • ISBN 92-0-404603-1 • STI/PUB/1073 • €12.50
Spanish Edition (34 pp.; 2004) • ISBN 92-0-308004-X • STI/PUB/1073 • €12.50

Financial Aspects of Decommissioning

IAEA TECDOC Series No. 1476

Estimating decommissioning costs and collecting the necessary funds for the eventual decommissioning of nuclear facilities is a prerequisite for safe, timely and cost effective decommissioning. The report identifies the types of costs that should be considered when developing a cost estimate and provides information on the collection and management of the funds. It also provides a discussion of the social impacts of decommissioning and how decommissioning can affect the surrounding communities.

(2005) • ISBN 92-0-110905-9 • IAEA-TECDOC-1476 • €15.00

Implications of Partitioning and Transmutation in Radioactive Waste Management

Technical Reports Series No. 435

Partitioning and transmutation (P&T) is a potential complementary route in the management of spent fuel resulting from the generation of nuclear power. It has the potential to open new avenues for long term waste management by eliminating long term radionuclides and their thermal effects and thus reducing the necessity or capacities of disposal facilities. Recycling and reuse of nuclear material and other transuranic radioisotopes would have positive effects on the sustainability of nuclear energy and reduce proliferation concerns by burning nuclear material and other transuranic radionuclides. This report analyses, from an international perspective, the current status of P&T, the potential options for its implementation and its impact on waste management programmes and strategies.

(126 pp., 25 figs; 2004) • ISBN 92-0-115104-7 • STI/DOC/010/435 • €35.00

Long Term Behaviour of Low and Intermediate Level Waste Packages under Repository Conditions

IAEA TECDOC Series No. 1397

This publications covers the Coordinated Research Project (CRP) on Long Term Behaviour of Low and Intermediate Level Waste Packages Under Repository Conditions. This CRP was intended to promote research activities on the subject area in Member States, share information on the topic among the participating countries, and contribute to advancing technologies for near surface disposal of radioactive waste. This publication provides an overview of scientific and technical issues related to the behaviour and performance of a wide range of low and intermediate level waste packages in the context of overall repository performance and safety. Specific approaches for the testing and assessment of waste package components, including modelling considerations in predicting waste package performance, are presented and discussed. In addition, the major findings of the research projects are presented, summarizing the variety of approaches and technologies used in waste package development, testing and evaluation.

(2004) • ISBN 92-0-107904-4 • IAEA-TECDOC-1397 • €15.00

Forthcoming

Management of Long Term Radiological Liabilities: Stewardship Challenges

Technical Reports Series No. 450

Radioactively contaminated sites often cannot be remediated to residual levels of contamination that are not of concern and released for unrestricted use. Residual contamination, buried wastes and other hazards may remain after cleanup is complete for several reasons: technical limitations, economic feasibility, worker health and safety issues, or prevention of collateral environmental impacts. An optimization between social and economic cost and level of protection has to be found. Hence, maintenance of institutional control is likely to be required for very long periods of time. The present publication discusses the relevant issues and approaches to tackle the conceptual, management and technical problems of maintaining institutional control over possibly hundreds or even thousands of years. These provisions and processes for maintaining institutional

control over prolonged periods of time and to manage the radiological liabilities are often referred to as 'stewardship'.

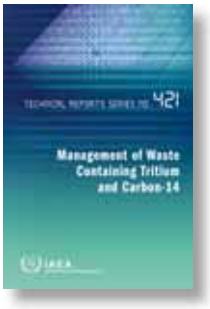
(Forthcoming 2006) • ISBN 92-0-101806-1 • STI/DOC/010/450 • €48.00

Management of Problematic Waste and Material Generated During the Decommissioning of Nuclear Facilities

Technical Reports Series No. 441

Decommissioning of old nuclear facilities may introduce several problems associated with management of some specific materials and waste with not only a radioactive nature but also with chemical toxicity, other dangerous properties or complicated characteristics. Materials such as asbestos, beryllium, cadmium, mercury, lead and PCBs could be considered, which were widely used in the past in the construction of facilities. This report describes several specific forms of materials and waste generated during decommissioning of old nuclear facilities, and outlines the management options for such waste and materials, which are different from those for waste generated during the facility's normal operation.

(71 pp., 18 figs; 2006) • ISBN 92-0-104605-7 • STI/DOC/010/441 • €38.00



Management of Waste Containing Tritium and Carbon-14

Technical Reports Series No. 421

This report reviews and analyses experience in the application of different organizational and technological approaches to the management of waste containing ^{14}C and tritium, and reviews the different sources of such waste and the characteristics important in the selection of appropriate methods for its processing, storage, disposal and release.

(109 pp., 8 figs; 2004) • ISBN 92-0-114303-6 • STI/DOC/010/421 • €20.00

Management of Waste from the Use of Radioactive Material in Medicine, Industry, Agriculture, Research and Education

Safety Guide

Safety Standards Series No. WS-G-2.7

This Safety Guide provides recommendations and guidance on the fulfilment of the safety requirements established in Safety Standards Series No. WS-R-2, Predisposal Management of Radioactive Waste, Including Decommissioning. It covers the roles and responsibilities of different bodies involved in the predisposal management of radioactive waste and in the handling and processing of radioactive material. It is intended for organizations generating and handling radioactive waste or handling such waste on a centralized basis, and for the regulatory body responsible for regulating such activities.

Contents: 1. Introduction; 2. Protection of human health and the environment; 3. Roles and responsibilities; 4. General safety considerations; 5. Predisposal management of radioactive waste; 6. Acceptance of radioactive waste in disposal facilities; 7. Record keeping and reporting; 8. Management systems; Appendix I: Fault schedule for safety assessment and environmental impact assessment; Appendix II: Flow diagram for the management of solid radioactive waste; Appendix III: Flow diagram for the management of biological radioactive waste; Appendix IV: Flow diagram for the management of disused sealed radiation sources; Appendix V: Disused and spent radiation sources and identification of techniques for their management; Appendix VI: Strategy for the identification and location of spent and/or disused sealed radiation sources.

(73 pp., 4 figs; 2005) • ISBN 92-0-113704-4 • STI/PUB/1217 • €20.00

Methods for Maintaining a Record of Waste Packages during Waste Processing and Storage

Technical Reports Series No. 434

During processing, radioactive waste is converted into waste packages and sent for storage and ultimately for disposal. A principal condition for acceptance of a waste package for storage or disposal is its full compliance with waste acceptance criteria for disposal or storage. To declare compliance of a waste package with waste acceptance criteria, a system for generating and maintaining records should be established to record and track all relevant information, from raw waste characteristics, through changes related to waste processing, up to final checking and verification of waste package parameters. Records generated during waste processing are a constituent part of the more complex system of waste management record keeping, covering the entire life cycle of radioactive waste from generation to disposal and even the post-closure period of a disposal facility. The IAEA is systematically working on the preparation of a set of publications to assist its Member States in the development and implementation of such a system. This report covers all the principal aspects of the establishment and maintenance of records during waste processing and storage.

(37 pp., 2 figs; 2005) • ISBN 92-0-114704-X • STI/DOC/010/434 • €35.00

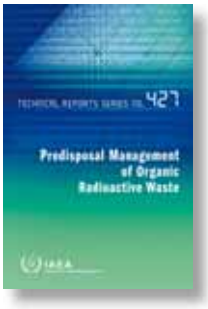
Planning, Managing and Organizing the Decommissioning of Nuclear Facilities: Lessons Learned

IAEA TECDOC Series No. 1394

This publication is intended to encourage the development and improvement of decommissioning planning and management techniques with the focus on organizational aspects, reduce the duplication of efforts by different parties through transfer of experience and know-how, and provide useful results for those Member States planning or implementing decommissioning projects. In general it can be stated that any decommissioning project can be completed without any deleterious effects on the

safety of the workforce and the public or any identifiable impact on the environment. However, timeliness and cost effectiveness are not always optimal. It has been noted on several occasions that the major weakness in decommissioning projects (as well as in other industrial projects) is often not the lack of technologies, but rather poor planning and management. This publication is intended to stimulate awareness of the need for early and efficient planning and to foster developments in management and organization in association with planned or ongoing decommissioning projects. A companion report on Organization and Management for Decommissioning of Large Nuclear Facilities was published by the IAEA in 2000 (Technical Reports Series No. 399) which provides generic guidance on organizational and management aspects. This publication is complementary to the existing publication in that it highlights practical experience – in particular, typical issues, evidence of poor management, undue delays and lack of timely funding – and distils lessons learned from this experience.

(2004) • ISBN 92-0-104404-6 •
IAEA-TECDOC-1394 • €15.00



Predisposal Management of Organic Radioactive Waste

Technical Reports Series No. 427

A wide variety of organic radioactive waste is generated at different nuclear fuel cycle facilities, as well as during different nuclear applications including medicine, research, agriculture, industry, education and training. Processing of organic waste for storage and disposal requires specific approaches. In many cases application of special techniques to destroy organic components of waste or to provide reliable immobilization to isolate organic waste from the environment is required. The processing of organic waste is a rapidly developing field. Various treatment and conditioning options are being investigated, developed and widely applied in several IAEA Member States. This report revises and summarizes available information on different treatment and conditioning options applied for predisposal management of organic radioactive waste.

(87 pp., 10 figs; 2004) • ISBN 92-0-103204-8 •
STI/DOC/010/427 • €30.00

Predisposal Management of Radioactive Waste, Including Decommissioning

Safety Requirements

Safety Standards Series No. WS-R-2

This publication establishes safety requirements relating to the predisposal management of radioactive waste arising from: the operation and decommissioning of nuclear facilities; the application of radionuclides in industry, medicine and research; the processing of raw materials containing naturally occurring radionuclides; and the cleanup of contaminated sites. Safety requirements for the relevant aspects of the decommissioning of nuclear facilities are established. The book includes the provisions required to bring radioactive waste into a state suitable for storage or disposal in designated facilities and to ensure the safety of the facilities. Relevant requirements and associated responsibilities for the protection of human health and the environment are included. The safety requirements are established on the basis of principles set out in the Safety Fundamentals publication, The Principles of Radioactive Waste Management (Safety Series No. 111-F, 1995).

Contents: 1. Introduction; 2. Protection of human health and the environment; 3. Responsibilities associated with predisposal management of radioactive waste, including decommissioning; 4. Interdependence; 5. Elements of predisposal management of radioactive waste; 6. Decommissioning; 7. Safety of facilities; Glossary.

Chinese Edition (21 pp.; 2005) • ISBN 92-0-517204-9 •
STI/PUB/1089 • €11.00
English Edition (26 pp.; 2000) • ISBN 92-0-100300-5 •
STI/PUB/1089 • €11.00
French Edition (33 pp.; 2004) • ISBN 92-0-202704-8 •
STI/PUB/1089 • €11.00
Russian Edition (33 pp.; 2003) • ISBN 92-0-404703-8 •
STI/PUB/1089 • €11.00
Spanish Edition (29 pp.; 2004) • ISBN 92-0-310804-1 •
STI/PUB/1089 • €11.00

Forthcoming

Redevelopment of Nuclear Facilities after Decommissioning

Technical Reports Series No. 444

In the coming decades a large number of nuclear facilities will reach the end of their useful lives and require decommissioning. Many of these facilities will be decommissioned with the aim of either replacing them with new facilities that serve the same purpose or reusing the site for another, completely different purpose. By recognizing and promoting the redevelopment potential of facilities and their sites at the design stage or earlier in their operating life, it is possible to enhance the prospects for worthwhile redevelopment, offsetting the costs of decommissioning and ensuring that best use is made of the material, land and human resources associated with each facility. A range of factors to consider has been identified and illustrated using case studies drawn from Member States, and practical guidance has been provided for involved parties to help promote successful and effective redevelopment of decommissioned nuclear installations in the future.

(Forthcoming 2006) • ISBN 92-0-105505-6 •
STI/DOC/010/444 • €50.00

Remediation of Sites with Dispersed Radioactive Contamination

Technical Reports Series No. 424

This report provides an overview of remediation technologies that are particularly suited to the remediation of dispersed contamination. Dispersed low level contamination poses a particular challenge. Many techniques are not efficient below certain concentration

thresholds or entail more severe impacts on certain environmental compartments than the contamination itself. The technologies are outlined in brief, and their advantages and limitations are discussed. The need for a holistic design of the remedial action is stressed.

(117 pp., 23 figs; 2004) • ISBN 92-0-114603-5 • STI/DOC/010/424 • €21.00

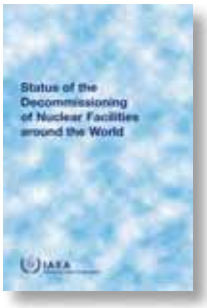
Forthcoming

Remediation of Sites with Mixed Contamination of Radioactive and Other Hazardous Substances

Technical Reports Series No. 442

The IAEA attaches great importance to the dissemination of information that can assist Member States with the development, implementation, maintenance and continuous improvement of systems, programmes and activities that support the management of the legacies of past practices and accidents. In response to this, the IAEA has initiated a comprehensive programme of work covering all aspects of environmental remediation. Mixed radioactive and hazardous substances contamination poses a particular challenge because of the combination of types of hazards and potential exposures. While radionuclides and toxic (heavy) metals pose similar and mostly compatible challenges, organic contaminants often require different approaches that may not be compatible with the former. Additional complexity is introduced into the problem by a different and sometimes conflicting regulatory framework for radiological and non-radiological contamination, including the prescribed waste management routes. In consideration of the added complexities of remediating 'mixed' contamination, the IAEA has determined that this subject sufficiently warrants the development of a specialized report for assisting Member States.

(Forthcoming 2006) • ISBN 92-0-104705-3 • STI/DOC/010/442 • €45.00



Status of the Decommissioning of Nuclear Facilities around the World

This book reviews and summarizes the decommissioning activities that have been performed to date, those that are currently under way and those that will need to be performed in the future. The aim of the book is to quantify the level of effort that will be required on the part of the industry in order to safely perform the necessary decommissioning activities. The book will be of interest to regulators, engineers and planners as a basis for developing a regulatory infrastructure and implementing a decommissioning programme. A CD-ROM is included which gives details of the location, type and status of nuclear power plants, research reactors, fuel cycle facilities and particle accelerators, along with relevant associated data.

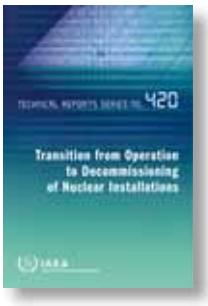
(27 pp., 1 fig.; 2004) • ISBN 92-0-108704-7 • STI/PUB/1201 • €32.00

Surveillance and Monitoring of Near Surface Disposal Facilities for Radioactive Waste

Safety Reports Series No. 35

The publication deals with surveillance and monitoring activities for the purposes of demonstrating the safety of near surface radioactive waste disposal facilities. It covers all phases of facility development from siting through construction and operation to closure. It identifies the activities over which surveillance needs to be exercised and the parameters to be monitored, and provides examples of such programmes for present-day facilities. It also addresses programmes that may be necessary for older facilities which were not built to present-day standards and for which surveillance and monitoring may have to be carried out to identify remedial measures to be taken.

(75 pp., 4 figs; 2004) • ISBN 92-0-114903-4 • STI/PUB/1182 • €17.50



Transition from Operation to Decommissioning of Nuclear Installations

Technical Reports Series No. 420

The transition period between operation of an installation and implementation of the decommissioning strategy is a critical one. In this period, a number of modifications, both technical and organizational, are needed to adjust a plant to meet new objectives and requirements. It is essential that detailed planning for decommissioning begin in good time during plant operation and that preparatory actions for implementation of the decommissioning strategy be initiated immediately after permanent shutdown. This ensures a gradual transition and minimizes uncontrolled loss of resources. The purpose of this report is to highlight technical, management and organizational issues during the transition period, to provide guidance to minimize delays and undue costs, to optimize personnel and other resources, and to initiate preparatory activities for decommissioning in a planned, timely and cost effective manner.

(221 pp., 54 figs; 2004) • ISBN 92-0-114103-3 • STI/DOC/010/420 • €39.00

Upgrading of Near Surface Repositories for Radioactive Waste

Technical Reports Series No. 433

This report considers a variety of circumstances that may require corrective actions to be assessed or implemented at near surface disposal facilities. The circumstances leading to the corrective actions, or the corrective actions themselves, may be of either a technical or

a non-technical nature. Methodologies that can be employed to implement effective solutions to problems are discussed, including assessment of alternative options prior to selecting corrective actions, and the planning, implementation and verification of the specific measures adopted. Examples are provided of approaches and technologies that may be used to improve repository performance and safety. Information is also provided in the Annex on experience in various Member States with the upgrading of disposal facilities.

**(2005) • ISBN 92-0-112704-9 •
STI/DOC/010/433 • €38.00**

Plasma Physics and Nuclear Fusion

Elements of Power Plant Design for Inertial Fusion Energy

IAEA TECDOC Series No. 1460

There are two major approaches in fusion energy research, magnetic fusion energy (MFE) and inertial fusion energy (IFE). The basic physics of IFE (compression and ignition of small fuel pellets containing deuterium and tritium) is becoming increasingly well understood. On the basis of advances by individual countries, IFE has reached a stage at which benefits could be obtained. This report is focused on interface issues including those related to (i) the driver/target interface, (ii) the driver/chamber interface and (iii) the target/chamber interface. The report includes an assessment of the state of the art of the technologies required for an IFE power plant (drivers, chambers and targets) and systems integration as presented and evaluated by members of the IAEA Coordinated Research Project on elements of power plant design for inertial fusion energy.

(2005) • ISBN 92-0-107005-5 • IAEA-TECDOC-1460 • €15.00

Physics and Technology of Inertial Fusion Energy Targets, Chambers and Drivers

IAEA TECDOC Series No. 1466

The outline of the issues discussed at the Third IAEA Technical Meeting on Physics and Technology of Inertial Fusion Energy Targets, Chambers, and Drivers are summarized in this publication. It is expected that new megajoule laser facilities which are under construction in the USA and France will demonstrate fusion ignition and burn, and, in around 2010–2015, gain of energy. This will be an epoch making achievement in the history of fusion energy development, which will provide a real means to solve the future energy and environmental problems of the world. A strategic approach towards the final goal, namely fusion energy production for humanity on a commercial basis, is now required. An inertial fusion energy (IFE) power plant and its development are based on a large number of advanced concepts and technologies, such as drivers, target fabrication and injection, reaction chamber and remaining system. The separability of IFE power plant systems means that these concepts and technologies can be developed semi-independently and later assembled to form a system.

(2005) • ISBN 92-0-108405-6 • IAEA-TECDOC-1466 • €15.00

Forthcoming

Theory of Plasma Instabilities: Transport, Stability Issues and their Interaction

Proceedings of the Second Technical Meeting, held in Trieste, Italy, 2–4 March 2005,

This publication contains the proceedings of the second technical meeting on the theory of plasma instabilities, held in March 2005 in Italy. The meeting gave the opportunity to 49 scientists from 21 countries, actively involved in this research field, to present their latest work and discuss their results. Many different types of plasma instabilities have been found in plasma devices. These have been partially explained by theoretical models, but knowledge is still incomplete and has to be supplemented by further theoretical and experimental efforts. Plasma turbulence results in cross-field transport of one or two orders of magnitude larger than the transport arising from neoclassical transport due to binary collisions. The consequent reduction in plasma performance has implications for the development of fusion energy as an economic alternative power source. Thus a comprehensive understanding of plasma turbulence remains an important scientific objective. New ideas for explaining and modelling the new different types of plasma instabilities and turbulence that have been found in plasma devices have recently emerged, such as the interplay between different types of instabilities, cascades of instabilities and their interaction with plasma turbulence.

CD Edition (forthcoming 2006) • ISBN 92-0-102406-1 • €20.00

20th IAEA Fusion Energy 2004

Proceedings of an International Conference held in Vilamoura, Portugal, 1–6 November 2004

C&S Papers CD Series No. 25

This publication is the CD-ROM proceedings of the 20th International Atomic Energy Agency (IAEA) Fusion Energy Conference (FEC). More than 600 delegates representing 33 countries and three international organizations attended. The scientific experimental and theoretical papers have been grouped with respect to the following themes: overview of magnetic and inertial fusion, advanced scenarios and steady state, edge localized modes, fusion technology, transport theory, beta limits, hybrid scenarios, 11-mode and transport, ITER, Alfvèn modes and wave heating, operational limits and momentum transport, energetic particles and stability, neoclassical tearing modes, transport and turbulence, inertial fusion, configuration effects and transport, and plasma–wall interaction.

(2005) • ISBN 92-0-100405-2 • IAEA-CSP-25/CD • €15.00

International Nuclear Information System

INIS: Authority List for Journal Titles

INIS Reference Series No. 11 (Rev. 31)

The 31st revision of this manual contains the names of 13104 journal titles covered by INIS. It is arranged in six parts. In Part I, all key journals are grouped under the name of the country or international organization responsible for their input to INIS, then sorted alphabetically under their title. In Part II, all key journals are sorted alphabetically under their title. In Part III, all journals that are regularly scanned by INIS centres are grouped under the name of the country or international organization responsible for their input to INIS, then sorted alphabetically under their title. In Part IV, all journals that are regularly scanned by INIS centres are sorted alphabetically under their title. In Part V, all journals are grouped under the name of the country or international organization responsible for their input to INIS, then sorted alphabetically under their title. In Part VI, all journals are sorted alphabetically under their title.

(644 pp.; 2005) • ISBN 92-0-101905-X • IAEA-INIS-11 (Rev. 31) • €54.00

Joint Thesaurus Part I (A–L) and Part II (M–Z)

ETDE/INIS Joint Reference Series No. 1 (Rev. 1)

This is the first revision of the INIS/ETDE Joint Thesaurus. It contains 20953 valid descriptors and 8600 forbidden terms, and was last updated in December 2003. The Joint Thesaurus contains the controlled terminology for indexing all information within the subject scope of both the INIS (International Nuclear Information System) and ETDE (Energy Technology Data Exchange) information systems. The terminology is intended for use in the subject description for input of information to or retrieval of information from those systems. The original basis of the terminology found in this thesaurus was the 1969 edition of the Euratom Thesaurus. The structure subsequently given to that terminology was the result of a systematic study performed by subject specialists. Further expansion of the thesaurus terminology was done by ETDE to incorporate information on all forms of energy. The Joint Thesaurus is the result of continued editing carried out in parallel to the processing of the INIS and ETDE databases.

(1162 pp.; 2004) • ISBN 92-0-105604-4 • IAEA-ETDE/INIS-1 (Rev. 1) • €120.00

Environment

Application of the Concepts of Exclusion, Exemption and Clearance

Safety Guide

Safety Standards Series No. RS-G-1.7

This Safety Guide provides guidance on the application of the concepts of exclusion, exemption and clearance as established in the International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources. The Safety Guide includes specific values for activity concentrations for both radionuclides of natural origin and those of artificial origin that may be used for bulk amounts of material for the purposes of applying the concepts of exclusion and exemption.

Contents: 1. Introduction; 2. The concepts; 3. Basis for the derivation of activity concentration values; 4. Values of activity concentration; 5. Application of the values.

(29 pp.; 2004) • ISBN 92-0-109404-3 • STI/PUB/1202 • €16.00

Developments in Uranium Resources, Production, Demand and the Environment

IAEA TECDOC Series No. 1425

Globalization has led to a growth in importance of the uranium production industries of the world's developing countries. Uranium supply from these countries could be increasingly important in satisfying worldwide reactor requirements over time. Along with the increasing contribution to worldwide uranium supply, the environmental impact of uranium production in developing countries has come under increasing scrutiny from the nuclear power industry, the end users of this supply, and from communities affected by uranium mining and processing. The papers presented at the meeting on Developments in Uranium Resources, Production, Demand and the Environment provide an important overview of uranium production operations and of their environmental consequences in developing countries, as well as offering insight into future production plans and potential.

(2005) • ISBN 92-0-112904-1 • IAEA-TECDOC-1425 • €15.00

Dispersion of Radioactive Material in Air and Water and Consideration of Population Distribution in Site Evaluation for Nuclear Power Plants

Safety Guide

Safety Standards Series No. NS-G-3.2

This Safety Guide deals with consideration of the potential effects of a nuclear power plant on the environment and of the population distribution in the surrounding area in site evaluation for a nuclear power plant. It supplements Safety Standard No. NS-R-3, Site Evaluation for Nuclear Installations, which supersedes Safety Series No. 50-C-S (Rev. 1), Code on the Safety of Nuclear Power Plants: Siting (1988). The present Guide supersedes Safety Series No. 50-SG-S3, Atmospheric Dispersion in Nuclear Power Plant Siting (1980); No. 50-SG-S4, Site Selection and Evaluation for Nuclear Power Plants with Respect to Population Distribution (1980); No. 50-SG-S-6, Hydrological Dispersion of Radioactive Material in Relation to Nuclear Power Plant Siting (1985); and No. 50-SG-S7, Nuclear Power Plant Siting: Hydrogeological Aspects (1984).

Contents: 1. Introduction; 2. Transport and diffusion of effluents discharged into the atmosphere; 3. Transport and diffusion of effluents discharged into the hydrosphere; 4. Uses of land and water in the region of the site; 5. Population distribution; 6. Consideration of the feasibility of an emergency plan; 7. Quality assurance programme.

English Edition (32 pp.; 2002) • ISBN 92-0-110102-3 • STI/PUB/1122 • €11.50
Russian Edition (41 pp.; 2004) • ISBN 92-0-404304-0 • STI/PUB/1122 • €11.50

Environmental and Source Monitoring for Purposes of Radiation Protection

Safety Guide

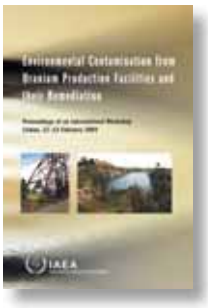
Safety Standards Series No. RS-G-1.8

The purpose of this Safety Guide is to provide international guidance, consistent with contemporary radiation protection principles and IAEA safety requirements, on the strategy of monitoring in relation to: (a) control of radionuclide discharges under practice conditions, and (b) intervention, such as in cases of nuclear or radiological emergencies or past contamination of areas with long lived radionuclides. Three categories of monitoring are discussed: monitoring at the source of the discharge (source monitoring), monitoring in the environment (environmental monitoring) and monitoring of individual exposures in emergencies (individual monitoring). The Safety Guide also provides general guidance on assessment of the doses to critical groups of the population due to the presence of radioactive materials or radiation fields in the environment both from routine operation of nuclear and other related facilities (practice) and from nuclear or radiological emergencies and past contamination of areas with long lived radionuclides (intervention). The dose assessments are based on the results of source monitoring, environmental monitoring, individual monitoring, or their combinations. This Safety Guide is primarily intended for use by national regulatory bodies and other agencies involved in national systems of radiation monitoring, as well as by operators of nuclear installations and other facilities where natural or human made radionuclides are treated and monitored.

Contents: 1. Introduction; 2. Meeting regulatory requirements for monitoring in practices and interventions; 3. Responsibilities for monitoring; 4. Generic aspects of monitoring programmes;

5. Programmes for monitoring in practices and interventions; 6. Technical conditions for monitoring procedures; 7. Considerations in dose assessment; 8. Interpretation of monitoring results; 9. Quality assurance; 10. Recording of results; 11. Education and training; References; Glossary.

(119 pp., 2 figs; 2005) • ISBN 92-0-113404-5 • STI/PUB/1216 • €26.00



Environmental Contamination from Uranium Production Facilities and their Remediation

Proceedings of an International Workshop held in Lisbon, Portugal, February 2004

Proceedings Series

The legacies of past uranium mining and milling continue to be of concern and require assessment and remedial action. This problem has been recognized in many parts of the world over the past three decades, but has received increased attention since the end of the Cold War. Considerable effort and resources have been expended in dealing with this legacy. However, it has to be noted that the search for uranium has covered almost all countries on the globe. The result in some countries is a legacy of numerous small scale mines and mills. For economic and other reasons, including less stringent environmental standards and awareness at the time, these operations may not have been properly closed out and made safe. The remediation strategies and techniques developed by major problem holders, such as the USA and Germany, would often be out of scale for the problems in other countries. Therefore an international workshop was organized in Lisbon from 11 to 13 February 2004 as a forum for the exchange of views and experiences of countries with smaller scale uranium mining legacies.

(262 pp., 64 figs; 2005) • ISBN 92-0-104305-8 • STI/PUB/1228 • €80.00

Fluvial Sediment Transport: Analytical Techniques for Measuring Sediment Load

IAEA TECDOC Series No. 1461

Sediment transport data are often used for the evaluation of land surface erosion, reservoir sedimentation, ecological habitat quality and coastal sediment budgets. Sediment transport by rivers is usually understood as occurring in two major ways: (1) in the flow as a suspended load and (2) along the bed as a bed load. This publication provides guidance on selected techniques for the measurement of particles moving in both modes in the fluvial environment. The relative importance of the transport mode is variable and depends on the hydraulic and sedimentary conditions. The potential user is directed in the selection of an appropriate technique through the presentation of operating principles, application guidelines and estimated costs.

(2005) • ISBN 92-0-107605-3 • IAEA-TECDOC-1461 • €15.00

Guidebook on Environmental Impact Assessment for In Situ Leach Mining Projects

IAEA TECDOC Series No. 1428

Assessment of the potential environmental impact of an in situ leach (ISL) project is the first step in the permission and licensing process. An Environmental Impact Assessment (EIA) serves as the basis for preparing an Environmental Impact Statement (EIS), which in turn identifies the potential environmental and socioeconomic impact of a proposed project and outlines measures to mitigate this impact. The EIS review process serves to inform the public about a proposed project as well as to provide regulatory agencies with assurance that ISL technology will comply with environmental standards, and that project sites can be rehabilitated to pre-mining use. This publication provides a step-by-step description of project parameters that must be addressed in conducting an EIA and preparing an EIS. It also includes EIA/EIS case histories for current operations in Australia, the Czech Republic, Kazakhstan and the United States of America. The publication will be useful to companies considering the development of ISL projects and to regulatory personnel who are responsible for writing environmental regulations and licensing ISL projects.

(2005) • ISBN 92-0-113004-X • IAEA-TECDOC-1428 • €15.00

Isotopic Composition of Precipitation in the Mediterranean Basin in Relation to Air Circulation Patterns and Climate

IAEA TECDOC Series No. 1453

This publication is a compilation of the results obtained under the Coordinated Research Project (CRP) on Isotopic Composition of Precipitation in the Mediterranean Basin in Relation to Air Circulation Patterns and Climate, from 2000 to 2004. The isotopic composition of precipitation is closely connected with the conditions for rain formation, i.e. with the temperature of formation, the origin of the air masses, and the degree and mechanism of rainout. Stable isotopes are, therefore, powerful tools for investigating the precipitation and formation conditions, and for monitoring their changes in parallel to the observed climatic changes. Hydrologists, hydrogeologists and meteorologists were involved in the project and collaborated at the national and regional levels.

(2005) • ISBN 92-0-105305-3 • IAEA-TECDOC-1453 • €15.00

Isotopes in Environmental Studies

Proceedings of an International Conference held in Monaco, 25–29 October 2004

C&S Papers Series No. 26

This publication reviews the present state of the art in applications of radioactive and stable isotopes in achieving a better understanding of environmental processes and in the protection of the aquatic environment. The main topics include: studies on the behaviour, transport and distribution of isotopes in the aquatic environment, climate change studies using isotopic records in the marine environment, global ocean isotopic studies, groundwater dynamics studies, submarine groundwater investigations, modelling of environmental processes, management of freshwater sources in coastal zones, new trends in radioecological investigations, concentrating on the protection of marine biota against radioactive contamination, transfers in analytical technologies from bulk analyses to particle and compound specific analyses of environmental samples, development of new isotopic techniques, such as ammonium molybdophosphate (AMP) and inductively coupled plasma methods (ICPMS), and their applications in environmental studies.

(2005) • ISBN 92-0-111205-X • IAEA-CSP-26 • €15.00

CD Edition (forthcoming 2006)• ISBN 92-0-100906-2 • IAEA-CSP-26/CD • €15.00

Naturally Occurring Radioactive Materials (NORM IV)

Proceedings of an International Conference held in Szczyrk, Poland, 17–31 May 2004

IAEA TECDOC Series No. 1472

In line with the IAEA's safety related programme objective to foster information exchange, this publication is aimed at disseminating important new information on exposure to natural sources to a wide spectrum of technical and regulatory personnel working in this area. Although natural sources of radiation are not usually of regulatory concern, some exposures to radon and naturally occurring radioactive material (NORM) may warrant consideration as to whether controls should be applied. More and more countries are regulating exposures to natural sources, and the body of radiological data on such exposures is growing rapidly. This international conference, NORM IV, is the fourth in a series dating back to 1997, and also follows on from an international symposium held in Rio de Janeiro in 1999 (the proceedings of which were published as IAEA-TECDOC-1271). Among the topics addressed at NORM IV were exposure to radionuclides of natural origin in mining and other industrial operations involving NORM (including environmental impacts), standards and regulations, and measurement techniques.

(2005) • ISBN 92-0-110305-0 • IAEA-TECDOC-1472 • €15.00

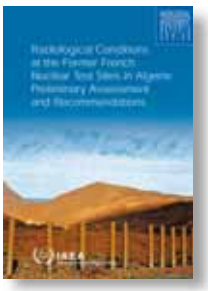
Protection of the Environment from the Effects of Ionizing Radiation

Proceedings of an International Conference held in Stockholm, Sweden, 6–10 October 2003

Proceedings Series

Radioactive materials as environmental pollutants have been of concern with regard to both human exposure and exposure of non-human species. This concern has recently led to a reconsideration of an assumption on which current standards are based, namely, that if humans are adequately protected then other species will also be adequately protected. This subject is now under consideration by all relevant international organizations in the field of radiation protection, including the International Commission on Radiological Protection (ICRP), the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) and the IAEA. The conference which is the subject of these proceedings is the latest in the series of international conferences on biota protection from radiation (Stockholm, 1996, Ottawa, 1999, and Darwin, 2002). It had the objective of reviewing recent scientific and policy developments in this subject area and the implications for further work at national and international levels. These proceedings contain all of the presentations and discussions held during the conference, as well as summaries of each session and the overall findings of the conference. The contributed papers are provided on a CD-ROM which accompanies these proceedings. The proceedings are primarily intended for use by regulatory bodies and authorities of the nuclear fuel cycle facility locations, international bodies involved in environmental protection and experts in environmental radioactivity worldwide.

(548 pp., 30 figs; 2005) • ISBN 92-0-104805-X • STI/PUB/1229 • €80.00



Radiological Conditions at the Former French Nuclear Test Sites in Algeria: Preliminary Assessment and Recommendations

Radiological Assessment Reports

There are various locations around the world that have been affected by radioactive residues. Some of these residues are the result of past peaceful activities, while others result from military activities, including residues from the testing of nuclear weapons. Stimulated by concern about the state of the environment, movement away from military nuclear activities and improved opportunities for international cooperation, attention in many countries has turned to assessing and, where necessary, remediating areas affected by radioactive residues. Representatives of the Algerian government requested the IAEA to carry out a study of the radiological situation at the former French nuclear test sites in Algeria. The findings of this assessment are summarized in this report.

(60 pp., 27 figs; 2005) • ISBN 92-0-113304-9 • STI/PUB/1215 • €30.00

Forthcoming

Radiological Conditions in the Dnieper River Basin

Radiological Assessment Reports

In 1986, in the Dnieper River Basin, a densely populated area in the middle of eastern Europe, the most severe nuclear accident in human history occurred at the Chernobyl nuclear power plant, Ukraine. The accident destroyed a high power nuclear reactor and resulted in the release of large amounts of radionuclides into the environment. In the other areas of Ukraine adjacent to the middle reaches of the Dnieper River, uranium mining and milling facilities have been in operation since 1948 which have left substantial tailings containing naturally occurring radioactive materials. These, together with the accident, resulted in the contamination of substantial areas with radioactive residues, and some associated health effects such as elevated thyroid cancer incidence have been noted. This publication was prepared by an IAEA project team within the framework of the Dnieper Basin Environmental Programme carried out under the United Nations Development Programme — Global Environment Facility. This report includes the findings and conclusions of the IAEA project team on radioactive contamination in the Dnieper Basin and its radiological consequences, as well as recommendations to the governments of Belarus, the Russian Federation and Ukraine in the area of radiation and environmental protection. The report is primarily intended for use by these national governments and local authorities of the Dnieper Basin countries, international bodies involved in the Dnieper Basin Environmental Programme and experts on radioactivity in the environment worldwide.

(Forthcoming 2006) • ISBN 92-0-104905-6 • STI/PUB/1230 • €38.00

Recent Developments in Uranium Exploration, Production and Environmental Issues

IAEA TECDOC Series No. 1463

The uranium industry is in a period of transition. In Europe, the industry is in transition from uranium production to site rehabilitation. The WISMUT project in Germany, which is featured in this publication, is the largest and one of the most advanced rehabilitation projects in the world. By contrast, other countries such as China, India and Argentina are expanding their industries to meet growing uranium demand. Activities in these countries, which are also described in this publication, range from new project licensing to application of new technology to increase productivity and lower costs at existing operations. Changes within the uranium industry are nowhere more evident than in the marketplace, where the price of uranium has more than doubled in the past two years. There is a discussion of the reasons for this price rise and the adequacy of production capacity to meet reactor uranium requirements.

(2005) • ISBN 92-0-108005-0 • IAEA-TECDOC-1463 • €15.00
CD Edition (2005) • ISBN 92-0-112105-9 • IAEA-TECDOC-CD-1463 • €15.00

Forthcoming

Regulatory and Management Approaches for the Control of Environmental Residues Containing Naturally Occurring Radioactive Material (NORM)

IAEA TECDOC Series No. 1484

This publication contains the papers presented and the ensuing discussions from the technical meeting on 'Regulatory and Management Approaches for the Control of Environmental Residues containing Naturally Occurring Radioactive Materials (NORM)' and in addition some papers from a similar meeting held in Vienna in 2002. All the papers present an overview of the current NORM residue regulation and management situation in a number of Member States. The subsequent discussions from the 2004 meeting are summarized, and the report goes on to list the meeting's recommendations for actions that need to be taken to improve guidance on future management of residues containing NORM.

(Forthcoming 2006) • ISBN 92-0-113305-7 • IAEA-TECDOC-1484 • €15.00

Sediment Distribution Coefficients and Concentration Factors for Biota in the Marine Environment

Technical Reports Series No. 422

In 1985 the International Atomic Energy Agency published Technical Reports Series No. 247, entitled Sediment K_ds and Concentration Factors for Radionuclides in the Marine Environment, containing sediment distribution coefficients and concentration factor data for marine biological material, which could be used in models simulating the dispersion of radioactive wastes disposed of in the sea. TRS 247 has proved to be a valuable reference for radioecologists, marine modellers and other scientists working in the field of assessment of the impact of radionuclides in the marine environment. In 2000 the IAEA initiated the revision of this publication to take account of the many new data that have been gathered. The sediment distribution coefficients and concentration factors provided in the revised publication were calculated using the same approach adopted in TRS 247. These values should, therefore, be used instead of the values published in TRS 247. In addition, this revised publication contains concentration factors for a limited number of elements for marine mammals, which were not included in the first version of the report.

(95 pp.; 2004) • ISBN 92-0-114403-2 • STI/DOC/010/422 • €19.00

Soil Sampling for Environmental Contaminants

IAEA TECDOC Series No. 1415

This report is a suitable guide for analytical and radioanalytical laboratories. The protocols described in the report help specialists to improve the quality and reliability of their analysis. The report will help Member State laboratories in developing

countries to assess environmental contamination of soils and develop strategies for remediation.

**(2004) • ISBN 92-0-111504-0 •
IAEA-TECDOC-1415 • €15.00**

Status of Industrial Scale Radiation Treatment of Wastewater and its Future

IAEA TECDOC Series No. 1407

Fundamental studies of the radiation process for wastewater treatment, its analogues and differences to other advanced oxidation technologies and of combined processes are presented in the report. Possible fields of application, technical solutions and economic factors concerning engineering and other applications are addressed. Developments concerning accelerator design, engineering and construction as well as other features of radiation sources are reviewed. Further discussions include the design of under-beam systems. Such progress and developments are critical for further applications. A reduction in cost and an improvement of technical reliability are expected; in particular high power accelerators are needed for environmental applications. The book points out that such applications should be carefully revised in accordance with the existing regulations and state of the art knowledge. The results of the discussions summarized in the publication may serve as the basis for the preparation of guidelines and feasibility studies for full-scale process implementation. Public awareness and technology acceptance are additional factors to be considered for further dissemination; therefore this publication is a valuable source providing necessary information for engineers, environmentalists and decision makers.

**(2004) • ISBN 92-0-110104-X •
IAEA-TECDOC-1407 • €15.00**

Testing of Environmental Transfer Models Using Data from the Remediation of a Radium Extraction Site

IAEA BIOMASS-7

This publication has been produced by the Remediation Working Group of the BIOMASS project and is intended for use by experts in environmental remediation assessment. The main aim of this group was to test the accuracy of predictions of environmental assessment models that form part of the assessment of the radiological impact of remediation decisions. Two scenarios were constructed and applied based on the contamination around the site of a former radium extraction plant in Olen, Belgium, which arose due to the discharge of liquid effluents into a local brook — waste disposal practices and the use of waste material as a road surfacing material. These scenarios were designed to allow modellers the ability to consider the impact of possible future remediation actions, based on input data for a real site. Differences between model predictions were mainly due to differences in user interpretation of the scenario description. The main sources of uncertainty were the radium distribution in the root zone before deep ploughing and the effectiveness of deep ploughing.

**(2004) • ISBN 92-0-109103-6 •
IAEA-BIOMASS-7 • €15.00**

Worldwide Marine Radioactivity Studies (WOMARS): Radionuclide Level in Oceans and Seas

IAEA TECDOC Series No. 1429

This publication summarizes the results of a Coordinated Research Project carried out by the IAEA's Marine Environment Laboratory in Monaco. The results obtained confirm that the dominant source of anthropogenic radionuclides in the marine environment is global fallout; however, important contributions have also been due to authorized releases of radionuclides to the marine environment from the Sellafield and Cap de la Hague reprocessing plants, as well as from the Chernobyl accident. Time trends in radionuclide concentrations in surface water were studied and radionuclide mean residence times in the world oceans were estimated. Similar mean residence times were obtained for ^{90}Sr and ^{137}Cs, 28 ± 3 years, and 13 ± 1 year for ^{239,240}Pu. The results provide the most complete data set available to Member States on levels of anthropogenic radionuclides in the marine environment. They are used as the international reference source on the average levels of anthropogenic radionuclides in the marine environment, so that any further contributions from nuclear reprocessing plants, radioactive waste disposal sites, nuclear bomb test sites and possible nuclear accidents can be identified.

**(2005) • ISBN 92-0-114904-2 •
IAEA-TECDOC-1429 • €15.00**

Physical Protection of Radioactive Material

Categorization of Radioactive Sources

Safety Guide

Safety Standards Series No. RS-G-1.9

This Safety Guide provides a risk based ranking of radioactive sources and practices in five categories. The categorization system is based on a logical and transparent method that provides the flexibility for it to be applied in a wide range of circumstances. On the basis of this categorization, risk informed decisions can be made in a graded approach to the regulatory control of radioactive sources for the purposes of safety and security.

Contents: 1. Introduction; 2. Categorization scheme; 3. Implementation of the categorization scheme; Appendix I: Categories for sources used in some common practices; Appendix II: Plain language descriptions of the categories; References; Annex I: Rationale and method for the categorization of radioactive sources; Annex II: The D value; Glossary.

(55 pp.; 2005) • ISBN 92-0-103905-0 • STI/PUB/1227 • €18.00

Detection of Radioactive Materials at Borders

IAEA TECDOC Series No. 1312

The purpose of this publication is to provide guidance for Member States for use by customs, police or other law enforcement bodies on the radiation monitoring of vehicles, people and commodities at border crossing facilities as a countermeasure to illicit trafficking and also to detect inadvertent movement of radioactive materials. Such monitoring may be one component of efforts towards finding radioactive materials that have been lost from control and which may enter a Member State.

Arabic Edition (2004) • ISBN 92-0-606404-5 • IAEA-TECDOC-1312 • €15.00
English Edition (2004) • ISBN 92-0-116102-6 • IAEA-TECDOC-1312 • €15.00
French Edition (2004) • ISBN 92-0-207903-X • IAEA-TECDOC-1312 • €15.00
Russian Edition (2003) • ISBN 92-0- 92-0-407603-8 • IAEA-TECDOC-1312 • €15.00
Spanish Edition (2004) • ISBN 92-0-306304-8 • IAEA-TECDOC-1312 • €15.00

Forthcoming

Monitoring of Radioactive Material in International Mail Transported by Public Postal Operators

Technical Guidelines

IAEA Nuclear Security Series No. 3

The illegal transport of conventional explosives and biological material has been observed in public mail and could lead to serious health hazards. In response to Member States' requests to establish guidance for detecting the movement of radioactive material in international mail, the IAEA and the Universal Postal Union (UPU) undertook a joint effort to prepare this publication. It considers how radioactive materials in international mail might be detected, how best to monitor for these materials in mail facilities and how to respond appropriately. This publication brings together a concise but comprehensive description of the various techniques and equipment used to detect and control radioactive material during mail processing.

(Forthcoming 2006) • ISBN 92-0-100406-0 • STI/PUB/1242 • €23.00

Forthcoming

Nuclear Forensics Support: Guidelines for Responding to Illicit Events Involving Nuclear or Other Radioactive Material

IAEA Nuclear Security Series No. 2

Nuclear scientists have recognized that much can be learned from the analysis of reported cases of illicit trafficking of nuclear and other radioactive material: What specifically could the material have been used for? Where was the material obtained from: stock, scrap or waste? Was the amount seized only a sample of a much more significant quantity? These and many other questions can be answered through detailed technical characterization of seized material samples. The combination of scientific methods used for this purpose is normally referred to as nuclear forensics, which has become an indispensable tool for use in law enforcement investigations of nuclear trafficking. This publication is unique in bringing together for the first time a concise but comprehensive description of the various tools and procedures of nuclear forensics investigations that have heretofore been described independently in the scientific literature. It also incorporates the experience accumulated over the last decade by law enforcement agencies and nuclear forensics laboratories confronted with cases of illicit events involving nuclear or other radioactive materials.

(Forthcoming 2006) • ISBN 92-0-100306-4 • STI/PUB/1241 • €26.00

Nuclear Security: Global Directions for the Future

Proceedings of an International Conference held in London, 16–18 March 2005

Proceedings Series

The principal aim of the International Conference on Nuclear Security: Global Directions for the Future was to share information on how to most successfully combat substate and criminal threats now and in the future, and to foster a better understanding and awareness of the global changes since 11 September 2001. The conference considered the threat of malicious acts involving nuclear and other radioactive material; the experiences, achievements and shortcomings of national and international efforts to strengthen the prevention

of, detection of and response to malicious acts involving these materials; and the ways and means to achieve future improvements. These proceedings contain the opening and keynote addresses and the invited papers presented during the various topical and panel sessions. The conference generated an extensive exchange of information on key issues related to a number of aspects of nuclear security. The summaries of these discussions, as well as the findings, as presented by the President of the Conference are also included.

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Prevention of the Inadvertent Movement and Illicit Trafficking of Radioactive Materials

IAEA TECDOC Series No. 1311

This publication will primarily be of interest to customs, border police and other law enforcement bodies. It outlines the typical regulatory framework so that customs, police and other law enforcement staff are aware of the measures being taken to prevent loss of control. It also deals with the roles of customs, border police and other law enforcement bodies in the prevention of the inadvertent movement and illicit trafficking of radioactive materials.

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Safety Guide

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This Safety Guide is intended to assist States in implementing the requirements established in Safety Standards Series No. GS-R-1, Legal and Governmental Infrastructure for Nuclear, Radiation, Radioactive Waste and Transport Safety, for a national regulatory infrastructure to regulate any practice involving radiation sources in medicine, industry, research, agriculture and education. The Safety Guide provides advice on the legislative basis for establishing regulatory bodies, including the effective independence of the regulatory body. It also provides guidance on implementing the functions and activities of regulatory bodies: the development of regulations and guides on radiation safety; implementation of a system for notification and authorization; carrying out regulatory inspections; taking necessary enforcement actions; and investigating accidents and circumstances potentially giving rise to accidents. The various aspects relating to the regulatory control of consumer products is explained, including justification, optimization of exposure, safety assessment and authorization. Guidance is also provided on the organization and staffing of regulatory bodies.

Contents: 1. Introduction; 2. Legal framework for a regulatory infrastructure; 3. Principal functions and activities of the regulatory body; 4. Regulatory control of the supply of consumer products; 5. Functions of the regulatory body shared with other governmental agencies; 6. Organization and staffing of the regulatory body; 7. Documentation of the functions and activities of the regulatory body; 8. Support services; 9. Quality management for the regulatory system.

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Response to Events Involving the Inadvertent Movement or Illicit Trafficking of Radioactive Materials

IAEA TECDOC Series No. 1313

The prime objective of this publication is to provide Member States with practical information for use by emergency response and law enforcement personnel involved in dealing with incidents of inadvertent movement or illicit trafficking of radioactive materials. The purpose of the response is to regain control of the relevant radioactive materials so that the risk of harm to people and the environment is mitigated.

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IAEA TECDOC Series No. 1388

The control of radioactive sources is a high visibility and high priority topic in contemporary society. Fatalities from orphan radioactive sources and the possible use of radioactive sources in radiological dispersal devices make it more important than ever that governments know about and have good control over radioactive sources within their territories, especially Category 1, 2 and 3 sources. This publication provides the necessary background and a systematic methodology for governments to evaluate how well they are controlling radioactive sources. Part I of the report provides details of the applications of radioactive sources and Part II describes the process for gathering information, performing an evaluation and then developing a prioritized national strategic action plan. Many

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IAEA Nuclear Security Series No. 1

States have the responsibility for combating illicit trafficking and inadvertent movements of radioactive material. A major portion of that effort is devoted to monitoring borders to detect and then confiscate any radioactive material which might be moving across borders in an illegal manner. The IAEA has responded to requests from its Member States to provide a set of technical specifications that can be used in the design testing, qualifying and purchasing of border radiation monitoring equipment. The purpose of this publication is to provide deployment specifications rather than just test specifications. That is, the system parameters discussed here can be used as the specification for how the equipment will actually be deployed for border security applications rather than only for use during comparisons of equipment from various manufacturers.

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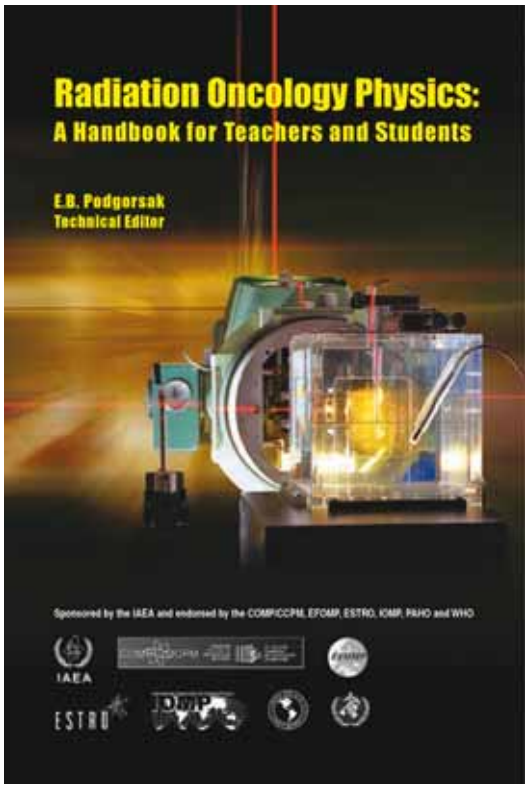

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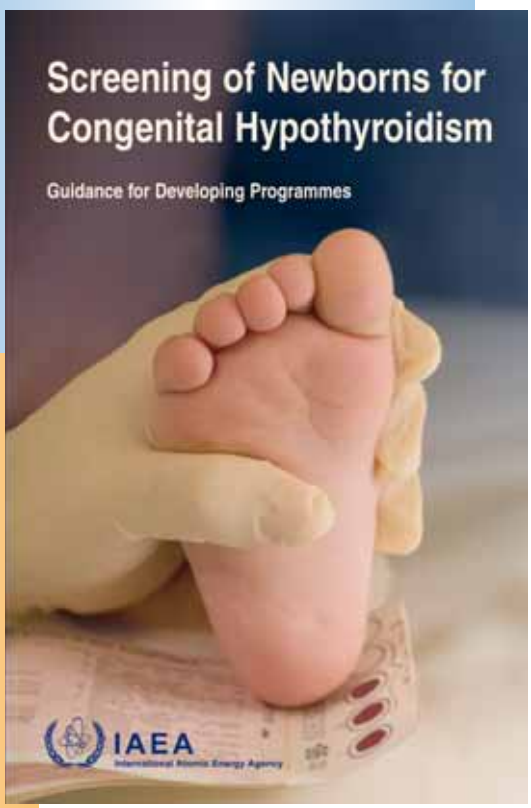

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