



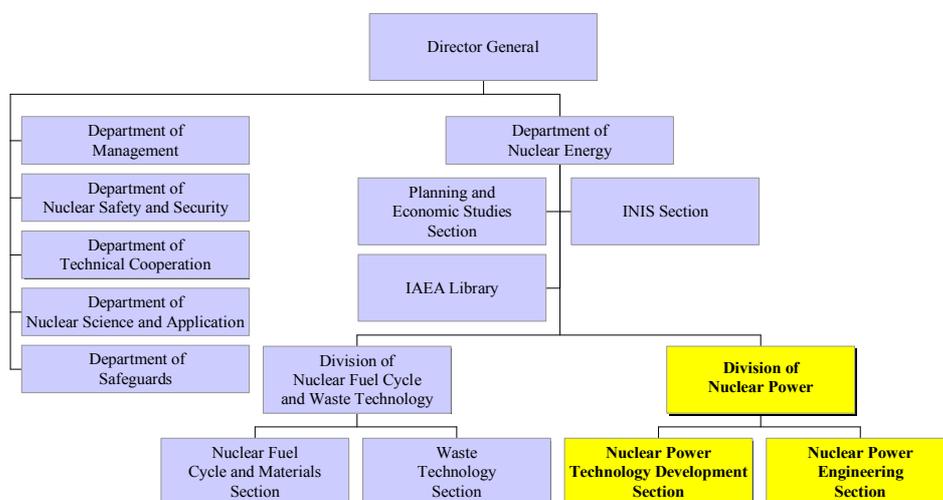
**A newsletter of the Division of Nuclear Power  
Vol. 1, No. 1, September 2004**

<http://www.iaea.org/OurWork/ST/NE/NENP/index.html>

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## Division of Nuclear Power

The Nuclear Power Division of the Department of Nuclear Energy is responsible for implementation of the IAEA programme on Nuclear Power. The mission of the Division is to increase the capability of interested Member States to implement and maintain competitive and sustainable nuclear power programmes and to develop and apply advanced nuclear technologies.

### FOUR SUBPROGRAMMES FOR 2004-2005

During 2004-2005, the mission of the Division of Nuclear Power is carried out under four Subprogrammes:

- Operational Performance Improvement and Life Cycle Management
- Improving Quality Assurance, Technical Infrastructure and Human Performance
- Co-ordination of International Collaboration for the Development of Innovative Nuclear Technologies, which covers the Agency's activities of the International Project on Innovative Nuclear Reactors and Fuel Cycles (INPRO)
- Technology Developments and Applications for Advanced Reactors

## MESSAGE FROM THE DIRECTOR, Mr. A. OMOTO



The major function of the Division of Nuclear Power is to provide support to Member States in establishing, maintaining and strengthening infrastructure for nuclear power and the nuclear fuel cycle. The Division also works to catalyze innovation for sustainable growth, and to assure the continuity and further development of nuclear

knowledge in the light of aging facilities and workforce. The Division works closely with the Division of Fuel Cycle and Waste Technology and the Planning and Economic Studies Section who are both also part of the Department of Nuclear Energy.

Within the Division there are a wide spectrum of activities to assist Member States in utilizing nuclear science and technology in such areas as use of nuclear energy for power generation, desalination and hydrogen generation. It goes without saying that these activities are carried out with due regard to safety, security and non-proliferation.

The Division of Nuclear Power systematically compiles information through various expert meetings, workshops and coordinated research programmes and disseminates the results in the form of Technical Reports, Technical Documents (TECDOCs), or databases as a service for the Member States. However, there always is a concern as to what extent the Agency is responding to the needs of the customers (the Member States) and the level of use of the output from the Division.

Consequently, the Division of Nuclear Power is, in addition to its web site (please see below), sending periodically newsletters to the readers who may benefit from the information contained in it and we would welcome comments or suggestions on these or other activities.

## Important WebSite links

Division Introduction : NENP home: <http://www.iaea.org/OurWork/ST/NE/NENP/index.html>

NENP Meetings: <http://www.iaea.org/OurWork/ST/NE/NENP/meetings.html>

### Nuclear Power Engineering Section (NPES)

<http://www.iaea.org/OurWork/ST/NE/NENP/NPES/index.html>

- Main activities and result  
<http://www.iaea.org/OurWork/ST/NE/NENP/NPES/Activity/index.html>
- Publications and documents  
<http://www.iaea.org/OurWork/ST/NE/NENP/NPES/publications.html>
- Contact persons  
<http://www.iaea.org/OurWork/ST/NE/NENP/NPES/staff.html>
- Databases (PRIS, CNPP, ENTRAC), software (SAT) and downloads  
<http://www.iaea.org/OurWork/ST/NE/NENP/NPES/Downloads/index.html>

### Nuclear Power Technology Development Section (NPTDS)

<http://www.iaea.org/OurWork/ST/NE/NENP/NPTDS/Projects/index.html>

- Databases and software
  - ▶ Fast Reactors Databases:  
<http://www-frdb.iaea.org/index.html>
  - ▶ ADS Databases:  
<http://www-adsdb.iaea.org/index.cfm>
  - ▶ User friendly education with nuclear reactor simulators  
<http://www.iaea.org/OurWork/ST/NE/NENP/NPTDS/Projects/edu.html>
- Active Co-ordinated Research Projects (CRPs)  
<http://www.iaea.org/OurWork/ST/NE/NENP/NPTDS/crps.html>
- Technical Documents Published by NPTDS 1995-2004  
<http://www.iaea.org/OurWork/ST/NE/NENP/NPTDS/docs.html>

# Engineering and Management Support for Competitive Nuclear Power

## NPP PERFORMANCE MANAGEMENT

The NPES has established a CRP on *International Outage Coding System* to develop a general, internationally applicable system of coding NPP outages providing worldwide nuclear utilities with a standardized tool for reporting and learning from outage information.

TECDOC-1393 was published this year and provides information for transformation of the historical outage data into the new coding system. It takes into consideration the existing systems for coding nuclear power plant events (WANO, IAEA-IRS and IAEA PRIS), but avoids duplication of efforts to the maximum possible extent.

The TWG on *NPP Control and Instrumentation* has an active role in the I&C activities of NPES. Developing the following two TECDOCs was recommended by the TWG members. A technical document on *Management of Life Cycle and Ageing at NPPs Improved I&C Maintenance* is in the final preparations and it will be available in 2004. The goal of this document is to provide the latest information on aging, obsolescence, and performance monitoring of those I&C equipment that are classified as safety equipment and/or safety-related equipment, are operated in harsh environments in NPPs, and are important in plant life extension. A second technical document is being prepared on *on-line signal monitoring techniques* to be used for instrument calibration purposes in NPPs. The document provides guidelines for reducing the need for calibrating process instruments such as pressure, level, flow transmitters, resistance temperature detectors and neutron flux detectors via non-intrusive on-line data acquisition and analysis.

## NPP LIFE MANAGEMENT

A new module of the International Database on Life Management of NPPs mainly, International Database on NPP Steam Generators is undergoing. The software is in beta testing.

The decision to extend the life of a NPP (PLEX) is quite complex, involving a number of political, technical and economic issues. The economic viability is a cornerstone of the decision-making process for PLEX. To assist the decision makers addressing the issue, the Agency developed of a PC based computer model aimed to assess the economic effectiveness of PLEX against other options. The software is in beta testing and will be available in the second half of 2004.

A technical guidelines on measuring the best irradiated fracture toughness parameters using relatively small test specimens for assuring structural integrity of reactor pres-

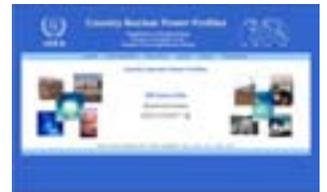
sure vessel (RPV) materials will be available in the second half of 2004. These Guidelines have been written to allow utility engineers and scientists to directly measure fracture toughness using small surveillance size specimens and apply the results using the Master Curve approach for RPV structural integrity assessment in nuclear power plants.

## DATABASES

The Power Reactor Information System (PRIS) covers general and design information on NPPs, data on operating experience with NPPs, including description and performance of non-electrical applications. Currently, the IAEA is also collecting information on NPPs in decommissioning and a project started to compile and collect information on delayed NPPs.



The fifth edition of the Country Nuclear Power Profiles (CNPP) has been issued on CD-ROM, hard copy and web versions and updated the country information. It reviews the organizational and industrial aspects of nuclear power programmes in 36 participating countries and provides information about the relevant legislative, regulatory, and international framework in each country. It compiles the current issues in the new environment of the electricity and the nuclear sector.



A new activity is being launched this year, which deals with the personnel training for decommissioning. Member States, operating organizations, specialized companies and individual experts are invited to participate in the accumulation and dissemination of experience in the training for decommissioning. More detailed information will be placed on the NPES web based Electronic Nuclear Training Catalogue (ENTRAC).

The Nuclear Economic Performance International System (NEPIS) was initiated to achieve the necessary optimization between economic and technical performance in cooperation with the Electric Utility Cost Group (EUCG). The database considers all aspects of economic performance. Currently, three years of data collection are available in NEPIS from 12 Member States and covering about 2/3 of the operating NPPs worldwide.

# Improving Human Performance, Quality and Technical Infrastructure

## QUALITY MANAGEMENT & QA



The 6<sup>th</sup> IAEA- FORATOM joint workshop on *Managing an Aging Workforce and Transfer of Knowledge in Nuclear Installations and Regulatory Bodies* will be convened at Vienna, from 5-7 October, 2004. The emphasis will be on strategy for managing an ageing workforce; knowledge management and

managing an ageing workforce: regulatory aspects.

The IAEA is revising the requirements and guidance in the subject area of Quality Assurance contained within the Safety Series 50-C/SG-Q (1996) into a new Safety Standard on "Management Systems for the Safety of Nuclear Facilities and Activities involving the use of Ionising Radiation". The term "Management System" has been adopted in the revised series of documents instead of the term Quality Assurance/Quality Assurance Programme. This development integrates all aspects of managing a nuclear facility, including the Safety, Health, Security, Environment and Quality requirements into one coherent system. The revision takes into account the ISO standards, which deal with the supplier/customer interface, while the IAEA safety standards address the quality assurance requirements from the regulatory body and deal with the regulatory body/operator interface. The new safety Standard will be published in 2006.

## EFFECTIVE TRAINING TO ACHIEVE EXCELLENCE IN HUMAN PERFORMANCE

A new technical document *The Nuclear Power Industry's Ageing Work Force: Transfer of Knowledge to the Next Generation* (TECDOC-1399, 2004) has been developed that provides information on experiences gained in retaining the knowledge needed to design, operate and maintain NPPs in IAEA's Member States in the context of the ageing nuclear workforce. Information is provided on the transfer of knowledge including lessons learned in nuclear power operating organizations, along with selected examples of management strategies and initiatives. Awareness and use of this information can assist NPPs and training organizations in dealing with challenges of the retirement of the NPP workforce and the recruitment of new personnel.

A new document *Use of Control Room Simulators for Training of NPP Personnel* (IAEA-TECDOC-1411) will be available in 2004. The objective of a new technical report is to provide the NPP managers, training center managers and personnel involved in control room simula-

tor training with information and practical recommendations they can use to improve the performance of NPP personnel. While the emphasis in this report is on simulator training of control room personnel using full-scope simulators, information is also provided on how organizations have effectively used control room simulators for training of other NPP personnel, including simulators other than full-scope simulators.

A technical document *Developing the Instructors for NPP Personnel Training* (TECDOC-1392) has been published in 2004 to provide practical guidance on various aspects of instructor selection, development and deployment, by quoting actual examples from different countries.

A new activity on accumulating and disseminating information on NPP personnel authorization has been launched in 2003. The objective is to disseminate the related good practices through developing the technical document (TECDOC, to be finalized in 2005). This TECDOC can be used by authorizing organizations, regulatory bodies and operating organizations in Member States to establish or improve the authorization process of control room personnel in order to ensure availability of sufficient number of competent personnel for NPP operation. A wide range of actual and useful examples from various countries will be included.

## MANAGEMENT OF PRE AND PROJECT ACTIVITIES

A TECDOC-1390 on *Construction and Commissioning Experience of Evolutionary Water Cooled Reactors* was published in 2004. The document is intended to provide an overview of the most advanced technologies, methods and processes used in construction and commissioning of recent water-cooled nuclear projects. Information from the following recent nuclear projects: Qinshan III Units 1&2 and Lingao Units 1&2 in PR of China, Kashiwazaki-Kariwa Units 6 &7 in Japan, Yonggwang Units 5&6 in Rep. of Korea and Tarapur Units 5&6 in India were collected and analyzed.

A technical document on management strategies and technical approaches to reduce the capital costs of water-cooled reactors is in the final preparations. While focused on capital cost reductions it includes some reported actions aimed at reducing O&M or fuel costs, especially since some actions such as an increase of the availability factor acts favorably on both the capital and O&M component of the kWh cost. There were targeted the new designs expected to be ready by 2005 – 2010, with possible commercial operating date by 2012-2020.

## Co-ordination of International Collaboration for the Development of Innovative Nuclear Technology

The IAEA's INPRO project has reached a milestone in its Phase-IB by finalizing case studies for the validation of INPRO methodology. 14 final reports of 6 national and 8 individual case studies from 7 Member States have been submitted to the Agency. The results of these case studies are being thoroughly analyzed by the International Coordinating Group of INPRO and incorporated into the final report on INPRO methodology by November 2004. A TECDOC on Innovative Fuel Cycle Technologies: Status and Trends is under preparation by INPRO. This TECDOC will summarize the status of innovative nuclear fuel cycles and associated nuclear reactor developments and will provide information to Member States for their assessment of innovative nuclear energy systems (INS) with the updated INPRO methodology during the second part of INPRO Phase-IB. The TECDOC is planned to be submitted for publication by the end of 2004.

A process has been started for the definition of the possible scope of INPRO Phase-II. In cooperation with the Department of Safeguards and Department of Safety and Security, the IAEA/INPRO Secretariat has produced suggestions for more than 20 possible activities, encompassing further development of INPRO methodology in the areas of safety, proliferation resistance, environment, and sustainability, promotion of infrastructure changes to facilitate the deployment of INSs, as well as certain topics for coordinated research under the auspices of the Agency. These suggestions will be reviewed by an Ad Hoc Working Group in October 2004 and then be submitted to the 7th INPRO Steering Committee Meeting in December 2004.

A Coordinated Research Project on Small Reactors Without on Site Refueling (2004-2007) has been established. This CRP has the goal of increasing the capabili-

ties in IAEA Member States to achieve progress in the development and deployment of Small Reactors without On-Site Refueling by formulating requirements and increasing international cooperation for the development of key enabling technologies for such reactors, including long-life cores and passive safety features and systems. Small Reactors without On-Site Refueling are those reactors which have the capability to operate without refueling and reshuffling of fuel for a reasonably long period consistent with the plant economics and energy security, with no fresh and spent fuel being stored at the site outside the reactor during its service life. The CRP on Identification of Competitive Technological Options for Small and Medium Sized Reactors (SMRs) for 2006-2009 has been approved. The CRP will provide a forum for the analysis and development of technological options for SMRs to reduce their costs and to increase their proliferation resistance. The CRP will also provide for dynamic systems simulations of SMR deployment in selected countries or regions for a given scenario of energy growth and the consideration of multinational Fuel Cycles.

On 7-11 June 2004 NPTDS convened IAEA Technical Meeting "Innovative Small and Medium Sized Reactors: Design Features, Safety Approaches and R&D Trends" which was attended by 16 nominated participants from 13 Member States. The meeting has provided a forum for the exchange of information on the state-of-the-art in development, design and demonstration of innovative Small and Medium Sized Reactors (SMRs), on the application potential of SMRs, and on strategies for their development. The presentations at the meeting covered 30 innovative SMR concepts and designs and several INSs based on such reactors.

# Technology Developments and Applications for Advanced Reactors

## TECHNOLOGY ADVANCES IN WATER COOLED REACTORS FOR IMPROVEMENT IN ECONOMICS AND SAFETY

The 11th Meeting of the Technical Working Group (TWG) on Advanced Technologies for LWRs and the 7<sup>th</sup> Meeting of the TWG on Advanced Technologies for HWRs were held with some joint sessions from June 9-11, 2004 at IAEA Headquarters. Each representative presented the current status of water-cooled reactors in their countries, as well as status and future plans for water-cooled reactor technology development. One of the important documents produced as a result of a TWG recommendation is TECDOC 1391, *Status of Advanced LWR Designs: 2004*. This report, issued at the meeting, presents design descriptions of 35 advanced LWR designs. A new CRP, *Heat Transfer Behaviour and*



Artist's concept of the European Pressurized Reactor, planned to be constructed in Finland (Olkiluoto-3). (two existing BWRs, Olkiluoto-1&2, are shown in the background)

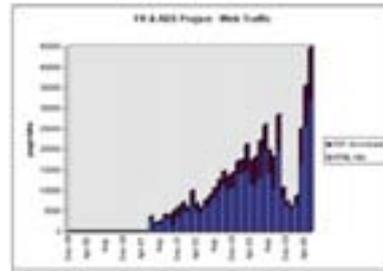
*Thermo-hydraulics Code testing for Supercritical Water Reactors (SCWRs)* is being planned within the frame of activities of the TWG-LWR and the TWG-HWR.

The NPTD Section, working in collaboration with NSNI, has established a CRP on *Natural Circulation Phenomena, Modelling and Reliability of Passive Systems that Utilize Natural Circulation*. The CRP plans to share data contributions from up to 12 different experimental test facilities and to benchmark a variety of thermal hydraulic computer codes used for passive safety system design and performance assessment. This CRP will produce a TECDOC that summarizes the state-of-the-art in natural circulation computation and experimentation and establish a natural circulation and passive safety system database for code assessment. A training course on natural circulation in water-cooled reactors has been convened at ICTP.

Another activity involves the preparation of an internet data base of thermo-physical properties of materials of LWRs and HWRs, including over 1300 data files, resulting from collaboration in the CRP on *Thermophysical Properties of LWR and HWR Materials*. Also in preparation is a TECDOC presenting the new measurements as well as the data assessments conducted during the CRP.

Preparations are underway for the Workshop on NPP Simulators for Education, which will be convened at ICTP, Trieste from 8-19 November, 2004.

## TECHNOLOGY ADVANCES IN FAST REACTORS AND ACCELERATOR DRIVEN SYSTEMS (ADS)



The 37<sup>th</sup> Annual Meeting of the TWG on Fast Reactors (TWG-FR), was held at the IAEA headquarters in Vienna in May 2004. The representatives presented the status of

fast reactor and ADS technology development and research activities in their Member States, and reviewed TWG-FR's ongoing and planned information exchange and collaborative R&D activities. Among the highlights, are two ongoing CRPs on *Updated Codes and Methods to Reduce the Calculational Uncertainties of the Liquid Metal Fast Reactors Reactivity Effects* and on *Studies of Advanced Reactor Technology Options for Effective Incineration of Radioactive Waste*, and the upcoming TM on *Utilization of MONJU for International Cooperation in Fast Reactor R&D* (1-2 Dec. 2004, hosted by JNC in Tsuruga, Japan). Three new CRPs are being planned: *Comparative Assessments of the Performance of Various Thorium-based Reactor and Fuel Cycle Concepts*, *Analytical and Experimental Benchmark Analyses of Accelerator Driven Systems*, and (as part of the Agency's fast reactor knowledge preservation initiative) *Analyses of and Lessons Learned from the Operational Experience with Fast Reactor Equipment and Systems*.

## TECHNOLOGY ADVANCES FOR GAS COOLED REACTORS

High-Temperature Gas-cooled Reactors (HTGRs) continue to attract international interest, claiming features of enhanced safety & competitive economics. The IAEA related activities include collaborative research, information exchange and educational training. In the area of collaborative research, two CRPs are ongoing, one on *HTGR performance evaluation*, where core physics and thermal-hydraulic codes are benchmarked against each other as well as against experimental data and the second CRP focusing on *advances in coated fuel particle technology*. In the area of information exchange, the IAEA is cooperating with the European HTR-Network on the second international conference on high-temperature reactors (HTR-2004), scheduled in September 2004 in Beijing, China. In the area of educational training, a workshop on safety demonstration and market potential of HTGRs is also scheduled at Tsinghua University, Beijing, China in September 2004. More information can be found at [www.iaea.org/htgr](http://www.iaea.org/htgr)

## SUPPORT FOR DEMONSTRATION OF NUCLEAR SEAWATER DESALINATION

The CRP on *Optimization of the Coupling of Nuclear Reactors and Desalination Systems* ended last year. The studies from the participating institutes outlined details of optimum coupling of SMRs (PWR, PHWR, fast reactors, heating reactors and floating reactors) with desalination systems, based on thermal, membrane and hybrid processes. A draft of the TECDOC is being reviewed.

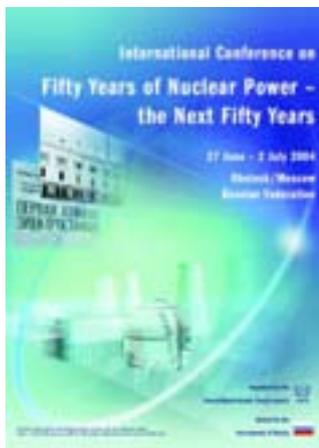
Under the inter-regional technical cooperation project INT/4/134 on nuclear desalination, three activities were taken up. The third and final Progress Review Meeting of the Indonesian project was held in February 2004 at Vienna. The final draft of the “*Preliminary economic feasibility of nuclear desalination in Madura Island*” and the “*User requirement document*” submitted by BATAN and KAERI were reviewed and modifications suggested dur-

ing the meeting. Under the framework of TC Project INT/4/134, an International Workshop on *Techno-economic aspects of nuclear desalination* will be held on September 27-30, 2004 at Jakarta. The Tundesal project between France and Tunisia for the La Skhira site also made progress towards preparation of final report. Expert missions were provided for the Pakistan national project of setting up a demonstration desalination plant at KANUPP. Work is continuing on the project EGY/0/046 for the simulation of nuclear desalination plant.

An Expert Panel Meeting for Programme Evaluation of project was held in May 2004. The Panel report was presented at the INDAG meeting held in July 2004 for follow-up actions. A TM on “*Integrated Nuclear Desalination Systems*” is to be held at Kalpakkam on December 13-16, 2004. The experiences of the existing and planned demonstration projects from the Member States will be shared in the meeting.

## The International Conference on “Fifty Years of Nuclear Power - the Next Fifty Years”

The International Conference on “Fifty Years of Nuclear Power - the Next Fifty Years”, was inaugurated in Moscow on 27 June 04, by the Prime Minister of the Russian Federation and the Director General, IAEA. The technical part of the conference continued in Obninsk from 28 June to 2 July 2004. The conference highlighted the mature stage reached by nuclear power, and several countries considered it as vital to their energy sector. There was significant support for the continuation of innovation in technology and infrastructure. Developments in spent fuel recycling, the use of fast reactors and the technol-



ogy of waste management were considered important to enhance nuclear contribution over the next fifty years.

Communication with the public and decision makers needs to be improved through a greater openness and provision of objective data about the issues that are of concern to the public. The conference noted the need to maintain the option to adopt nuclear energy for those countries that wish to do so. To achieve this, issues such as economics and infrastructure developments in comparative risk assessments were identified by conference participants as areas requiring further effort.

Further details of the conference, the Director General's speech in Moscow, and the summary conclusions of the Conference, can be found on the web site or home page.

## Recent Publications

### Year 2004

IAEA-TECDOC-1411	Use of Control Room Simulators for Training of NPP Personnel
IAEA-TECDOC-1406	Primary Coolant Pipe Rupture Event in Liquid Metal Cooled Reactors
IAEA-TECDOC-1405	Operational and Decommissioning Experience with Fast Reactors
IAEA-TECDOC-1400	Improvement of In-Service Inspection in Nuclear Power Plants
IAEA-TECDOC-1399	The Nuclear Power Industry's Ageing Workforce: Transfer of Knowledge to the Next Generation
IAEA-TECDOC-1393	International Outage Coding System for Nuclear Power Plants
IAEA-TECDOC-1392	Development of Instructors for Nuclear Power Plant Personnel Training
IAEA-TECDOC-1391	Status of Advanced LWR Designs: 2004
IAEA-TECDOC-1390	Construction and Commissioning Experience of Evolutionary Water Cooled Nuclear Power Plants
IAEA-TECDOC-1389	Managing Modernization of Nuclear Power Plant Instrumentation and Control Systems
Reference Data Series 2/23	Nuclear Power Reactors in the World, Reference Data Series No. 2
n/a	Operating Experience in NPP in Member States in 2003
n/a	Country Nuclear Power Profiles 2003 Edition

### Year 2003

IAEA-TECDOC-1382	Evaluation of the High-Temperature Gas Cooled Reactor Performance: Benchmark Analysis Related to Initial Testing of HTTR and HTR-10
IAEA-TECDOC-1365	Review of National Accelerator Driven System Programmes for Partitioning and Transmutation
IAEA-TECDOC-1362	Guidance for the Evaluation of Innovative Nuclear Reactors and Fuel Cycles. Report of phase 1A of the International Project on Innovative Nuclear Reactors and Fuel Cycles (INPRO)
IAEA-TECDOC-1356	Emerging Nuclear Energy and Transmutation Systems: Core Physics and Engineering Aspects
IAEA-TECDOC-1349	Potential of Thorium-Based Fuel Cycles to Constrain Plutonium and Reduce the Long-Lived Waste Toxicity
IAEA-TECDOC-1348	Power Reactor and Sub-Critical Blanket Systems with Lead and Lead-Bismuth as Coolant and/or Target Material
STI/PUB/1174	Operating Experience in NPP in Member States in 2002
IAEA-TECDOC-1335	Configuration Management in Nuclear Power Plants
IAEA-TECDOC-1358	Means of Evaluation and Improving the Effectiveness of Training of Nuclear Power Plant Personnel
IAEA-TECDOC-1364	Managing Human Resources in the Nuclear Power Industry
IAEA-TECDOC-1383	Guidance for Optimizing Nuclear Power Plant Maintenance Programmes
Training Course Series 23	Boiling Water Reactor Simulator: Workshop Material
Training Course Series 22	Pressurized Water Reactor Simulator: Workshop Material
Reference Data Series 2/22	Nuclear Power Reactors in the World, Reference Data Series No. 2
CD Series No. 21	Nuclear Power Plant Life Management


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