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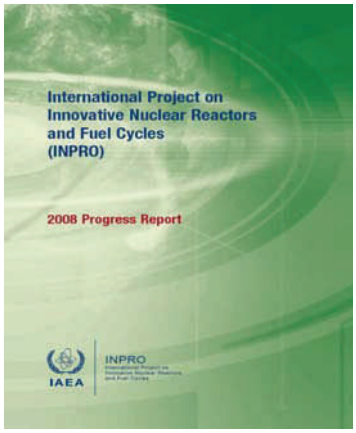
Beijing International Ministerial Conference on Nuclear Energy in the 21st Century

The IAEA organized an International Ministerial Conference on Nuclear Energy in the 21st Century in Beijing, China, from 20 to 22 April 2009. The conference allowed participants to discuss developments and emerging issues relevant to the role of nuclear power in providing clear and sustainable energy for national and regional development. It provided an opportunity to review the status and prospects of nuclear power including progress in the evolution of technology and to discuss the necessary actions to carry forward the positive momentum that nuclear power has witnessed in recent years. It also offered a forum for many countries considering the potential benefits of introducing nuclear power in their national energy mix to further assess the viability of the nuclear power option. *Read more on page 15*



INPRO Steering Committee Determines Future Directions

At its 14th meeting, the Steering Committee of the International Project on Innovative Nuclear Reactors and Fuel Cycles (INPRO) welcomed the re-structuring of INPRO activities presented in the Project's 2010-2011 Action Plan. The IAEA Deputy Director General, and INPRO Project Manager, Mr. Yuri Sokolov introduced the Project's new organizational structure.

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Construction Technology for New Nuclear Power Plants

Long construction periods for nuclear power plants are no longer the norm. One of the activities currently pursued at the Agency in support of the worldwide nuclear renaissance is a comprehensive study reviewing current conventional and advanced construction technologies and their potential application to new nuclear power plant construction.

Read more on page 2

Message from the Director

In 2005, the Paris Conference on Nuclear Power, organized by the IAEA in cooperation with OCED/NEA, had a significant impact on the world by providing an opportunity to think about nuclear power and its potential to help meet growing energy needs. The IAEA has seen this impact by the increasing number of countries considering embarking on nuclear power programmes and we defined 2006 as the year of rising expectations. Four years later, the experience of soaring fossil fuel prices and growing concern over the environment has driven many countries not yet operating nuclear power programmes to consider nuclear energy as a viable option, to the point that the number of these new comer countries now stands at more than 60. The Beijing Conference on Nuclear Power in 2009 confirmed this upward trend. Likewise, NENP is experiencing a significant increase in the number of Technical Cooperation projects to assist new entrants in the introduction of nuclear power. This year, the number of such projects in which NENP is acting as technical officer has tripled in comparison with 2008.

As a result of this growing emphasis on assisting newcomer countries, the NENP Newsletter's role is also expanding. Naturally, the number of readers is increasing and it is becoming more important for the Newsletter to clearly and concisely communicate "what the IAEA is accomplishing". As I had mentioned in the previous issue, we are striving to change our reporting style to convey more defined descriptions of our work and to focus more on the results achieved through the IAEA's activities rather than simply stating information on the method. The change is still in process; however, we are determined to continuously improve the quality of information that we are providing with each issue. Your feedback is always welcome and we look forward to hearing your comments and suggestions.

This June issue follows our new editorial direction as much as possible. In addition, we have highlighted more information on forthcoming conferences, major meetings and symposia, although we do not cover all the meetings. We hope that you find our new approach effective and we welcome and greatly appreciate your feedback.

Construction Technology for New Nuclear Power Plants

The length of the construction and commissioning phases of nuclear power plants have historically been longer than for conventional fossil fuelled plants, often having a record of delays and cost overruns as a result from several factors including legal interventions and revisions of safety regulations. Recent nuclear construction projects however, have shown that long construction periods for nuclear power plants are no longer the norm. While there are several inter-related factors that influence the construction time, the use of advanced construction techniques has contributed significantly to reducing the construction length of recent nuclear projects.

Lifting the dome module into place at Lingao-4 in China

One of the activities currently pursued at the Agency in support of the worldwide nuclear renaissance is a comprehensive study reviewing current conventional and advanced construction technologies and their potential application to new nuclear power plant construction. The project covers technologies that are generally used for large civil construction projects, not unique to the nuclear industry or to any specific nuclear plant design. The study incorporates the experiences and insights from recent nuclear construction projects all over the world, and provides a discussion of the advantages and disadvantages of each of these techniques from various points of view, such as capital and construction costs, schedule and quality assurance.

The construction methods available for new nuclear power plants are generally the same as those used for other large construction projects. There have been numerous improvements in the construction methods used

for large construction projects in the last few years, and the recent experience in nuclear plant construction has shown that those advanced methods are fully applicable and can help shorten the construction schedule. Recent nuclear construction projects have achieved schedules as short as four years. For some construction methods, the decision whether to apply them should be made in the conceptual design stage, and then must be followed throughout the project. In some cases, although advanced construction methods reduce labour costs at the construction site, they require earlier investments for factories and workshops, and earlier outlay of funds to purchase materals. Therefore achieving a shorter schedule does not necessarily imply reduced total cost. However, recent experience has made it clear that short and efficient construction schedules can be achieved for new nuclear plants through use of advanced construction methods and an integrated approach to the management of the design, procurement, installation and testing.

A consultant meeting with a core group of experts from Canada, India, Japan, Republic of Korea, South Africa and the United States of America was convened in Vienna on April 27-30, 2009 with the objective to finalize the draft NE Series document on Construction Methods for Nuclear Power Plants that compiles the results of this study. This draft document will be reviewed by a larger group of construction experts from all over the world in another consultancy meeting that will take place in Vienna on June 9-12, 2009. In addition, a preliminary summary of this study was included in latest issue of Nuclear Technology Review 2009.

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Instrumentation and Control System Technologies

Advanced Surveillance, Diagnostics, and Prognostics (SDP) Techniques used for Health Monitoring of Systems, Structures, and Components in Nuclear Power Plants with the purpose of meeting the needs for advanced surveillance, diagnostics, and prognostics to support existing plants, their life extensions, their power uprates, and future plant designs. As an increasing number of NPPs are going through power uprates and renewals of their operating licence, the deployment of additional SDP techniques at the NPP is necessitated. Similarly, advanced SDP techniques can be incorporated in new NPP designs as an integral part of their I&C systems. In a recent CRP meeting, the working materials and task definitions were further developed by an international group of 36 experts from 12 countries. The meeting was held on 1-3 April 2009 in Knoxville, Tennessee, USA, hosted by the Analysis and Measurement Services Corporation.

Research needs were identified in the following four technical areas:

- Reactor signal noise analysis, including data collection, signal processing systems, interpretation of noise measurements, and presentation of results to end-users.
- Acoustic and vibration monitoring methods and systems, including loose part monitoring and leakage detection.
- Prognostics for structural integrity and material degradation, including identification of measurable parameters that are sensitive to certain degradation mechanisms.
- Instruments and equipment condition monitoring, including on-line monitoring, statistical analysis, new sensing and data transfer techniques.

The results of the CRP are expected to be published in an NE Series Report at the completion of the project. Also, recommendations to utilities and regulatory bodies will be available regarding the implementation and maintenance of SDP systems. Technology gaps will be identified to which universities, research institutes, and utilities can direct future development to improve the capabilities of SDP techniques.

22nd Meeting of the IAEA Technical Working Group on NPP I&C

The Technical Working Group on Nuclear Power Plant Instrumentation and Control (TWG-NPPIC) is a group of experts providing advice and support programme implementation, reflecting a global network of excellence and expertise in the area of instrumentation and control, human-machine interface, on-line condition monitoring, and modernizing obsolete I&C systems in nuclear power plants. The Technical Working Group met on 20-22 May 2009 in the Vienna International Centre, with the following objectives:

- Exchanging information on national and international

- I&C programmes in NPPs;
- Advising the IAEA and giving recommendations on future activities related to NPP I&C; and
- Reviewing and further developing the draft of the Nuclear Energy Series Report on "Core Knowledge on Instrumentation and Control Systems in Nuclear Power Plants".

Twenty-seven experts from twenty-one countries attended the advisory group meeting. Their presentations and the follow-up discussion covered a wide range of relevant issues of NPP I&C. Their recommendations to IAEA were compiled and prioritized. In addition to the I&C field, IAEA staff presentations were made on related areas, such as cyber security, nuclear safety, nuclear knowledge management, plant life management, and human resources and training.

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Nuclear Power Plant Life Management for Long Term Operation

VERLIFE — The Lifetime Assessment Procedure for WWER NPPs

The first technical meeting to upgrade the current VERLIFE procedure was held from 11-13 March at NRI, Czech Republic and was focused on developing a road map for the entire 2009-2011 project duration. VERLIFE is the unified procedure that has been created within the European Commission Framework Programme and provides a methodology for the lifetime assessment of components and piping in NPPs with WWER (water cooled water moderated power) type reactors during their operation from the point of view of fast failure caused by non-ductile and ductile fracture, fatigue and mechanical corrosion damage under operational conditions.

Meeting participants proposed six new appendices to be developed for the procedure through a series of technical and small working group meetings. The Nuclear Research Institute in Rez, Prague, Czech Republic (NRI) will summarize all comments and prepare a revised version of VERLIFE for the discussion at the second technical meeting, planned in March 2010. A unified database of fracture toughness will be created and NRI will prepare and distribute a format for such data collection.

VERLIFE is based on former Soviet/Russian rules and codes applied during design and manufacturing of components and piping of WWER-type reactors and also incorporates some approaches used in PWR codes and rules. This procedure is not intended to replace the national legislative documents. However, VERLIFE suggests modern, applicable procedures for component integrity assessment and remaining lifetime evaluation for WWER-type plants.

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Meeting Held on Life Management of NPPs

The bi-annual technical working group on life management (TWG – LM NPP) meeting to summarize and to discuss developments in the Member States (MSs) in field of plant life management for long-term operation of nuclear power plants (NPPs) was held in March 2009. Nineteen members from 16 countries attended.

The TWG-LM NPP provided the IAEA with its recommendations for the next time period from 2012-2013. For potential tasks to be implemented in 2012-2013, all recommendations were summarized and divided into five categories as follows: 1) Programme Aspects, 2) Technological Aspects, 3) Human Resource Management Aspects, 4) Regulatory Aspects and 5) 3rd international PLiM symposium in 2012. The conclusions of TWG meeting were:

- The ageing of NPPs remains a major issue concerning utility decisions for 60 years' long-term operation.
- Not only systems, structures and components (SSCs), but also the ageing workforce (knowledge transfer issues) is of the highest importance.
- It is essential to determine safety criteria appropriate to assess a potential service life extension to the non-replaceable systems, structures and components (SSCs).
- Containment integrity and cable ageing management are becoming increasingly important issues.
- The national reports indicated that the plant life management programme (PLiM) will create conditions favorable to safe long-term operation.

TWG-LM NPP elected unanimously that Mr. G. Young from the USA will take over the chair for the next 4 years.

Significance of Pressurized Thermal Shock to Reactor Pressure Vessel Integrity

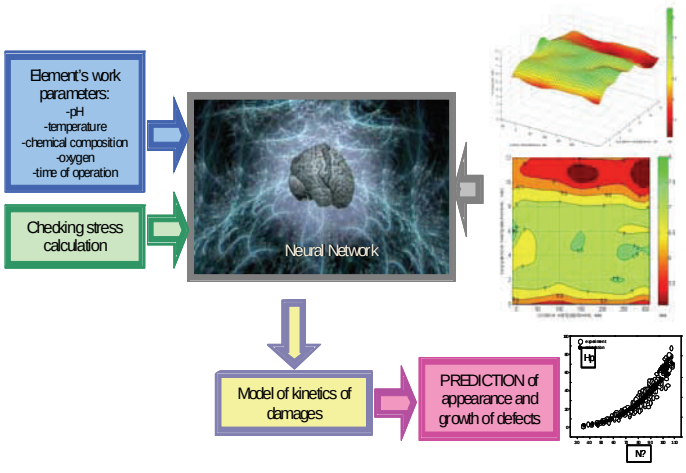
In recent years, major attention and priority have been given to the class of challenges to reactor pressure vessel (RPV) known as pressurized thermal shock

(PTS). Whereas many technical documents have been published to handle various key technical aspects of assessment methodologies and regulatory approaches to PTS evaluations, TRS is intent to issue a comprehensive technical document on state-of-the-art technology in the PTS area. To meet this intent, TRS has the following objectives: 1) provide a clear description of the phenomenon known as PTS, 2) identify circumstances in light water reactor (LWR) systems that might lead to PTS transients, 3) describe the process necessary to evaluate the significance of PTS transients, 4) provide an overview and compare national approaches to RPV integrity assessment for PTS transients, and 5) provide a synthesis of current practice and unifying themes in assessments methods.

Erosion-Corrosion in Nuclear Power Plants

After the 2005 workshop on Flow Accelerated Corrosion (FAC) held in Vienna, the IAEA recognized that Erosion-Corrosion (E/C) including FAC and Environmentally Assisted Cracking (EAC) are significant ageing degradation mechanisms for various types of safety components in nuclear power plants. FAC/EAC is now considered one of the important issues to be addressed in order to predict remaining service life and confirm the structural integrity of components as part of the safety assessment for plant life management and safe long-term operation. In this regard, the IAEA organized a technical meeting 21~23 April 2009 in Moscow, Russian Federation, which was hosted by the JSC Concern Energoatom and 80 specialists from 19 countries attended. All presentations were focused on:

- Mechanism of E/C and prevention approaches of equipment and pipelines in NPPs.
- Control and diagnostic activities for mitigation of E/C.
- On-line monitoring crack/leakage in equipment and pipelines.



Application of Neural Networks for E/C Prediction

During the panel discussion, six topics were discussed:

- Defect detection in dissimilar metal joints.
- Cost reduction of repair activities equipment and pipelines repair activities in NPPs.
- Commercial software benchmarking analysis.
- Uncertainty of the NDE test.
- Chrome in steels is effective for FAC control under the conditions where magnetite forms and the FAC rate decreased as the Chrome content of the steel was increased for all the de-aerated conditions.
- Local mass transfer and entrance effects.

Three prediction programmes, COMSY developed by Areva-NP, BRT-CICERO™ developed by EDF, and RAMEK 1 developed by Geoterm-EM were introduced to prevent E/C of equipment and pipelines in NPPs. Also, artificial neural networks for E/C prediction was suggested.

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Support to Member States on Infrastructure for Nuclear Power

Supporting Latin American and Caribbean Countries Contemplating New Nuclear Programmes

The new IAEA TC regional project RLA0038 "Supporting the Introduction of Nuclear Energy (ARCAL XCV)" was kicked off in March 2009. The ten countries currently involved in the project (Bolivia, Chile, Dominican Republic, Ecuador, El Salvador, Haiti, Jamaica, Peru, Uruguay and Venezuela) had approached the Agency for guidance to better understand the requirements, pre-requisites, and other legal, financial, technical and prerequisite obligations which are associated with the decision to embark on a nuclear power programme. In particular, this project seeks to promote regional cooperation among the Latin American and Caribbean Member States in the area of development and deployment of new nuclear power programmes and facilitate the exchange of information and experience about national approaches among the participating countries. An ambitious work plan for the 2009-2001 triennium was established during the first coordination meeting, including both IAEA sponsored training and workshops as well as internal ground work at each one of the Member States.

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Growing interest to ENTRAC

Several information resources are maintained by the IAEA to provide for preservation and transfer of information and knowledge. One of those is ENTRAC http://entrac.iaea.org/ – a resource that is actively used by the industry managers and specialists as well as by young generations.

ENTRAC is maintained by the IAEA Division of Nuclear Power to provide nuclear industry specialists with information that help them and their organizations to continually improve and learn from others. ENTRAC contains information collected by both the IAEA and nuclear industry organizations in many areas of nuclear sector such as reliable supply of competent workforce; personnel training; human performance improvement; integrated management systems; various phases of a nuclear facility life cycle including design, construction and commissioning, operation and decommissioning; infrastructure for the nuclear power sector and new builds; and nuclear power engineering and technology. The interest to ENTRAC significantly increased during last three years.

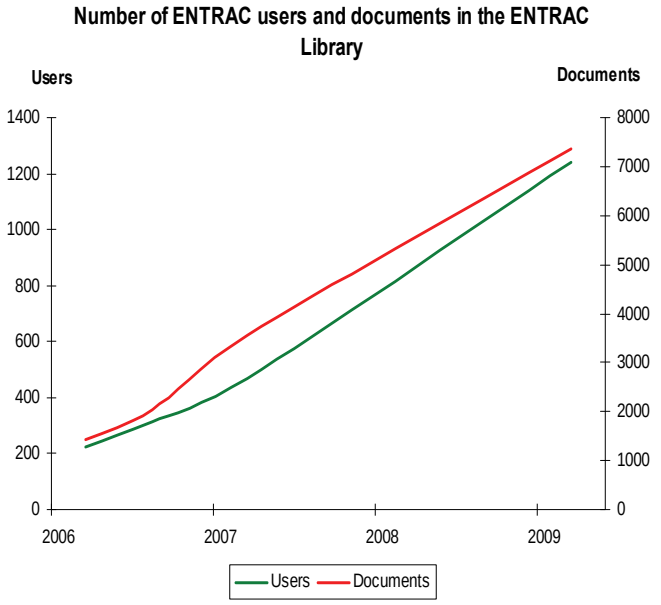
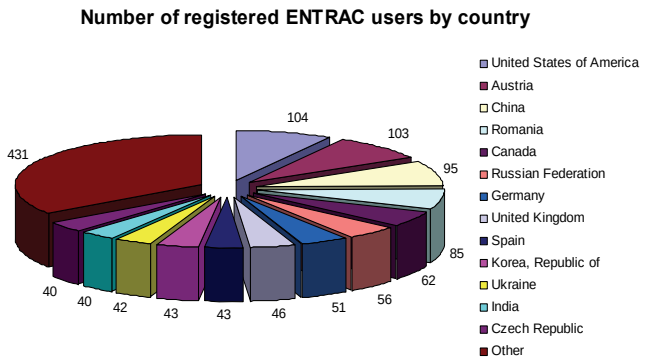


Fig. 1. ENTRAC Users and Library

The ENTRAC's library; information on the training courses and meetings; collection of useful web links; and effective search mechanism provide a framework for networking the ENTRAC users and sharing experience (Fig 1). Unique knowledge from various workshops and projects is being preserved and used by



regulatory bodies, technical support and training organizations, academia and universities, R&D organizations, suppliers, governmental agencies and international organizations in many countries.

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Guidance for Nuclear Facility Personnel Training

Training is one of important measures to achieve and maintain the required competence of various categories of nuclear facility personnel, including nuclear power plants, and one of important activities in the framework of overall Management System to improve organizational and human performance of a nuclear facility. It is vitally important to have proven and effective training methodology based on actual experience.

The IAEA publication Technical Reports Series No. 380 'Nuclear Power Plant Personnel and its Evaluation. A Guidebook' was published in 1996. Since then the nuclear industry has accumulated valuable experience in the field of personnel training; therefore a new publication 'Nuclear Facility Personnel Training' within the IAEA Nuclear Energy Series is being prepared, that will supersede Technical Reports Series No. 380. This new publication will serve for ensuring quality and reliable training of all main categories of nuclear facility personnel, and will bring to the IAEA Member States the best and updated world-wide practices in the use of a systematic approach to training (SAT) that is recognized a method for producing fully auditable training programmes, and also recognized as a tool for integrating training in the overall process of performance improvement. Those organizations and industry professionals interested to contribute, please contact us.

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INIR: The New IAEA Peer Review Service

The Integrated Nuclear Infrastructure Review (INIR) service (see Nuclear Power Newsletter, Vol. 6, No. 1,

March 2009 / page 6) provides for external peer review missions conducted by the IAEA upon request from a Member State. The objective of the INIR missions is to evaluate the overall status of the national nuclear infrastructure development. A recent IAEA brochure published in March 2009 gives guidance on preparing and conducting INIR missions. It includes the main activities undertaken by the Team Leader and Team Members responsible for implementing INIR missions.

The scope comprises the mission setting-up, preparatory activities, review approach, conduct and reporting. While the intended users of the guidance are the IAEA staff and external experts assigned to the INIR missions, it may also be useful to the requesting Member State for making the necessary country arrangements for the review.

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Alternative contracting and ownership policies for NPPs

Some Member States expressed interest in using Build-Own-Operate (BOO) or Build-Own-Operate-Transfer (BOOT) contracts for ownership and operation of first nuclear power plants, but these practices have not been used widely, if at all, in the nuclear field. A consultant meeting held on 25-29 April 2009 discussed some of the issues associated with BOO/BOOT, as well as regional ownership and leasing arrangements for nuclear power plants. Member States who are considering using these arrangements, who have some experience with non-nuclear BOO/BOOT projects, as well as finance, legal, and regulatory experts, participated at the consultancy. The consultancy produced a draft outline for a report to be prepared by the end of 2009.

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Coordination of infrastructure assistance

A consultant meeting held from 7-8 May 2009 explored ways for the IAEA to assist in the coordination of assistance to countries introducing nuclear power. Member States are providing bilateral assistance with infrastructure development, and in order to maximize the benefits to the recipients of this and IAEA technical cooperation assistance, the consultants considered proposals for how to coordinate. Sharing information about recipients' needs, gaps, and on-going bilateral cooperation are the basis for IAEA coordination efforts. The results of infrastructure self-assessments and Integrated Nuclear Infrastructure Review (INIR) missions contribute to set a base line of a Member State's infrastructure status. The IAEA is launching an internal database on a country nuclear infrastructure profile to better integrate the information that it receives regarding Member States' planning for nuclear power introduction.

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Invitation and Evaluation of Bids for Nuclear Power Plants

Member States participating in a technical meeting held in June 2009 to review the Nuclear Energy Series Report on *Invitation and Evaluation of Bids for Nuclear Power Plants* (NPP) shared their experiences, good practices and lessons learned on this subject. The main objective of this report is to provide integrated and updated practical guidance on bid invitation specification, and technical and economic evaluation of bids for nuclear power plants. Target users of this future publication are decision makers, advisers, senior managers and staff involved in the bidding process in government, utilities, and industrial organizations in countries initiating or expanding nuclear power programmes. Member States with experience in international bidding of NPPs and those who are considering using the bidding process to launch an NPP participated, as well as suppliers.

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International Project on Innovative Nuclear Reactors and Fuel Cycles (INPRO)

INPRO Steering Committee Determines 2010–2011 Directions

A review of progress and future directions for the International Project on Innovative Nuclear Reactors and Fuel Cycles (INPRO) were on the agenda of the Project's Steering Committee (SC) at its 14th meeting in February 2009. INPRO provides a forum for discussion and cooperation on developing and deploying, in a sustainable manner, innovative nuclear energy systems in the 21st century (see **www.iaea.org/INPRO**).

Highlighting changes and achievements of the past years, IAEA Deputy Director General and INPRO Project Manager Mr. Yuri Sokolov introduced a new organizational structure of the Project, including new positions of INPRO Group Leader (Mr. R. Beatty) and Programme Liaison Officer (Mr. P. Gowin). He also presented the first-time publication of an INPRO progress report and introduced the draft INPRO action plan for 2010-2011, which the Steering Committee discussed and approved in draft form. The action plan is to be finalized and will be presented at the next SC meeting in November 2009.

New organizational chart of INPRO as of 2008

Currently 30 countries are members of the project, with another ten countries participating on a working level or as observers. Further countries have pledged interested in becoming members. INPRO is funded mostly by voluntary contributions of INPRO Member States.

Recently the Russian Federation decided to provide financial support to INPRO for another five years. INPRO is working in cooperation with other international projects such as the Generation IV International Forum (GIF), the Global Nuclear Energy Programme (GNEP) and the European Sustainable Nuclear Energy Platform (SNETP) to ensure that each of the projects are complementary and synergetic.

Major INPRO achievements to date have been the development and application of the INPRO methodology, and collaborative projects on scenarios for nuclear energy development, nuclear safety, proliferation resistance, technical challenges in reactor technologies, and environment and infrastructure.

Restructuring INPRO Activities

The INPRO Steering Committee supported the proposed consolidation and re-structuring of INPRO activities into four programmatic areas:

A: Nuclear Energy System Assessments (NESA) Using the INPRO Methodology

To assist Member States in performing Nuclear Energy System Assessments (NESA) using the INPRO methodology, in support of long-term strategic planning and nuclear energy deployment decision making.

B: Global Vision

To develop global and regional nuclear energy scenarios, on the basis of a scientific-technical pathway analysis that lead to a global vision on sustainable nuclear energy development in the 21st century, and to support Member States in working towards that vision.

C: Innovations in Nuclear Technology

To foster collaboration among INPRO Member States on selected innovative nuclear technologies and related R&D that contribute to sustainable nuclear energy.

D: Innovations in Institutional Arrangements

To investigate and foster collaboration on innovative institutional and legal arrangements for the use of innovative nuclear systems in the 21st century and to support Member States in developing and implementing such innovative arrangements.

A cross-cutting area is the ***INPRO Dialogue Forum*** which brings together technology holders, users and newcomers to discuss and share information on desirable innovations, long-term nuclear energy planning strategies and the global nuclear energy system.

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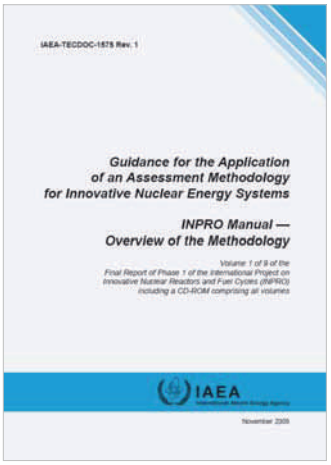
New INPRO Publications

Nuclear Energy Systems Assessments (NESA) Using the INPRO Methodology

The INPRO methodology is suitable for countries with established nuclear programmes to assess existing and future innovate energy solutions, and by countries that want to embark on a new nuclear programme. Member States can assess their existing or planned nuclear energy systems for sustainability in seven areas: ***economics, infrastructure, waste management, proliferation resistance, physical protection, environment (impact of stressors and resource depletion) and safety***.



So far, the INPRO methodology was applied successfully in six national assessment studies in Argentina, Armenia, Brazil, India, Republic of Korea and Ukraine, and in a joint study involving Canada, China, France, India, Japan, the Republic of Korea, the Russian Federation and Ukraine. Other countries have expressed interest to undertake national studies to assess their energy systems, so-called **Nuclear Energy Systems Assessments (NESA)**. The INPRO methodology is now fully documented in an IAEA publication (TECDOC 1575 rev1) with one summary volume (printed) and nine volumes attached on CD-ROM.

Lessons Learned from NESA

At a recent TC workshop on NESAs, the above eleven countries which had participated in assessment studies, agreed that using the INPRO methodology was a "*worthwhile effort and provided valuable insights, and clear identification of gaps in nuclear power development or installation programmes, leading to follow-up actions.*" The studies represented both technology users and developers and different levels of assessments, covering a complete nuclear energy system with all facilities, or specific components of an nuclear energy system, assessing all seven areas of a NESA, or a limited number of areas, and achieving different depths of evaluation, i.e. an assessment of each INPRO criterion, or a scoping assessment at the INPRO basic principle or user requirement level.

Contributions of the workshop participants helped to finalize an IAEA document on Lessons Learned from Nuclear Energy System Assessments (NESA) Using the INPRO Methodology which summarizes the results of the completed assessments.

News from INPRO Collaborative Projects

Ukraine Enhances Participation in GAINS Project

Ukraine has been an active member in INPRO since the country joined the project in 2005. Evaluating the sustainability of the country's energy system, Ukraine performed a national study on innovative nuclear energy systems during the past couple of years, and came to the conclusion that the closed nuclear fuel cycle would be a viable option to solve problems of uranium supply and high-level waste.

With this in mind, in 2008, Ukraine joined one of the INPRO Collaborative Projects which specifically studies the closed nuclear fuel cycle:

Global architecture of innovative nuclear energy systems based on thermal and fast reactors including closed fuel cycles; (GAINS)

This collaborative project is developing a methodological platform to assess future nuclear energy systems in compliance with requirements of sustainable development, and validate results by sample analyses.

Recently, relations between the Ukrainian team and the IAEA were strengthened when energy experts of the Ukrainian Ministry of Fuel and Energy of Ukraine, managers of the state-owned company ENERGOATOM and IAEA representatives from the INPRO Secretariat and the IAEA Planning and Economic Studies Section met in Kiev to discuss the role of nuclear power in Ukraine's energy mix, and reactor types and associated fuel cycles that would best fit the country's situation. Since the IAEA provides assistance in applying the INPRO methodology and computer-supported tools to evaluate all options for long-term energy development, the kind of support that would benefit the Ukraine was also discussed.

The Ukraine will enhance its participation in the GAINS collaborative project. This will include estimates of national nuclear electricity consumption and generation for the period up to 2100, developing scenarios of nuclear deployment based on thermal and fast reactors, and modeling them using IAEA tools.

It is planned to review the scenarios to assess if they comply with criteria of sustainable nuclear energy development, using the INPRO methodology. The final aim is to identify an optimal balance between national efforts and multilateral cooperation.

The Ukraine is also considering a revision of some aspects of the nuclear energy system assessment (NESA) using the INPRO methodology, which was carried out between 2006 and 2008.

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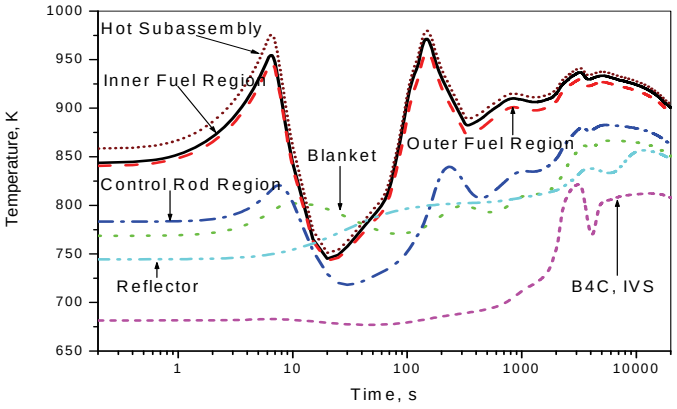
Progress in Benchmarking the Decay Heat Removal System of Liquid Metal Reactors

In 2008, China, India, Republic of Korea, Russian Federation and the European Commission launched an INPRO Collaborative Project (CP) to develop and benchmark computer codes to analyze the decay heat removal (DHR) function of liquid metal cooled reactors. Recently, preliminary results and calculations were discussed in a meeting held at the Indira Gandhi Centre for Atomic Research (IGCAR) in Kalpakkam, India. All CP participants modeled the DHR System with codes available in their countries taking into account the assumptions and boundary conditions agreed and documented, and using empirical correlations of their choice for calculating specific phenomena. Additional development of the codes and correlations is also part of this CP.

The Korea Atomic Energy Research Institute (KAERI) used the MARS-LMR code (1D, transient, two-fluid model for two-phase flows), adapting the thermal hydraulic LWR code MARS to the characteristics of a FR system cooled by sodium. The values in steady state were reproduced and the transient conditions for loss-of-offsite-power were calculated for the case where the inter-wrapper flow is not considered. Four hours were calculated in total with the transient starting at 5000 s. The figure below illustrates the sodium temperature at the core outlet during the transient.

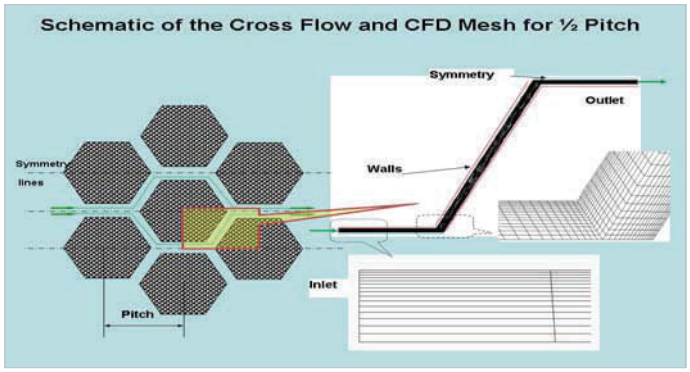


Sodium temperature at core outlet (transient)

The Russian Institute of Physics and Power Engineering (IPPE) used the GRIF code (3D for sodium thermal hydraulics in the primary circuit). Nodalization and input data set for transient calculations of the reactor model were performed. Modeling of secondary circuits, including the DHR and improvements on the reactor model are in progress. Results of preliminary calculations for the available model were presented at the meeting at Kalpakkam.

The China Institute of Atomic Energy (CIAE) modeled the primary circuit using the code OASIS (1D) and performed preliminary calculations of the steady state transient, considering the intermediate exchanger and the DHR as a heat sink and the sub-assemblies as a porous medium.

The European Commission's JRC Institute for Energy (JRC-Petten) used the CFD code (3D) CFX11 for their studies. An unstructured mesh of about 4.5 M cells is being used. First, the steady state of the primary circuit was calculated without taking into account the effects of the inter-wrapper flow (IWF). The next step, which is to include the IWF effects, is in progress. The objective of this study is to estimate the difference of core outlet temperature with and without inclusion of the IWF.



IGCAR in India carried out a steady state analysis with a detailed 360^{O} CFD model (3D) of the primary circuit. Pressure drop and heat transfer characteristics of IWF are being studied in laminar and turbulent flow regime. As the detailed 3-D modeling of IWF along with entire primary circuit is not possible with the existing computational facilities, correlations for heat transfer and pressure drop are being developed separately. Transient analysis with and without IWF, for the primary circuit and development of the models for the secondary sodium circuit and corresponding components are also in progress.

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Technology development for water cooled reactors

Benchmarking Severe Accident Computer Codes for HWR Applications

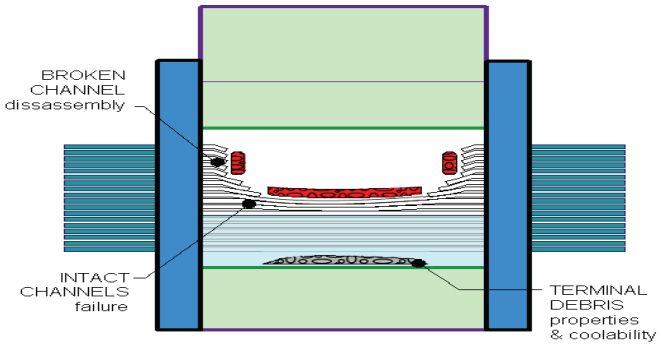
Currently different countries follow different regulatory requirements for severe accident considerations in HWRs. It is expected that the new reactor projects will explicitly and systematically consider severe accidents during the design phase to minimize the likelihood of severe core damage and large radioactivity releases.

Computer codes used for the analy sis of design basis events have been validated against integral and/or separate effects tests, whereas in the case of severe a ccident computer codes it is rather im possible, or at least quite expensive, to carryout a validation exercise against integrated experiments. Consequentl y, the code capabilities have to be assessed bas ed on benchmarking against other severe accident computer codes. In view of this, a benchmarking exercise becomes necessary to assess the results fro m various com puter codes to provide an i mproved un derstanding of modelling approaches, strengths and lim itations. The exercise could also suggest way s to overcom e code lim itations and t hereby increase the confidence in severe accident code predictions. A benchmarking exercise encompassing the va rious severe ac cident codes in use within the HWR community is important not only for pro viding confi dence in the overall performance of the codes but also for the reduction of uncertainties in their predictions.

The IAEA started a CRP in 2009 on benchmarking severe ac cident co mputer co des for HWR applications to improve the safety for currently operating plants and to facilitate more econo mic and safe designs for fut ure plants.

Institutes participating in this CRP are: Korea Atomic Energy Research Institute (Rep. of K orea), Shanghai Jiao Tong University (China), Politehnica University of Bucharest (Romania), Atomic Energy of Canada, L td. (Canada), Bhabha Atom ic Resea rch Ce ntre (India), and Nuclear Power Corp. of India Ltd. (India). The firs t research coordination meeting was held in Vienna in Feb ruary 2009. Planned activities within the CRP include:

- Collection and evaluation of existing models, correlations, experiments, and com puter codes applicable to HWR severe accident analysis.



Core Disassembly Phenomena during a Severe Accident in HWR

- Determination of referenc e design and severe ac cident scenario for benchmarking analy sis considering operating H WRs and av ailable co mputer codes i n Member States.
- Establishment of criteria for failure of fuel, fuel channel, calandria vessel and containment, reactor vault, fuel channel disassembly, and core collapse.
- Benchmark analy sis for Phase 1 (accident initiation to fuel channel dry out), Phase 2 (fuel channel dryout to core collapse), Phase 3 (core collapse to calandria vessel failure), and Phase 4 (calandria vessel failure to containment failure), and
- Benchmark analysis for experiment.

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Technology Development for SMR Reactors

Developing Methodologies to Assess Passive Safety System Performance in Advanced Reactors

The First Research Coordination Meeting of a IAEA CRP on Development of Methodologies for Assessment of Passive S afety Sy stem Perfor mance in Advanced Reactors (CRPI3101 8) was convened in Vienna with 11 participants/observers fro m 8 IAEA Member States. During the course of deliber ations, the role of test data vi s-à-vis methodologies under consideration was well comprehended. Am biguities of term s used in the area of methodology for reliabilit y assessment of passive systems were removed to a great extent.

This resulted in the proposal for creatin g a glossary specific to this area. The meeting resulted in better understanding of original proposals of participants and led to the adoption of a consens us course of action to achieve the goals of the CRP. The adjusted w ork plan for the first year, inter alia, includes the following tasks:

- Elaboration of requirements to the method of reliability asses sment of passive safety sy stems; a skel eton for such require ments was produced at a brainstorming session during the meeting;
- Elaboration of a set of definitions for reliability assessment of passive safet y s ystems and their treatment by PSA; the list of terms to be included in such glossary was defined at the meeting;
- Definition of the goals fo r methodolog y validations/ development of the requir ements for adequate tests/ selection of test facilities – several suggestions on each of these topics were produced dur ing the m eeting.

Assessing SMR Competitiveness

The Agency supports the development of new models and software to enable calculating levelized unit energy c ost not in the assu mption of constant expenditures and prod uction, as currently done in the G4-ECONS, but with tim e distributed parameters. Such models/software would enable adequate comparison of

NPP deployments and, specifically, in scenarios where deployment of several SMRs versus smaller number of larger reactors is considered. The progress in development and application of such models/software as well as some results of national assessment of SMR competitive deployment and application would be highlighted at IAEA technical meeting on Coordination of Case Studies on Competitiveness of SMRs in Different Applications, which will be convened in Vienna on 23-26 June 2009. So far, nominations have been received for 17 national experts from 9 IAEA member states. The meeting is still open for new nominations.

Fostering information exchange on SMR design status

The designers of 33 advanced SMRs had agreed to cooperate in providing updated design descriptions of their SMRs for a new electronic database of advanced reactor designs developed in NENP. The inputs will include several new developments such as NuScale and HYPERION POWER GENERATION module.

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Technology Development for Gas Cooled Reactors

21st Meeting of the Technical Working Group on Gas-Cooled Reactors (TWG-GCR-21)

The Technical Working Group on Gas-Cooled Reactors (TWG-GCR) met in Vienna on 9 – 12 February 2009. The objective of this meeting, which takes place every 12 – 18 months, is to review national and international gas cooled reactor programmes. Secondly, the meeting provides TWG-GCR members with an opportunity to learn about gas-cooled reactor activities pursued within the IAEA and consequently to accord them an opportunity to advise the IAEA on the future direction of the GCR programme. Nine Member States from the 12 Member States represented in the TWG-GCR and two representatives from international organizations (European Commission and the Generation IV International Forum (GIF) attended the meeting.
Different Member States reported progress on new HTGR projects and most notably, China reported progress on the HTR-Pebble bed Module (HTR-PM) project an HTGR industrial demonstration plant which features two reactor-steam generator modules (2x250 MW.th), producing super-heated steam to drive a turbine-generator unit of 200 MW(e). It was reported that the basic design of the plant has been completed and construction licensing is underway, procurement of long-lead components has started and site preparation is underway. First concrete is planned for the second half of 2009 and construction completion is planned for around the end of 2013.
The impact of the global financial crisis and the related impact on funding prompted the PBMR Company to consider a change in its product strategy by considering near-term market opportunities based on customer requirements to service both the electricity and process heat markets. One of the considerations under discussion is the modification of the design planned for the Demonstration Power Plant project at Koeberg to also service potential customers such as the Next Generation Nuclear Plant (NGNP) project in the US, oil sands producers in Canada, and the South African petro-chemical company Sasol.

The United States reported good progress made on the Next Generation Nuclear Plant (NGNP) project namely that as of 12/31/2008, the first of 8 irradiation tests in the Idaho National Laboratory (INL) Advanced Test Reactor (ATR) has accumulated 421 effective full-power days of irradiation, producing peak compact burnup of ~ 13.7% FIMA and peak fast fluence of ~2.7 x 10^{25} n/m2 without indication of fuel failure. Research labs are preparing the equipment for safety testing and post-irradiation examination (PIE) of the irradiated fuel. The TWG-GCR supported the initiation of two Collaborative Research Projects (CRPs) namely the CRP on Graphite Irradiation Creep to study the behavior of graphite under irradiation and in particular, the creep phenomenon and a CRP on Uncertainty Analysis in HTGR Modeling, which is very crucial in licensing on computer codes used in HTGR neutronics and thermal-hydraulics design. The CRPs will kick-off in 2009 and 2010 respectively.

Technical Meeting on Performance of Test Reactors and Use of Data for Benchmarking

This technical meeting hosted by the Juelich Research Centre in Germany took place 0n 21 – 23 April 2009. The purpose of this meeting was to: (a) discuss data collected in facilities such as the AVR Test Reactor, the THTR pebble-bed reactor, as well as other experimental facilities like the KUFA and the SANA in Juelich, Germany; (b) discuss available data from the US past HTR projects (Fort Saint Vrain, Peach Bottom); (c) discuss data collected from critical facilities such as the ASTRA critical facility and the HTR Proteus; (d) discuss data available from other test reactors currently operating in China and Japan; and (e) decide and agree how to best utilize data for the advancement of technology development. This meeting, in which 25 experts from 8 Member States participated, identified the data sources and as well as data needs for eventual deployment of new HTGR plants.

The data needs were also prioritized in terms of how crucial they can be in the progression of an HTGR project. Some of the crucial items identified as urgent data needs were (a) data on metallic fission product release and gas corrosion analysis, (b) HTR Tritium measurements, (c) activation product transport & deposition, (d) data on pebble flow in helium at different temperatures (e) high temperature experimental data. The experts all agreed that international cooperation driven by the IAEA is important to address these needs as it would be difficult for a single Member State to cover all these areas on its own. The HTR-10 test reactor in China was singled out as the most important available resource and that the IAEA must take the lead in initiating a close cooperation between China and other Member States to coordinate experimental projects on a shared basis.

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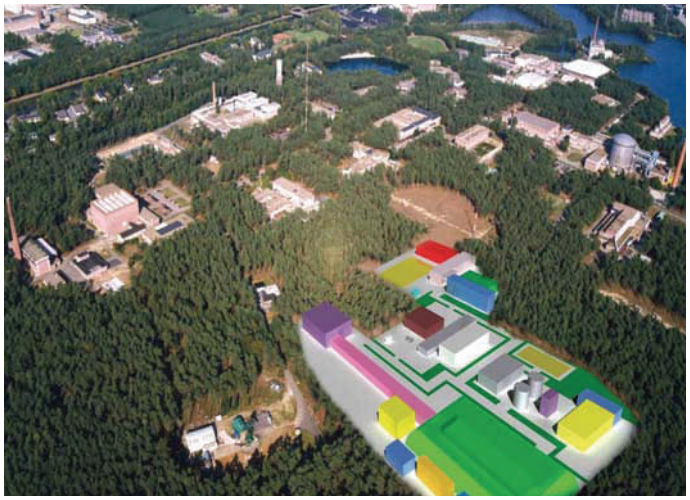
Technology Development of Fast Reactors and Accelerator Driven Systems

International Topical Meeting on Nuclear Research Applications and Utilization of Accelerators

The IAEA Project Technology Advances in Fast Reactors and Accelerator Driven Systems provided, along with the Division of Physical and Chemical Sciences and the Division of Nuclear Fuel Cycle and Waste Technology the scientific secretariat for the "International Topical Meeting on Nuclear Research Applications and Utilization of Accelerators", organized by the IAEA in cooperation with the American Nuclear Society (Vienna, 4 – 8 May 2009). The main objectives of the conference were promoting exchange of information among IAEA Member States and discussing new trends in accelerator applications including nuclear materials research, accelerator driven systems (ADS) for utilization and transmutation of minor actinides and some long-lived fission products, and accelerator technology. It was also aimed at enhancing research collaboration between Member States and promoting education on topics related to the conference, emphasizing the potential of accelerator based technology for solving a wide variety of societal issues. The topics dealt with in the ADS sessions included innovative nuclear systems, ADS experiments and test facilities, as well as nuclear data. A special Satellite Meeting, titled European Fast Neutron Transmutation Reactor Projects (MYRRHA/XT-ADS), focused on the European projects implemented in the area of fast-fission reactor concepts and fuel cycles that offer the flexibility needed to contribute decisively towards solving the problem of growing spent fuel inventories by utilizing fissionable isotopes and greatly reducing the volume of high-level waste that ultimately must be disposed of in long-term repositories.

The Satellite Meeting consisted of a series of invited papers and a round table to facilitate the discussion and agreement on conclusions and recommendations.



Artist's view of a possible location of the MYRRHA (Multi-purpose hYbrid Research Reactor for High-tech Applications) facility on the SCK•CEN site in Mol, Belgium (courtesy of SCK•CEN, MYRRHA Project Team)

Technical Working Group on Fast Reactors (TWG-FR).

The areas of collaboration between Member States within the framework of IAEA's Project on Technology Advances in Fast Reactors and Accelerator Driven Systems are identified by the Member States through participation in the IAEA Nuclear Energy Department's Technical Working Group on Fast Reactors (TWG-FR). The TWG-FR assists in defining and carrying out the Agency's activities in the field of nuclear power technology development for fast neutron systems. It promotes the exchange of information on national and multi-national programs and new developments and experience, with the goal of identifying and reviewing problems of importance and stimulating and facilitating cooperation, development and practical application of fast neutron systems. The third Research Coordination Meeting of the IAEA Coordinated Research Project (CRP) on Analyses of, and Lessons Learned from the Operational Experience with Fast Reactor Equipment and Systems, implemented within the framework of the TWG-FR, will be held from 15 – 18 June in Vienna. With focus on fast reactor operational experience with regard to steam generators, fuel and blanket subassemblies, as well as structural materials, the CRP participants are retrieving documents and feedback information, producing bibliographic catalogues, and preparing synthesis (lessons learned) reports. Hence the results or the CRP constitute a direct contribution to the IAEA Fast Reactor Knowledge Preservation (FRKP) initiative.

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Non Electrical Applications of Nuclea r Power

Non electric applications could m ake nuclear energy m ore viable, this is one of the co nclusions made by twenty two exp erts from eleven Mem ber States attended the technical m eeting on non electric applications held in Daejeon, R ep. of Korea during 3-6 March 2009. Another important concl usion was the need for an Active international collaboration could help accelerate progress on high cost R&D in non elec tric applicat ions such as devel opment of nuclear technolog y and p ilot plant for n uclear hy drogen production. Some interesting recommendations of the meeting include the need of the IAEA to emphasize the energy s ecurity a spect o f n on e lectric a pplication in view of the i ncreasing volatility on the fossil fuel price and the environmental security aspect in view of the acceleration of the global war ming by heavy depe ndency on f ossil f uel, a nd t hat e xisting n uclear f acilities should be made available to international cooperation.

Management of Water Use and Consumption in Water Cooled Nuclear Power

Efficient water use/consu mption is very im portant in several developing countries considering introduction of nuclear power, and in i ndustrialized countries considering expansio n of t heir n uclear power programme. In some countries, the lack of water has even resulted in shortages i n electricity g eneration. T herefore, t he e fficient management of water use at new nuclear power plants is highly im portant. Gathering best practice s followed on efficient water management and document the approaches. The IAEA is planning this consultant meeting in May 2009 with the objective to produce a draft document on efficient water use/consu mption in water cooled reactors and to form ulate a plan and schedule for the follow-up activities required to finalize the report.

Joint ICTP/IAEA Training Workshop on Technology and Perform ance of Desalinati on Systems

In co-operation with the International Center for T heoretical Physics, the IAEA organized a training workshop on T echnology a nd Pe rformance o f D esalination S ystems, held at ICTP, Trieste, from 11 to 15 Ma y 2009. 21 participants fro m 18 co untries were trained on technology and performance evaluation of energy sour ces and water desalination syste ms, including coupling of various sources of energy such as combined cycles, gas turbines, f ossil, a nd n uclear r eactors w ith d ifferent desalination processes using the IAEA DE EP software for economic evaluation methods of nuclear desalination.

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Highlighted Events

Workshop on IAEA Tools for Nuclear Energy System Assessment for Long Term Planning and Development, Vienna, Austria, 20–23 July 2009

An integrated approach on the use of the tools and methods available from the IAEA in support to the long-term energy planning and nuclear energy systems assessment will be provided in this TC Workshop. Feedback from Member States on the use of the tools, experiences gained and lessons learned will be also part of the workshop's programme.
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INPRO Dialogue Forum

Vienna, Austria, 11–13 November 2009

The INPRO Dialogue Forum will bring together technology holders and users to discuss and share information on desirable technical and institutional innovations, national long-term nuclear planning strategies and approaches and, on the highest level, the global nuclear energy system.
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For more information on IAEA Meetings, please visit:

http://www-pub.iaea.org/MTCD/Meetings/PDFplus/current.pdf

Beijing International Ministerial Conference on Nuclear Energy in the 21st Century

In the concluding Statement by the President of the Conference, Minister Li Yizhong, Minister of Industry and Information Technology, China, he stated that *"The conference recognized the positive momentum towards nuclear power and the decisions by many developed and developing States to pursue the use of nuclear energy. The Director General of the IAEA reported that more than 60 countries – mostly in the developing world – have informed the IAEA that they might be interested in launching nuclear power programmes. While respecting the right of each State to define its national energy policy in accordance with its international obligations, vast majority of participants affirmed that nuclear energy, as a proven, clean, safe, competitive technology, will make an increasing contribution to the sustainable development of humankind throughout the 21st century and beyond. It was widely recognized that:*

-Nuclear power contributes to global energy security while addressing climate change and avoiding air pollution;

-Nuclear power is a base-load source of electricity that can make a major contribution to meeting energy needs in a sustainable manner in the 21st century;

-Nuclear energy can make a valuable contribution to worldwide socio-economic development. "

In addition he presented some issues that need to be ensured to allow the development of further nuclear power programmes. He stated that *"international non-proliferation efforts should be strengthened and States must comply with their respective non-proliferation obligations, strengthen their export controls and enhance their cooperation with the IAEA"* and *"States having or developing a nuclear power program should give high priority to ensuring safety"*. He also indicated that consideration should be given to *"measures that will help to ensure reliable access to nuclear fuel supply, while maintaining the normal operation of the international nuclear fuel market"* and that *"safe management of spent fuel and the disposal of radioactive waste are of great importance for the sustainable development of nuclear power"*. He concluded that *"the progress made by the nuclear industry since the 2005 Paris Conference has been significant"* and that the *"IAEA plays an essential role in assisting States to develop the use of nuclear energy for peaceful purposes"*.

The Conference was extremely well organized by the Chinese hosts. Mr Huang Wei coordinated the activities of the Government representatives, the Conference building administration, the security services and all of the other groups who contributed to the management of the Conference in a manner that made all of the activities appear to be effortless. The fact that it was not easy was apparent on the day before the Conference when, during the Sunday there was a very large, high profile wedding ceremony and dinner in the Conference Hall. It seemed impossible for the Hall to be transformed into a Conference venue so quickly, but after the wedding party it was only two hours before the Hall resembled a major Conference venue. Large numbers of people moved and rearranged tables, the podium, microphones etc, and the culmination was the precision of the placing of the water for delegates, using lines to position the water so that the whole hall looked immaculate.

There were 29 speeches by or on behalf of 16 Ministers and these were arranged over the three days. Some Ministers were only available on one or other of the days, and some even wished a particular time for their speech. This required some delicate balancing of the speaking order, but eventually all speeches were accomplished. In addition to the Ministerial speeches, there were four technical sessions with invited speakers covering all key issues for the nuclear industry. Active discussion sessions followed each technical session, and discussions continued long after the end of the sessions over coffee, tea or lunch. All speeches and discussions in the Conference Hall were simultaneously translated into all six UN languages and this contributed to the ability of all participants to be fully involved.

At the close of the Conference, as his last remark, the President of the Conference Minister Li Yizhong commented that *"participants are looking forward to a further conference at the Ministerial level in another four years, which would be a valuable step in the direction of developing the support and assurance by all countries involved in the peaceful uses of nuclear energy"*.

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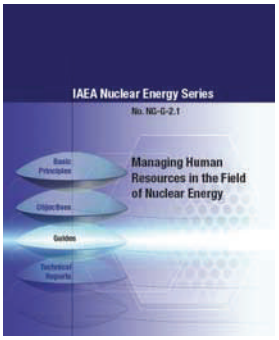
Vacancy Notices for Professional Posts

New vacancy notices will be available on the IAEA webpage addressing https://personnel.iaea.org/apps/phflink/p_vacancies.asp.

Applications from qualified women and candidates from developing countries are encouraged.

New Nuclear Energy Series Publications



The IAEA Nuclear Energy Series (NES), supporting the diverse informational needs of Member States, has published a new Guide and several new Technical Reports. In the area of *Human Resources*, the new Guide, **Managing Human Resources in the Field of Nuclear Energy** *(NG-G-2.1)*, comprehensively addresses aspects of managing human resources in the nuclear field which includes ensuring that individuals have the competence needed to perform their assigned tasks, organizing work effectively, anticipating human resource needs, and monitoring and continually improving performance. The new Technical Reports cover six additional nuclear energy topics. These and other NES publications and supporting documents are available on our web site as downloadable PDF files at http://www.iaea.org/OurWork/ST/NE/NESeries/ClickableMap/

Knowledge Management:
Development of Knowledge Portals for Nuclear Power Plants *(NG-T-6.2)*

Technology Development:
Implementing Digital Instrumentation and Control Systems in the Modernization of Nuclear Power Plants *(NP-T-1.4)*

Design and Construction of Nuclear Power Plants:
Common User Considerations (CUC) by Developing Countries for Future Nuclear Energy Systems: Report of Stage 1 *(NP-T-2.1)*

Operation of Nuclear Power Plants:
Integrity of Reactor Pressure Vessels in Nuclear Power Plants: Assessment on Irradiation Embrittlement Effects in Reactor Vessel Steels *(NP-T-3.11)*

Radioactive Waste Management and Decommissioning:
Locating and Characterizing Disused Sealed Radioactive Sources in Historical Waste *(NW-T-1.17)*

Determination and Use of Scaling Factors for Waste Characterization in Nuclear Power Plants *(NW-T-1.18)*
Geological disposal of radioactive waste: Technological implications for retrievability *(NW-T- 1.19)*

Decommissioning of Nuclear Facilities:
An Overview of Stakeholder Involvement in Decommissioning *(NW-T-2.5)*

Many more NES publications will be introduced at the General Conference in September 2009 (see box for upcoming highlights).

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NE Series Highlights – Coming Soon

Nuclear Power Objectives: Achieving the Nuclear Energy Basic Principles
This level 1 publication in the NES structure establishes what needs to be achieved to satisfy the Nuclear Energy Basic Principles in the area of Nuclear Power for each of the following topics: Technology Development, Design and Construction of Nuclear Power Plants, Operation of Nuclear Power Plants, Non-Electric Applications, and Research Reactors.

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Policies and Strategies for Radioactive Waste Management
This Guide level publication is intended as an aid, resource and reference for those engaged in the development or updating of national policies and strategies for radioactive waste management. Its objective is to set out the main elements of national policy and strategy for safe management of radioactive waste and spent fuel declared as waste recognizing that policies and strategies vary considerably depending on, among other things, the nature and scale of applications of radioactive material in a country.

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Issues to Improve the Prospects of Financing Nuclear Power Plants
This comprehensive report will provide direction across the range of issues involved in the establishment and financing of nuclear power plants (NPPs). It will identify the key influencing factors which impact financing, the potential risks and risk mitigation strategies, and options for improving financing prospects. Member States introducing nuclear power and others seeking an increase from a small base or restarting a dormant programme will benefit.

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