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Nuclear Power Newsletter

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Contents

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International Conference on Non-Electric Application of Nuclear Power

Participants at the conference, Oarai Japan, 16-19 April 2007

In co-operation with the OECD Nuclear Energy Agency and the International Desalination Association, the IAEA organized a conference on non-electric applications of nuclear power: seawater desalination, hydrogen production, district heating and other industrial applications. The conference was hosted by the Government of Japan through the Japan Atomic Energy Agency during the period of 16-19 April 2007. The objective of the conference was to exchange information on the status of non-electric applications of nuclear power and to obtain thoughts and suggestions for a future work plan of the IAEA in this area.

More than 130 participants from 30 countries and 5 International Organizations participated in the conference. More than 60 presentations were made in the fields of:

- Outlook for nuclear power and the future of process heat applications.
- Nuclear energy for non-electric applications: technology and safety.
- Economics and demand for non-electric applications.
- High temperature applications.

The theme of the conference that much more than producing electricity from nuclear reactors can be done was convincing and broadly expressed. The case of using nuclear heat for desalination and synthetic fuels was strongly made. The possibilities reviewed were directed toward real problems–e.g. supplying water, making synfuels, ameliorating the GHG-climate crisis. The conference provided an exceptional opportunity for sharing of technical information between countries – especially countries having little opportunity for such sharing.

An extensive new interest from many countries in making use of nuclear power for water production using seawater desalination and hydrogen production was feasible. A greater appreciation is made clear of the economic and financial aspects of both applications. In particular, the concept of dual purpose plants, e.g. electricity and hydrogen; or heating and desalination seems as a good option which may improve economics.

Several papers reported on interesting results including new experimental results and analysis. Demonstration and experimental plants are still favourable.

Participants identified the following challenges in the introduction of nuclear heat applications:

- System optimization of nuclear power plants (NPPs) for dual purpose use, in terms of process design
- Safety/radiological issues
- Feedstock: transport and location
- Region-specific needs
- Building infrastructure
- Initial investment and general financing issues
- Public acceptance
- Hydrogen economy: supply and storage
- Analysis tools and predictive modeling needs for the evaluation of integrated nuclear systems.
- Understanding real market needs
- IAEA role to be strengthened, better defined
- Socio-economic and environmental concerns and need for near-term solutions. The participants also recommended the following actions taken partly by the IAEA and partly by nuclear community as a whole:
- Share international experience in nuclear infrastructure planning and building, through the IAEA
- Educate the public on safety concerns such as contamination of desalinated water by IAEA disseminating objective and unbiased information
- Clearly identify opportunities, markets, customers, suppliers, investors and understand short- and long-term needs
- Demonstration projects of non-electric nuclear energy applications,
- Engage potential investors/financers in planning to make things happen
- Develop the regulatory requirements for non-electric application.

Many participants expressed their appreciations for the IAEA for organizing such a conference on a very important subject: the non-electric applications of nuclear power. Some participants expressed their country's willingness to have such a conference in their countries.

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Message from the Director

Welcome to the 2nd Newsletter of IAEA's Nuclear Power Division for 2007.

This Newsletter is an important tool to communicate with the potential beneficiaries of our activities. The information presented at the Conferences, Symposia and other IAEA meetings organized by the Division, as well as information published by the IAEA as a result of the Division's efforts may not be noticed by some potential beneficiaries unless we specially identify this information. The Newsletter is intended to serve this purpose.

Like earlier Newsletters from the Division of Nuclear Power, this June 2007 issue has ample information on meetings and documents. I myself attended several meetings in the March-May period covered by this Newsletter, including visits to countries considering introduction of nuclear power, and attendance at the Special Symposium for the IAEA's 50th Anniversary on *Global Challenges for the Future of Nuclear Energy and the IAEA*, the International Conference on *Non-Electric Applications of Nuclear Power*, the International Conference on *the Challenges Faced by Technical and Scientific Support Organizations in Enhancing Nuclear Safety*, and others.

The IAEA is celebrating the 50th anniversary of its foundation in 1957. This is an opportunity not to celebrate ourselves but to retrospectively visit our past achievements and to discuss in a forward-looking manner what the future challenges are and what needs to be done to secure the benefits from the use of nuclear science and technology while minimizing its potential adverse effects. One such opportunity was the above mentioned Special Symposium that was held in Japan on the 11th of April 2007. At this Special Symposium, senior officials from the IAEA reviewed the IAEA activities in Nuclear Power and the Fuel Cycle, Nuclear Safety and Security, and Non Proliferation, including IAEA Deputy Director General Mr. David Waller's Keynote Speech on historical review of the IAEA's 50-year activities. Senior officials and experts from Member States delivered speeches on national and international activities having strong

relevance with the IAEA programme. Throughout these sessions and the roundtable discussion, the increasingly important role of the IAEA was repeatedly emphasized in the context of minimizing proliferation risk, assuring safety and security and assisting developing countries in the introduction of nuclear power, especially on the matter of infrastructure building. All the information on this symposium is available at the IAEA web site: http://www-pub.iaea.org/MTCD/Meetings/cn161presentations.asp

The expected role of IAEA's Division of Nuclear Power is increasing in the light of rising expectations for the role of nuclear power, and consequential increase in IAEA's Technical Cooperation (TC) support to developing countries in their infrastructure building. The Division of Nuclear Power is supporting these countries through its TC programme, and is also working on guidance documents in this area. We will be publishing two guidance documents; Managing the first NPP project and an Infrastructure Milestone document, the latter of which could be utilized as a tool for self-assessment of infrastructure–preparedness. Further, if Member States want, the IAEA can send review missions on infrastructure–preparedness. A workshop is planned for this milestone document and on financing nuclear projects in November, 2007.

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Nuclear Power Plant Operation

Instrumentation and Control Systems

An IAEA Europe Region workshop titled *Qualification of nuclear power plant mechanical, electrical and instrumentation and control (I&C) components and equipment in harsh environment* was held on 20-23 March 2007 in Madrid, Spain. The purpose of the workshop was to exchange information and to share experiences in planning and implementing equipment environmental qualification (EQ) programmes at NPPs, including upgrading and preserving EQ status. Lessons learned from actual EQ projects were presented and discussed. Lecturers from Canada, Hungary Slovenia, Spain, and the USA delivered 20 presentations on a wide range of EQ areas. Twenty-five participants from the Europe Region attended the workshop.

The following additional meetings on various I&C subjects have been held recently:

A new IAEA-TECDOC on *Testing the response time and effectiveness of reactor protection systems and their instrumentation* was launched at a consultants meeting on 13-16 March 2007. The objective of the meeting was to establish the outline of the document and to produce its first draft version. Seven experts from five countries attended. The IAEA-TECDOC will describe techniques and tools to measure the time-line and to test the effectiveness of the operation of reactor protections systems and their instrument channels in NPPs. The scope includes all components of the time-line from the initiation of the protection action to the monitoring of the resulting shutdown state. Typical sources of time delays, such as sensor dynamics, relay/logic delays, computer/digital I&C timing, and response of actuators are identified. Some of the tests may be performed at full-power operating conditions in actual transients (e.g. operator initiated trip test), while some components of the protection system (sensors, measurement channels) can be tested in a non-intrusive passive way (e.g. by reactor noise analysis).

A consultants meeting was held on 3-5 April in preparation of a proposed Coordinated Research Programme (CRP) on *Advanced Surveillance, Diagnostics, and Prognostics Techniques used for System Health Monitoring in Nuclear Power Plants*. The purpose of the consultants meeting was to establish the scope of the CRP. As nuclear power plants enter into power uprate and license renewal projects, there is an increasing need for the use of advanced surveillance, diagnostics, and prognostic systems and techniques to assess the health of nuclear power plant systems and their instrumentation. Five experts from four countries attended the consultancy.

A draft IAEA-TECDOC on *Integration of analog and digital I&C systems in hybrid main control rooms*, initiated in March 2006, was further developed at a consultants meeting on 16-18 April 2007. Large scale I&C modernization projects often include upgrading the instrumentation, displays, and alarm systems of control rooms and other user interfaces. Because of the complexity of control room modernization projects, changes are made either in a long extended outage at once or in several steps during regular and shorter maintenance outages. In most cases, the latter is preferred for the reason of avoiding an extensive production loss. The incremental changes made during each maintenance outage result in control room configurations, which are combinations of old and new components. It is important that at any point in this incremental transition period, the control room is fully capable of controlling the plant. The IAEA-TECDOC discusses both the instrumentation and the human factor engineering aspects of designing,

implementing, licensing, and operating hybrid MCRs, providing guidelines for utilities, technical support organizations and regulators.

A draft IAEA-TECDOC titled *On-line Monitoring for NPPs; Part 2: Process and Component Condition Monitoring and Diagnostics* was completed at a consultants meeting on 8-11 May, 2007, in Balatonfüred, Hungary. The meeting was hosted by the Paks NPP. Six experts from five countries attend the meeting. The goal of on-line monitoring is to verify the performance and availability of process systems and components in a non-intrusive passive way by analyzing data accumulated at normal operation. The applications of on-line condition monitoring are becoming increasingly important, as utilities optimize maintenance practices and outage schedules. The IAEA-TECDOC describes state-of-the-art technologies and proven monitoring and signal processing procedures that can be applied for diagnostic purposes while the plant and its instrumentation are on-line.

Participants in the TWG-I&C, Vienna Austria, 23-25 May 2007

The 21st Meeting of the IAEA Technical Working Group on Nuclear Power Plant Control and Instrumentation (TWG-NPPCI) was held on 23-25 May 2007 in Vienna, Austria. The objectives of the Technical Working Group Meeting were (1) to exchange information on national and international instrumentation and control projects in nuclear power plants, (2) to advise the Agency on future activities related to NPP I&C; (3) to review the Agency's on-going activities and documents under preparation related to NPP I&C, and (4) to present Country Reports on the status of the NPP I&C industry in the Member States. 45 participants from 28 Member States and two international organizations attended the meeting and 31 presentations were delivered. The Member States' recommendations encompassed the following I&C areas:

- Design, Application and Qualification of Digital Systems
- Diversity, redundancy, and defence in depth
- Independence of failure modes, common cause failures
- SW engineering & qualification
- Use of pre-developed software and commercial-off-the-shelf products
- I&C international standards
- Data communication
- Cyber security
- Use of simulators for design & validation
- Equipment qualification
- I&C modernisation strategies
- Database on I&C operations and upgrades
- I&C ageing and obsolescence
- Plant license renewal
- Human factors, reliability, and control room design
- I&C maintenance and periodic testing
- Condition monitoring, diagnostics and prognostics
- Knowledge management and transfer, aging workforce
- Licensing guidelines and tools
- Advanced sensors & transmitters
- Wireless technology
- Advances in human system interfaces
- I&C in beyond design conditions
- I&C for next generation NPPs

An IAEA Technical Meeting on *Increasing Power Output and Performance of Nuclear Power Plants by Improved Instrumentation and Control Systems* was held from 29 to 31 May 2007 in Prague, Czech Republic. The meeting was organized by the IAEA and hosted by I&C Energo a.s. The purpose of the meeting was to provide an international forum for presentations and discussions of

Participants in the Technical Meeting, Prague, Czech Republic, 29-31 May 2007

experience in the field of I&C improvements leading to increased power output and improved performance of nuclear power plants. Eighty participants from 26 countries attended the meeting, delivering 43 presentations.

A draft IAEA-TECDOC on *Avoiding Common-cause Failures (CCF) in Digital Instrumentation and Control Systems of Nuclear Power Plants*, initiated in March 2006, was further developed at a consultants meeting on 7-8 June 2007. The meeting was hosted by ISTec in Berlin, Germany. The objective of the consultancy was twofold: (1) to further develop the technical document and (2) to work on the preparation of the IAEA TM on the same subject to be held in Bethesda, Maryland, USA. The task of preventing common-cause failures occurring in digital I&C systems is especially important in NPP I&C safety systems, since the occurrence of common-cause failures could defeat the effectiveness of the protection provided by the use of redundant components and safety instrument channels. Redundancy is commonly implemented in safety systems by deploying parallel channels and component duplications. The purpose of redundancy is to make the system immune to the consequences of single component failure, that is, no single failure can prevent safety system actuation, if that activation is needed, and no single failure can cause spurious activation of safety systems. Potential common-cause failures can occur in redundant systems, if the assumption of independence of parallel components is not valid due to internal design error or external environmental effects, such as electromagnetic interference.

An IAEA Technical Meeting on *Common-Cause Failures in Digital Instrumentation and Control Systems of Nuclear Power Plants* will be held on 19-21 June 2007, in Bethesda, Maryland, USA. The meeting will be co-hosted by the NRC, EPRI, NEI, and DOE. The purpose of the meeting is (1) to provide an expert forum for the exchange of information on the occurrences of common-cause failures in digital instrumentation and control systems, (2) to discuss the use of redundancies and defence-in-depth-and-diversity (D3) principles to prevent common-cause failures in reactor protection and control systems, and (3) to review the draft of a related IAEA technical document. The scope of the document includes both digital hardware/software components and the related sensing/measurement devices of I&C systems. Practical aspects of the following areas are discussed:

- Achieving functional, physical, and design diversity
- Defense-in-depth solutions
- System robustness and fault tolerance
- Functional and physical separation
- Parallel systems supporting the same function
- Testing digital I&C systems for susceptibility of common-cause failures
- Possible CCFs triggered by maintenance activities and human errors
- Potential increase in CCF by the use of commercial-of-the shelf components
- Potential increase in CCF with increasing system complexity
- CCF-proof system design and requirement specification

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NPP Maintenance

A consultants meeting on *Development of Guidance Document for Risk Informed In-Service Inspection (RI-ISI) of Piping Systems of NPPs* was held at the IAEA Headquarters, Vienna, on 13-15 March 2007. Six consultants from five countries (Czech Republic, Finland, Sweden, Switzerland, the US) attended the meeting.

At first, the meeting assessed the needs of NPPs and supporting organizations in the Member States for an IAEA guideline on Risk Informed In-Service Inspection of Piping Systems of Nuclear Power Plants, taking into account the existing regulatory and industrial requirements and guidelines, and current plant practices in the Member States; and then a document profile was worked out, based on the consensus of the participants. This NE report on RI-ISI should be a middle level document to inform and educate middle level managers, ISI supervisors, and lead ISI engineers of existing NPPs and TSOs with regard to the technology. It will describe

RI-ISI process, application status, technological issues, and developments.

Participants in the meeting, 13-15 March 2007, Vienna Austria

The 2nd meeting is planned in January 2008 at the VIC.

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NPP Life Management

Participants in the workshop, Angra Brazil, 16-18 May 2007

An IAEA regional workshop on *Optimization of Service Life of Operating Nuclear Power Plants* was held in Angra, Brazil, on 14-17 May 2007, followed by a technical visit to the Angra NPP. The agenda of the workshop included presentations on IAEA Activities in Plant Life Mangement(PLiM), PLiM Programmes in France and Spain, Aging management and degradation mode with life cycle management, Management aspects of service life on NPPs, Light water reactor vessel and internals, periodic inspections and monitoring application on established programs to enhance monitoring and diagnosis, PLiM code, standards and guides. Three invited experts and 40 participants from Argentina, Brazil and Mexico attended the workshop.

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The Research Coordinated Meeting for the coordinated research project (CRP) on *Review and benchmark of calculation methods for structural integrity assessment of reactor pressure vessels (RPVs) during pressurized thermal shock (PTS)* held on 26-28 March 2007 in the Hungary Atomic Research Center (KFKI), Budapest Hungary. A total of twelve experts from Czech Republic, Finland, France, Germany, Hungary, Republic of Korea, Russian Federation, Slovakia and JRC- IE participated in the meeting. The overall objective of the CRP is to perform benchmark deterministic calculations of a typical PTS regime with the aim to compare effects of individual parameters on final RPV integrity assessment during PTS, and then to recommend the best practice for their implementation in PTS technical guidelines. This will substantially contribute to better technical support of safe operation and life management. The phase of CRPs was divided in two phases as follows:

- Phase 1: Basic case, national codes calculations/comparison and sensitivity study for PWR and WWER,
- Phase 2: Preparation of technical guidelines on "Good practice Handbook for RPV deterministic integrity evaluation during PTS".

For phase 1 (Benchmark calculations) Mr. Vladislav PIŠTORA from Czech Republic gave an overview and updated analysis of the results, separately for WWER and PWR calculations including national codes. For phase 2 (Good practice handbook for RPV deterministic integrity evaluation during PTS) Mr. Nigel Taylor from JRC-IE gave information about the status of the preparation of this Handbook. The main text of the hand book was reviewed and almost finalized for publication after following modifications of the structure and content of the Handbook .

Participants in the research coordinated meeting, 26 to 28 March 2007, Budapest Hungary

Training Course on *CANDU Issues on Ageing Management* under TC ARG 4/091 was held from 16 to 18 April 2007 at Embalse nuclear power plant site. There are different approaches to the phases involved in a PLiM program. Embalse NPP is following a methodology developed by IAEA-TEDOC-1503. A typical program for CANDU PLiM has three main successive phases:

- Phase 1: Pre-project definition,
- Phase 2: Project Engineering and preparation, and
- Phase 3: Project Implementation.

Participants in the meeting, 24-25 May, Shanghai China

A preparatory meeting for the IAEA international symposium on plant life management(PLiM 2007) was held at Shanghai on 24-25 May in China.

The objective of the meeting is to finalize a symposium technical programme and arrange the detailed administrative issues. The technical meeting was participated by four IAEA staff members and nine international experts from Canada, Czech Republic, Hungary, Germany, Japan, Republic of Korea, Russian Federation and Switzerland and five from Chinese host organizations.

As a result of the meeting, the symposium technical programme was established as the table.

15th October 2007	*16th October 2007*	*17th October 2007*	*18th October 2007*
• Opening: • Two key note speeches from China and Finland • Session 1: Approaches to PLiM	• Three key note speeches from France, Canada, Germany • Session 2: Parallel session (2-1: General AM(1), 2-2: General AM (2), 2-3: AM for BWR, 2-4: ISI, 2-5: Prob. approach to AM, 2-6 AM for PHWR • Session 3: Parallel session (3-1: SCC, 3-2: EAC, 3-3: Non-metallic AM, 3-4: FAC, 3-5 Fatigue, 3-6: RPV and core internals integrity)	• Three key note speeches from Republic of Korea, USA and EC JRC • Panel discussion • Session 4: Parallel session (I&C refurbishment) • Session 5: Parallel session (Economics of PLiM) • Poster session	• One key note speech from Japan • Session 6 :Regulatory aspects of PLiM • Closing:

Note : AM : Ageing Management, SCC : Stress Corrosion Crack, EAC: Environmental Assisted Cracking , ISI : In-Service Inspection, RPV : Reactor Pressure Vessel

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Databases to Support NPP Performance

IAEA-TECDOC-1544 on *Nuclear Power Plant Design Characteristics: Structure of Nuclear Power Plant Design Characteristics in the IAEA Power Reactor Information System (PRIS)* was published.

The Power Reactor Information System (PRIS) is a comprehensive data source on nuclear power reactors in the world. It includes specification and performance history data of operating reactors as well as of reactors under construction or being decommissioned. The nuclear power plant design characteristics represent a fundamental part of the PRIS database. They provide important information on the main systems and components and can provide a comprehensive picture of unit design, technology and system configuration.

The characteristics can also be used as basic criteria to group reactors with similar or identical design features for operational performance analysis.

The aim of this publication is to provide guidelines for PRIS data providers and to detail information about PRIS design characteristics for those using PRIS data for performance analysis, benchmarking or just as a reliable source of technical information related to nuclear power plants.

A consultants meeting on development of the PRIS was held on 24-26 April 2007 in IAEA Headquarters to discuss areas for improvement in the PRIS Statistics application which provides end-users with practical tools for PRIS data analysis.

PRIS contains wide range of information about nuclear power plant status and performance. To assist in nuclear power performance analyses and benchmarking the outputs from PRIS have to be easily achievable in predefined structures, forms and reports. The objective is to meet requirements and needs of end-users from operating utilities, governmental agencies, research institution or engineering organisations, which may analyze nuclear power performance and its trends.

The Consultants Meeting has been organised to obtain feedback from various PRIS users related to information and outputs they would expect from PRIS statistics. The discussion was concentrated on the main three topics: reactor grouping, selection of standard reports and application of advanced statistical methods in the PRIS reporting system.

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Management Systems, Nuclear Power Infrastructures and Human Resources

Management Systems

The IAEA developed a new set of Safety Standards directed to establish requirements and provide guidance for implementing Management Systems that:

- Integrates all aspect of managing nuclear installations and activities including the safety, health, quality and environmental requirements in a coherent manner,
- Describes the planned and systematic actions necessary to provide adequate confidence that all these requirements can be satisfied, and
- Supports the enhancement and improvement of safety culture.

A technical meeting was held on 19-23 March 2007 in Vienna to discuss the new IAEA Safety Standards on Management Systems and the practical aspects of implementing an integrated management system. The objective of the meeting was to identify areas where the IAEA could provide additional support to aid the implementation of the new set of Safety Standards.

Participants in the meeting, Vienna Austria, 19-23 May 2007

The participants made presentations on their experiences/views in the application of integrated management systems. These presentations addressed the application of integrated management systems within utilities, regulatory bodies and supplier organizations. For each of the key topics, the presentations were followed by a facilitated discussion whereby participants shared their concerns and issues and identified the areas where additional support and guidance from the IAEA would be very beneficial.

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Nuclear Power Infrastructures

Financing, Market and Societal Challenges

The changing global environment of increasing energy consumption and need for energy security is influencing the type of and means for obtaining the resources (material, human and financial) necessary for nuclear power projects. The effects of issues such as financing arrangements for capital intensive plants, international design approval/evaluation, harmonization of codes and standards, and assurance of fuel cycle services need to be considered. The development of a Nuclear Energy Series Report on *Issues Improving Prospects for Financing Nuclear Power Projects* has been initiated. The first consultants meeting will be held on 2-4 July 2007. The Report will provide a review and practical approaches on the effects of infrastructure developments and other related topics upon reducing investment risks, and the actions possible that may improve prospects for financing nuclear power projects.

The international and national nuclear industries have to satisfy different objectives and requirements from the national authorities. These industrial organisations may include design companies, construction companies, utilities, operating and technical support organisations, and consultancy companies. The interface between these industrial organizations in a deregulated and commercial and competitive market has profound implications for the use of nuclear energy.

A work on Nuclear Energy Series Report on *Attributes of the Nuclear Industry to Meet the Market and Societal Challenges* has started.

As a first implementation step, the first consultants meeting will be held on July 23-25, 2007. This Report will provide review and practical approaches on the objectives of the different parts of the nuclear industry and on the attributes necessary within these organisations to meeting their objectives while ensuring that the objectives and requirements of government and regulatory authorities are also achieved.

The target users are decision makers, advisers and senior managers in the governmental, utilities, industrial and financial organizations in countries adopting or extending nuclear power programmes.

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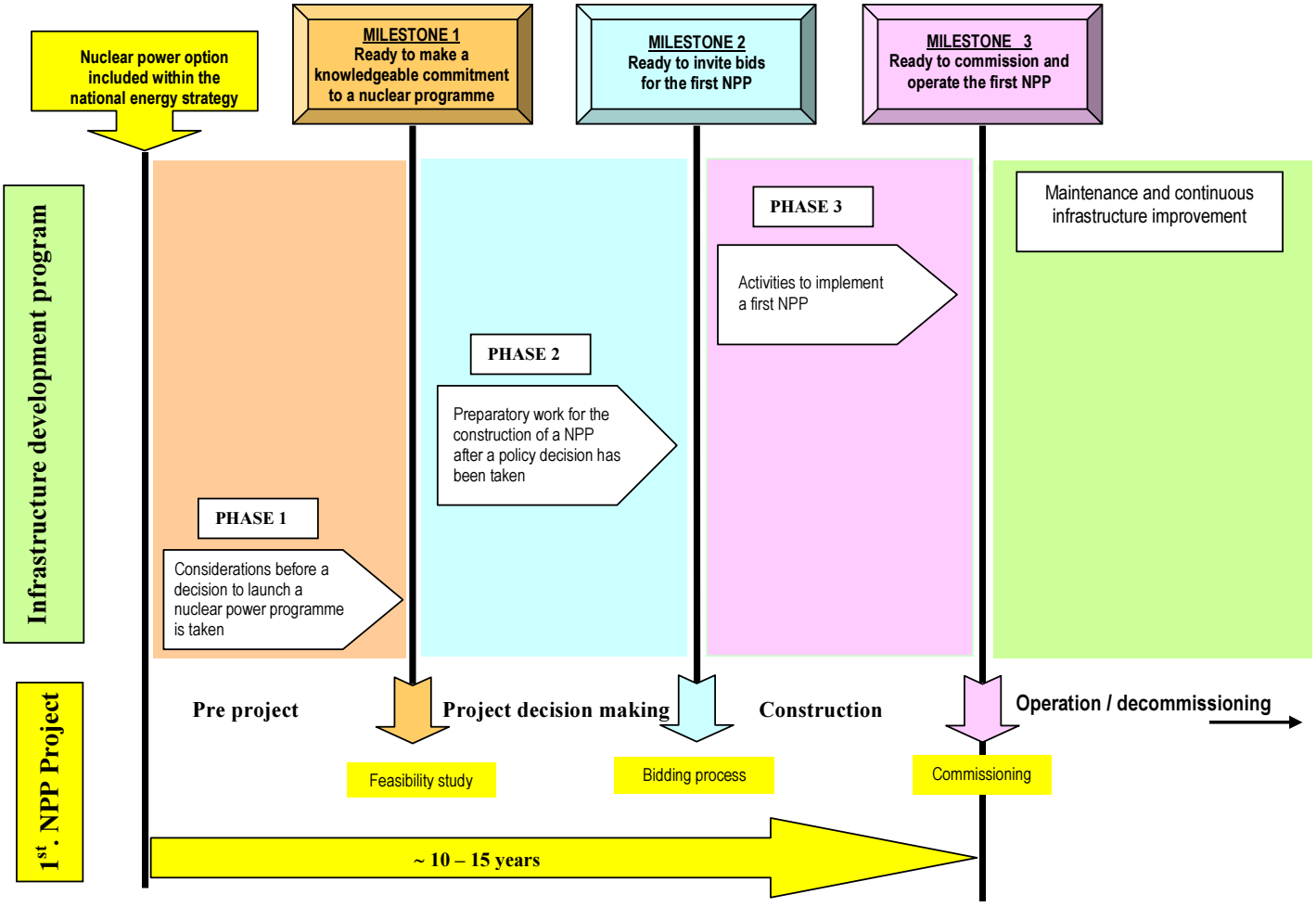
Preparation of guidance documents for infrastructure building

In preparing the infrastructure to introduce nuclear power there are several activities that need to be completed. These activities can be split into three progressive phases of development as described in GOV/INF/2007/2: *Considerations to Launch a Nuclear Power Programme*. These phases are of indeterminate duration, which will depend upon the degree of commitment and resources applied by the Member States. In order to assist with the best use of resources, a description of what conditions would be expected to be achieved by the end of each phase is provided in the draft on *Milestones in the Development of a National Nuclear Power Infrastructure* recently prepared for review at a technical meeting on 29-31 May 2007. The term *milestones* refers to the conditions necessary to demonstrate that the phase has been successfully completed. The completion of the infrastructure conditions of each of these phases is marked by a specific milestone at which the progress and success of the development effort can be assessed and a decision made to move on to the next phase. A schematic representation of the phases and milestones is given in the following figure.

A revised draft providing guidance on *Restarting a Delayed Nuclear Power Plant Project* was produced. The draft addresses specific management issues related with the process of restarting and finalizing the construction of a delayed NPP project. The scope addresses the preparation activities, evaluation of structures and materials preservation, commercial and financial arrangements, licensing and project implementation measures. Target users are senior managers and engineers from nuclear utilities and from their supplier and technical support organizations for NPP construction and commissioning. Managers and advisors from governmental organizations such as regulatory bodies will also find useful information. The draft will be reviewed and finalized during a consultants meeting scheduled 25-27 June 2007. Submission for publication in the Nuclear Energy Series is scheduled in the second half 2007.

A new publication, IAEA-TECDOC-1555, on *Managing the First Nuclear Power Plant Project* was recently issued. It provides concise practical information on the main project management activities during the stages composing the planning and implementing the first NPP in a country. The contents include excerpts from existing publications along with new material to reflect the



Infrastructure development programme

changes that have taken place over the years and provide references to relevant IAEA publications where the user can find more elaborated guidance. The target audience for the IAEA-TECDOC is the decision makers, advisers and senior managers in the governmental organizations, utilities, industrial organizations and regulatory bodies in the countries desiring to launch the first NPP project.

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Human Resources, Training and Improvement of Performance

Participants in the meeting, in Vienna Austria, 14-18 May 2007

A technical meeting *Effective management of NPP personnel training to increase organizational performance* was held at IAEA Headquarters on 14-18 May 2007. Twenty-eight participants from seventeen countries and six IAEA staff from three departments took part. Participants have reviewed the drafts of two new documents: a new Nuclear Energy series guide *Human Resources in the Field of Nuclear Energy*; and a new Nuclear Energy series report *Increasing Training Effectiveness and Improving Organizational Performance in Nuclear Facilities: Management Perspective*. These documents are planned to be prepared for publication in 2007. Two remarkable features of that meeting should be mentioned. The representatives of a wide spectrum of organizations from the nuclear sector took part, namely from the operating organizations and NPPs, regulatory bodies, technical support and training organizations, educational institutions, suppliers and governmental agencies. Secondly, the topic of the meeting attracted significant attention of the Member States' representatives. Constructive and open discussions were useful for improving the draft documents being prepared for publication, and for exchange of experience, in the psychologically receptive atmosphere. Material of the meeting can be found on ENTRAC http://entrac.iaea.org.

Multi-functional computer-based training systems for knowledge preservation and transfer

Computer-based training (CBT) systems are broadly used in the nuclear power sector. At some NPPs, up to 30% of training is conducted using CBT systems; many of them are available on-line. The following characteristic features of modern CBT systems could be mentioned:

- application of a systematic approach to training (SAT) methodology for the development and use of CBT systems;
- employment of multimedia, 3-D modeling, virtual reality;
- multifunctional knowledge bases and databases;
- adaptable web-based technologies;
- use of learning management systems allowing for:
  - management of learning content;
  - accountability of strategic training initiatives;
  - contribution to professional career development and succession planning;
- multi-functional use of computer-based systems for:
  - effective knowledge preservation;
  - transfer of knowledge, training and assessment;
  - pre-job briefings and performance support.

Examples of competence areas which the CBT systems are developed and used for are as follows:

- regulations;
- personnel licensing;
- fundamentals;
- procedures;
- plant systems, structures and components;
- maintenance activities including virtual mock-ups;
- comprehensive CBT for particular job positions and specific duty areas;
- CBT for all site personnel (site access training);
- control room equipment;
- plant layouts, virtual walk-downs and emergency drills;
- decision-making under emergency conditions;
- management staff training and assessment;
- CBT for various nuclear facility life cycle phases (including design, commissioning, operation and decommissioning).

The IAEA OSART and WANO Peer Review missions have identified the use of CBT systems at various NPPs as a 'good practice' or 'strength'.

A big and successful project on preservation and transfer of knowledge on WWER and RBMK type NPPs – using the CBT systems as a tool – was undertaken in late 80's through the mid of 90s of the last century; and these activities continued in the new century. Dozens of CBT

systems were developed and actually used. Several Russian and Ukrainian organizations (operating organizations, nuclear power plants, training centres, contractors) took part in that project; dozens of subject matter experts were involved. NPP technology, cognitive theory and cybernetics techniques were employed. Explicit and implicit unique knowledge on plant systems, structures and components was preserved in the following domains: design basis; technical specifications; functions and design of equipment; operation under normal and abnormal conditions; malfunctions; relationships between the systems and components; diagnostics; use of procedures; decision-making under emergency conditions. CBT systems were actively used for training and transfer of knowledge to the personnel of Russian, Ukrainian and other countries' nuclear power plants.

Development of Information Technology has offered more advanced tools. Multifunctional multimedia computer-based systems are being developed and supplied in the framework of the IAEA Technical Cooperation project for Ukraine, devoted to improvement of the NPP maintenance personnel performance and training system. Explicit, implicit and tacit knowledge is being captured, developed, preserved and disseminated. Advanced CBT systems are developed for improving maintenance and operation of reactor installations, reactor control systems, safety valves, steam generators, I&C equipment, electrical generators, pressurizers, pumps, spent fuel dry storage facility, performance of hazardous works.

Use of a CBT system (on safety valves) in a maintenance workshop

The use of inputs from the IAEA helps – along with other Ukrainian NPPs own activities – to continually improve performance of maintenance. The priority for implementation of CBT systems was identified by the Ukrainian NPPs due the following factors: overloading of managers and personnel by the dispersed information; difficulties in processing of big amount of information; loss of knowledge due to the retirement and turnover of personnel; the needs in effective tools supporting knowledge management; and the needs in increasing effectiveness and efficiency of training and learning processes.

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Technology Developments and Applications for Advanced Reactors

Collaborative Projects for INPRO

International Project on Innovative Nuclear Reactors and Fuel Cycles (INPRO), during its Phase-1 activity, had focused on the development of methodology for the assessment of INS. In the current phase, Phase-2, which had newly started in July of 2006, INPRO activities are oriented by three directions: 1) continuous improvement of methodology, 2) institutional / infrastructure activities and 3) collaborative projects (CPs) among INPRO Members.

CPs support the development and deployment of INS through international collaboration by sharing of resources, reduce required resources and create synergy by working together. During the 10th INPRO Steering Committee Meeting held in December 2006 Member States made 20 proposals for collaboration and discussed refining or consolidating proposals.

At the end of May a meeting to review the CP proposals was held in the IAEA. The goal of this meeting was to discuss Terms of Reference of CPs: i.e., the objectives of the projects, the partners, resources, funding, work plans and schedules, options for implementation, deliverables, etc.

Some CP proposals attracted 9 to 11 potential participants. Most CPPs were supported by 2 to 6 Member States. Currently, 13 proposals from 8 countries (including EC) are under discussion and are waiting for implementation after their endorsement by the 11th INPRO steering committee meeting which will be held on 4-6 July 2007.

The proposed CPs can be roughly grouped as follows:

Scenario studies

- Global architecture with thermal and fast reactors (GAINS)
- Scenarios in the period of raw materials insufficiency

Safety issues

- Passive Gaseous Provisions (PGAP)
- Safety for advanced HTRs and H2 producing plants
- Safety operation for the small power grid

Proliferation resistance (PR)

- Acquisition/diversion pathway analysis for PR

Technical solutions in reactor technologies

- Technological challenges on advanced HTRs
- Advanced water cooled reactors
- Decay heat removal system for liquid metal reactor

Environment & waste management

- Environmental impact benchmarking
- Spent nuclear fuel and radwaste in a small country

Alternative options

- Introduction of non-stationary NPPs with small and medium sized reactors in the developing countries
- Further Investigations of U-233/Th fuel cycle

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Common Technologies and Issues for SMRs

A CRP on *Small Reactors without On-site Refuelling* is preparing to hold its second Research Coordination Meeting on 4-8 June 2007, in Vienna. This CRP is ongoing with 17 participating institutions from 9 member states, and the topics to be discussed include new results and annual reports on source term calculations to justify reduced off-site emergency planning for SMRs, on benchmarking for whole core depletion models of lead-bismuth cooled reactors, on benchmarking for cells and fuel assemblies of light water reactors with coated particle based fuel, on data and information exchange regarding fuel and coolant properties and progress in design development for the concepts addressed, and on inter-regional and intra-regional scenario studies for energy systems with small reactors without on-site refuelling. Recently, a working communication has been established with the Informal heavy Liquid Metal Coolant Interest Group (ILHMCIG) that brings together stakeholders of the technology of lead and lead-bismuth cooled nuclear systems from around the world and with the NEA OECD's Lead-Alloy Cooled Advanced Nuclear Energy Systems (LACANES) group. With the latter, an option to participate in a benchmarking exercise for natural circulation of lead-bismuth coolant based on the tests performed in the HELIOS loop at the Seoul National University (the Republic of Korea) is being discussed. A Web page of the CRP is at: http://www.iaea.org/NuclearPower/SMR/CRP1/.

A series of case studies is ongoing to address competitiveness considerations for SMRs in different applications. The studies ongoing with several expert groups in member states include development of a country-independent model to examine and quantify the need for SMRs, analysis of a need of innovative SMRs in the world markets; development and application of models to assist decision making of public and private investors regarding SMRs, analysis of plant design and deployment strategies and associated issues, and a generic study with an approach taking into account all economic factors affecting present value capital costs of SMRs, see figure below. Several papers have been submitted for a new report on *Approaches to Assess SMR Competitiveness* to be published early in 2008. The results of all studies will be discussed at an IAEA technical meeting on 15-18 October 2007, to be announced soon.

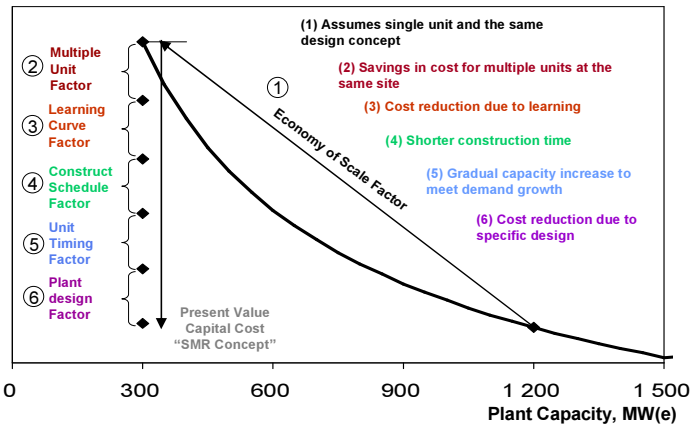


Illustration of a generic approach to take into account all factors affecting present value capital costs of SMRs (Westinghouse, USA)

Contact: V.V.Kuznetsov@iaea.org.

Advances in Water Cooled Reactors for Improvement in Economics and Safety

Refinement of IAEA's Passive PWR Nuclear Plant Simulator for Education

The IAEA has established an activity on *Nuclear Power Plant Simulators for Education* to assist Member States in education. IAEA's NPP Simulators for Education include a WWER-1000, a BWR, a CANDU, an Advanced CANDU, a PWR with Active Safety Systems and a PWR with Passive Safety Systems (the Passive PWR).

Further, the IAEA is conducting a Coordinated Research Programme on Natural Circulation Phenomena, Modelling and Reliability of Passive Systems that utilize Natural Circulation.

In order to apply newly acquired knowledge and technology in education, the IAEA's Passive PWR NPP Simulator for Education is being upgraded to with the capability to demonstrate passive safety system response during a small break LOCA (SBLOCA).

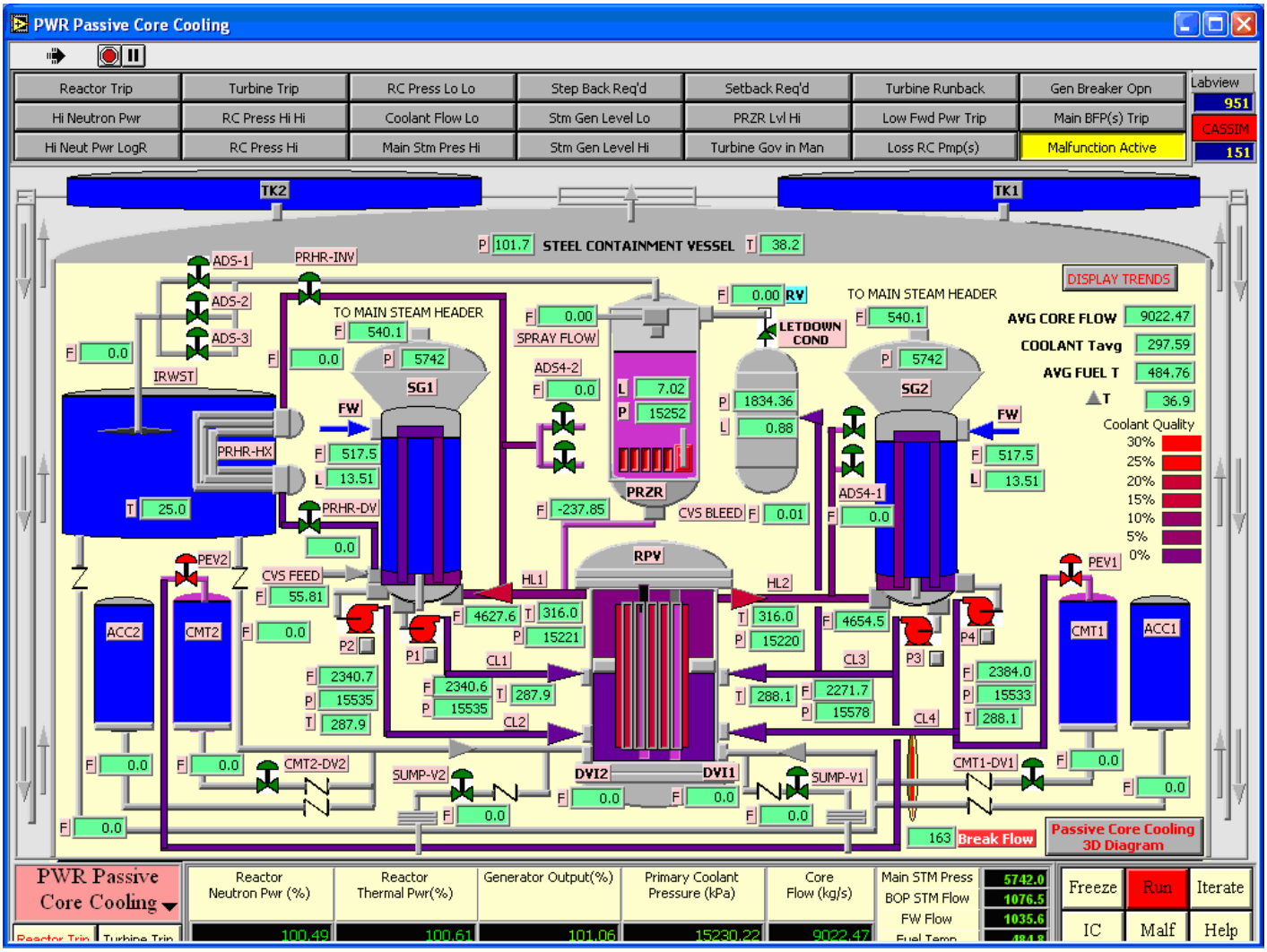
The simulator has a thermal hydraulic model for a passive core cooling safety system based on relevant design data in the public domain for the Westinghouse AP-600 nuclear plant, and on additional information on phenomena influencing natural circulation that has been published in IAEA TECDOC-1474, *Natural Circulation Phenomena, Modelling and Reliability of Passive Systems that Utilize Natural Circulation*.

The simulator addresses the following passive safety systems:

- Passive residual heat removal system
- Two core make-up tanks
- A four stage automatic depressurization system
- Two accumulator tanks
- An in-containment refuelling water storage tank, and
- A lower containment sump.

The upgraded thermal hydraulic models include the following processes:

- Primary system natural circulation and heat transfer
- Passive residual heat removal loop circulation and heat transfer
- Core make-up tanks loop circulation



PWR with passive safety system

- Lower containment sump recirculation

Further, the passive PWR simulator manual description and exercises are being revised to reflect the upgrading of the models.

For further information, please contact Mr. S.G. Moon of the Water Cooled Reactors Unit, Nuclear Power Technology Development Section (S.Moon@iaea.org)

Helping Member States to Improve Capability in Technology Assessment

An increasing number of Member States have turned to the IAEA for information and assistance regarding possible establishment or expansion of their nuclear power programmes. As part of the IAEA's response to these requests, the Nuclear Power Technology Development Section is organizing a Technical Cooperation workshop on *the process of conducting nuclear power plant (NPP) technology assessments*.

Technology Assessment is an exercise conducted by a country to determine, in general, which NPP technologies and plant concepts are suitable for the country so that they should be retained for further evaluation for introduction into the country. Technology assessment also provides the technical basis for several elements of infrastructure development, including assessment of national capabilities, defining the degree of national technical and industrial participation in the NPP programme; identification of appropriate sites for the NPP; and establishment of a fuel cycle policy. The technology assessment thus becomes the technical basis for preparation of bid documents in a subsequent stage.

The workshop will be conducted in Vienna from October 22-25, 2007 to bring together experts from within and outside IAEA and potential users of NPP technologies, to exchange information and discuss the approach and process of planning and conducting technology assessments. The discussion will also include general concerns and needs of Member States in planning to conduct technology assessments. The workshop will not be concerned with which designs are best candidates for any country – rather the workshop will examine the steps and approaches for successfully conducting technology assessment.

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IAEA's Thermo-physical Properties Database (THERPRO)

The IAEA has established the THERPRO data base in order to provide user's with openly available data on thermo-physical properties of reactor materials to achieve nuclear reactor design improvements and safety enhancements. As of the end of January 2007, there are 170 registered users from 38 Member States, representing 108 organizations

THERPRO contains over 13,000 data files for 250 reactor materials, descriptions of experiments, and bibliographic information.

Presently the data base is being updated with the addition of thermo-physical properties data of Russian nuclear reactor designs. This data has been received from IPPE, Obninsk, Russian Federation. The data include properties of nuclear fuel (metallic and ceramic), coolants (gases, water, D_2O, liquid metals), moderators, absorbers, and structural materials.

THERPRO is directly accessible via web site address http://therpro.hanyang.ac.kr] and through a link from IAEA's Web site.

Contact: S.Moon@iaea.org.

Advances in Fast Reactors and Accelerator Driven Systems

Activities are conducted with the advice and support of the Technical Working Group on Fast Reactors (TWG-FR), addressing all technical aspects of FR and ADS research and development, design, deployment, operation, and decommissioning. The following summarizes recent progress and plans:

The project has convened the kick-off Research Coordination Meeting (RCM) of the IAEA Coordinated Research Project (CRP) on *Analyses of, and Lessons Learned from the Operational Experience with Fast Reactor Equipment and Systems* in Vienna, from 23 to 26 April 2007. The specific objectives of the CRP are to preserve the feedback from commissioning, operation, and decommissioning experience of experimental and power sodium cooled fast reactors; enable easy access to the information from this feedback; and produce lessons-learned/synthesis reports from the commissioning, operation, and decommissioning of experimental and power sodium cooled fast reactors. To achieve these objectives, the CRP participants will retrieve, assess and archive all the documentation and information relevant to feedback from commissioning, operation, and decommissioning of sodium cooled fast reactors. The archiving step may include conversion of the documents in electronic form and the preparation of electronic databases organized along scientific/technical topics and reactors. Then, the CRP participants will work on the critical review, assessment, and systematization of the available data and will publish synthesis reports,

including the appropriate recommendations from the lessons learned. The participants in the RCM agreed to start the CRP addressing feedback from operational experience with regard to steam generators (SG), fuels and structural materials. A detailed list of activities, as well as work plan was established.

Participants at the Commemorative Symposium in Celebration of the 40th Anniversary of the TWG-FR, Tsuruga, Japan, 14-18 May 2007

The 2007 Meeting of the TWG-FR marked the 40th anniversary of this Technical Working Group. In commemorating 40 years of continued activities of the TWG-FR, and upon strong request from Member States, a Commemorative Symposium hosted by JAEA was held at the MONJU site in Tsuruga, Japan on the first day (14 May 2007) of the 40th TWG-FR Meeting.

In conjunction with the 40th TWG-FR Meeting on 14–18 May 2007, Member States interested in joining the IAEA's planned CRP on *Benchmark Analyses of Sodium Natural Convection in the Upper Plenum of the MONJU Reactor Vessel* (included in the P&B 2008 – 2009), participated in an IAEA consultants meeting on 11 May 2007 to prepare the CRP. The overall objective of the CRP is to improve the Member States' numerical simulation capabilities of complex thermal hydraulics of sodium cooled fast reactors. Specialists from the interested Member States will apply different methodologies in calculating the common benchmark exercises. In the first stage, benchmarking activities will focus on the numerical simulation of the natural convection phenomenon in the upper plenum of the MONJU reactor vessel, for which temperature and velocity field data measured during the original MONJU start-up experiments will be made available by JAEA. Based on the outcome of the first stage of the CRP, the possibility to extend the activities of the CRP to benchmark analyses of tests planned during the upcoming MONJU start-up will be discussed. By the same token, given the expressed views of the participants in the consultants meeting, the possibility to extend the scope of the CRP to benchmark exercises based on experimental data necessary for validating the coupled hydraulics of the hot pool and the remaining systems will be discussed in upcoming RCMs.

At the Commemorative Symposium to celebrate the 40th TWG-FR anniversary, senior Japanese and foreign scientists, as well as TWG-FR members delivered lectures and participated in a panel discussion. The overall objective of the Commemorative Symposium was to confirm the importance of the development and the utilization of nuclear energy, with particular emphasis on the fast reactor. Specifically, the lectures and the panel discussion addressed the future role of the fast reactor towards meeting sustainability requirements as a necessary condition for securing nuclear energy an important role in the world's long-term energy mix. The Commemorative Symposium looked back at the role of the TWG-FR (previously called IWG-FR, International Working Group on Fast Reactors) over the last 40 years and Member States' expectations for the future, as well as to the prospects of enhanced international collaboration under IAEA aegis. Last but not least, the expected role and contributions of MONJU to the benefit of worldwide fast reactor development efforts were discussed. The Commemorative Symposium was attended by approximately 100 participants, from JAEA, other Japanese organizations and universities, from local authorities and residents, especially students, and the press. The audience addressed questions to the panelists and to the lecturers, engaging them in a lively dialogue.

The 40th TWG-FR Meeting, hosted by JAEA in Tsuruga and Kyoto from 14 to 18 May 2007, reviewed national and international research and technology development activities in the area of fast neutron systems (critical and sub-critical). The meeting further reviewed the status of the activities performed within the framework of the TWG-FR, and discussed plans for future activities (P&B 2008–2009 and beyond).

Participants in the 40th TWG-FR Meeting, at the MONJU reactor site

Visit: http://www.iaea.org/inisnkm/nkm/aws/fnss/.
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Advances for Gas Cooled Reactors

The Technical Working Group for Gas Cooled Reactors (TWGGCR) met on 15-17 January 2007 to present the national programmes and to provide the IAEA with recommendations for activities in the area of gas cooled reactors and their application for electricity generation and process heat applications, such as desalination of seawater, enhanced oil recovery or hydrogen production.. Highlights of presentations include the following:

At the international level, HTGR-related R&D projects are under way in several Member States, including South Africa, China, Japan, Russian Federation, USA, several countries of the European Union, Republic of Korea and Switzerland. The European Commission is supporting and coordinating several important projects on the HTGR, such as RAPHAEL. Major work is also performed within 2 Generation IV projects on helium cooled reactors, i.e. the very high temperature reactor and the gas cooled fast reactor.

In China, safety tests have been successfully performed with the 10 MW(e) high temperature gas cooled reactor (HTR-10) and plans are also in place for the design and construction of a power reactor prototype (HTR-PM).

In France the gas-cooled reactor programme is focused on two Generation-IV concepts, namely the very high temperature reactor (VHTR) and the gas fast reactor (GFR) concepts. The VHTR programme is focused on fuel fabrication and qualification, helium, material and graphite testing as well as waste minimization. The GFR programme is currently focused on the selection of a reference design. A decision on the construction of a 50 MW(th) Experimental Technological Demonstration Reactor will be taken in 2007 and construction of a prototype might take place by 2025.

Germany has operated two HTGRs in the past, AVR and THTR-300, which are both in the decommissioning phase. R&D activities in the areas of safety, back-end and high-temperature materials are pursued with the frame of current EU projects such as RAPHAEL, PUMA, or EXTREMAT.

Following the oil crisis of 2005 in Indonesia, a national research agenda has advocated an energy mix policy with an increasing role foreseen in the future for nuclear and renewable energy sources. Interest in high temperature gas cooled reactors for co-generation of electricity and process heat continues with occasional national seminars held.

In Japan, a 30 MW(th) high temperature engineering test reactor (HTTR) began operation in 1998 and work continues on safety testing and coupling to a hydrogen production unit. A 300 MW power reactor prototype is also under consideration.

In the Republic of Korea a key technology development project was launched from 2006 for the six year period by the Ministry of Science and Technology. Main research topics under the project are the development of a computer code system for GCR core design and safety analysis, coated particle fuel manufacturing capability and characterization methods, iodine-sulphur thermo-chemical process of hydrogen production, and coupling technology between the reactor core and hydrogen production process.

In the Netherlands, two organisations are carrying out research on gas-cooled reactors: NRG and the Delft University of Technology. Two types of gas-cooled reactor are subject of research: the high temperature reactor and the gas-cooled fast reactor. Both projects are in the framework of the European Commission (i.e. RAPHAEL and GCFR).

The Russian Federation, in cooperation with the USA, continues its research and development work on a gas turbine modular helium reactor (GT-MHR) for plutonium disposition, the first module commissioning is expected to be in 2019. Up to the present, the conceptual and the preliminary designs were successfully completed. The present phase is the demonstration of technologies. Technology demonstration includes the R & D on main components (fuel, power conversion system, reactor system, vessel system).

In South Africa, PBMR (Pty) is accelerating its efforts on licensing work on a 165 MW(e) pebble bed modular reactor (PBMR) which is expected to be commissioned around 2012. The South African Government has already allocated initial funding for the project and orders for some lead components have already been made.

Switzerland is engaged in both gas reactor technologies within GIF, the very high temperature reactor and the gas cooled fast reactor. The main contribution of Switzerland concerning VHTR is in the field of materials. The main Swiss GFR contribution concerns design and safety aspects.

In the United Kingdom four Magnox reactors remain in operation. Performance of the 14 AGRs has been poor in recent times due to a serious of faults requiring rectification. Independent design / consultancy organisations and individuals are extensively involved in supporting international GCR projects such as the EU Framework 6 initiatives on materials qualification, the PBMR project and others. A national nuclear laboratory has been established on the Sellafield site, and University

research continues to be greatly assisted by initiatives from the British Nuclear Group.

Gas cooled reactor development in the United States is being driven by the Next Generation Nuclear Plant (NGNP) project. This project consists of research, development, design, construction, licensing, and operation of a prototype nuclear plant, including a very high temperature reactor that can be used to generate electricity, hydrogen, and/or process heat. The NGNP Project is to be conducted in two phases. Phase I entails research, development, and initial design of a prototype NGNP reactor to be completed no later than September 2011. Phase II entails development of a final design and the construction, operation, and U.S. Nuclear Regulatory Commission (NRC) licensing of the NGNP reactor with construction and initial operation of the reactor to be completed no later than September 2021.

The TWGGCR also made recommendations to the IAEA for activities in 2007, which included topics for coordinated research projects and for an information exchange meeting.

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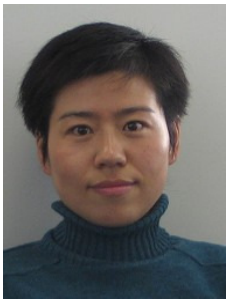
New Staff in Nuclear Power Division



LI, Xiaoping

Ms. Li has recently taken up duties in the Nuclear Power Engineering Section as a power engineer/economist where she will assist in formulating and implementing the Agency's activities on nuclear power planning methodologies. She will support activities related to direct assistance and advice to Member States in the area of infrastructure relating to bidding and financial planning for nuclear power plant construction. Ms. Li holds a Master of Science degree in Nuclear Engineering and Radiological Sciences from the University of Michigan. Ms. Li has been working in several engineering positions (safety analysis, maintenance and commissioning, and facility management), her latest being Section Head for the safety and licensing group at Sanmen Nuclear Power project where she worked in multi-national teams on bidding evaluations.

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Current Vacancy Notice for Professional Posts in the Nuclear Power Division

Below is the list of current vacancies in the Division of Nuclear Power, IAEA. Applications from qualified women and candidates from developing countries are encouraged.

Nuclear Engineer

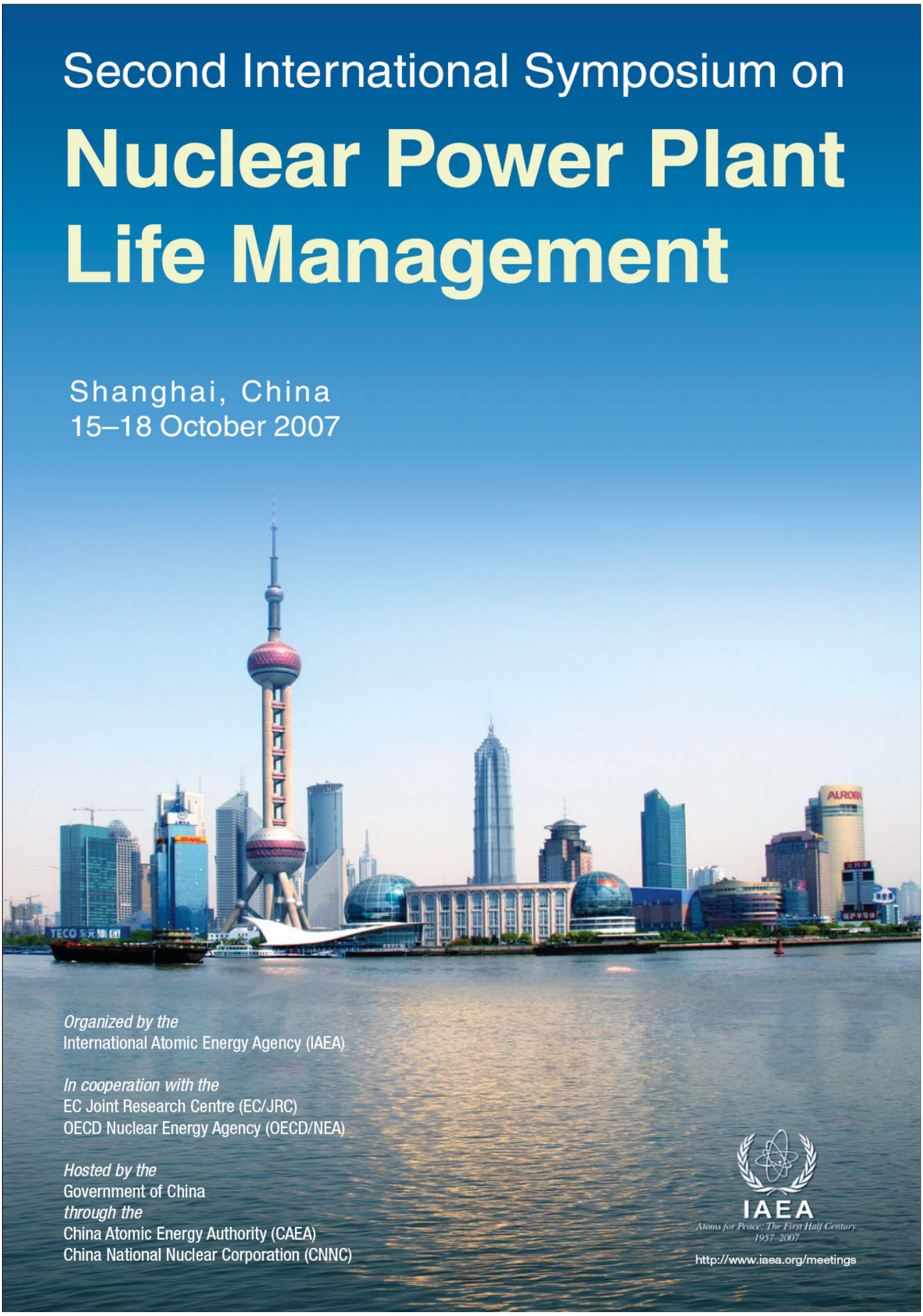
As part of a team led by the Head of Nuclear Power Technology Development Section, the Nuclear Engineer formulates, develops, organizes and implements the IAEA's activities on technology development and design aspects of innovative nuclear reactors, fuel cycles and their potential application. This assignment is related to the IAEA's INPRO, which is primarily an extrabudgetary programme.

For more information:

http://recruitment.iaea.org/vacancies/p/2007/2007_606.html

Upcoming Meetings

Start Date	End Date	Title	Location	Country
18-Jun	22-Jun	RCM of the CRP on Conservation and application of HTGR technology: Advances in HTGR fuel technology	Vienna	Austria
19-Jun	21-Jun	TM on Common-cause failures in digital Instrumentation and Control (I&C) Systems of NPPs	Bethesda	USA
25-Jun	29-Jun	Workshop on Natural Circulation in Water-Cooled Nuclear Power Plants	ICTP Trieste	Italy
02-Jul	04-Jul	11th INRPO Steering Committee Meeting	Vienna	Austria
02-Jul	04-Jul	Advisory meeting with nuclear hydrogen experts	Vienna	Austria
03-Jul	06-Jul	TM on methods for the replacement of main components (steam generator, reactor vessel head, reactor internal)	Vienna	Austria
28-Aug	31-Aug	TM on implementing and licensing digital I&C systems and equipment in NPPs	Halden	Norway
03-Sep	06-Sep	TM to disseminate good practices on training and performance of Nuclear Power Plant (NPP) maintenance personnel and contractors	Balatonfüred	Hungary
10-Sep	13-Sep	RCM of the CRP on natural circulation phenomena, modelling and reliability of passive systems which utilize natural circulation	Vienna	Austria
24-Sep	28-Sep	RCM of the CRP on advances in nuclear power process heat applications	Vienna	Austria
24-Sep	28-Sep	TM on Lessons Learned from Large Modernization Projects in I&C Systems	Chatou	France
01-Oct	03-Oct	TM on Water Chemistry of Nuclear Power Plants (NPPs)	Moscow	Russian Federation
08-Oct	11-Oct	TM on Country Nuclear Power Profiles	Vienna	Austria
15-Oct	18-Oct	International Symposium on Nuclear Power Plant Life Management	Shanghai	China
15-Oct	18-Oct	TM to review options to break the economy of scale for SMRs	Vienna	Austria
22-Oct	26-Oct	Deep User Group meeting	Gran Canaria	Spain
28-Oct	03-Nov	TM on integration of analog and digital instrumentation and control (I&C) systems in main control rooms of in Nuclear Power Plants (NPPs)	Toronto	Canada
29-Oct	09-Nov	Workshop on Nuclear Power Plant Simulators for Education	ICTP Trieste	Italy
05-Nov	09-Nov	TM/Workshop on Milestones for Nuclear Power Infrastructure Development	Vienna	Austria
12-Nov	16-Nov	RCM of the CRP on Analytical and Experimental Benchmark Analyses of Accelerator Driven Systems (ADS)	Rome	Italy
13-Nov	16-Nov	8th Joint Workshop on IAEA safety standards on management systems	Vienna	Austria
19-Nov	30-Nov	Workshop on technology and applications of accelerator driven systems	ICTP Trieste	Italy
03-Dec	05-Dec	12th INPRO Steering Committee Meeting	Vienna	Austria
10-Dec	14-Dec	TM on the preparation of a technical document on emerging designs and deployment challenges of modular HTGR plants	Vienna	Austria
10-Dec	13-Dec	TM on Integrated Nuclear Desalination Systems	Cadarache	France
11-Dec	14-Dec	TM on the implementation of fast reactor data retrieval and knowledge preservation activities	Vienna	Austria


Second International Symposium on
Nuclear Power Plant Life Management
Shanghai, China
15–18 October 2007
Organized by the
International Atomic Energy Agency (IAEA)
In cooperation with the
EC Joint Research Centre (EC/JRC)
OECD Nuclear Energy Agency (OECD/NEA)
Hosted by the
Government of China
through the
China Atomic Energy Authority (CAEA)
China National Nuclear Corporation (CNNC)
IAEA
Atoms for Peace: The First Half Century
1957–2007
http://www.iaea.org/meetings

INTERNATIONAL ATOMIC ENERGY AGENCY
and
FORATOM Business Excellence Working Group
8th Joint Workshop

IAEA Safety Standards on Management Systems

From Concept into Practice

Nov 13-16, 2007 Vienna, Austria

IAEA International Atomic Energy Agency

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