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Nuclear Power Newsletter

A newsletter of the Division of Nuclear Power
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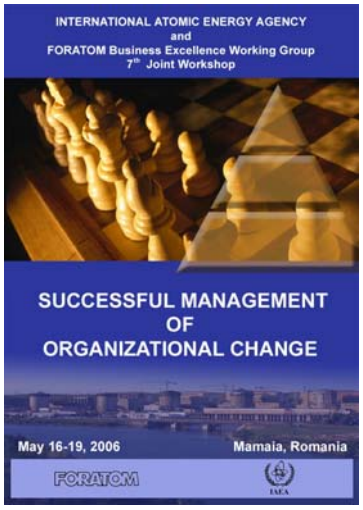
The 7th IAEA - FORATOM Joint Workshop on Successful Management of Organizational Change



The IAEA and FORATOM continue their fruitful cooperation and after 18 months of preparation a very important workshop was organized in Mamaia, Romania on 16-19 May 2006, which addressed the specifics of organizational change. The topic is very current because organizations engaged in applying nuclear technology research and application have undergone dramatic changes since their inception, but never so much as now. As in the past, the rewards for proactively changing in anticipation of emerging demands are great, but the cost of failure is also great. Much has been learned since 2000 about planning and implementing organizational change. The overriding influence on these factors is strong leadership of the business, involvement of the workforce throughout the change process and effective regulation. In particular, it is necessary for both nuclear organizations and their regulators to understand that enhancing safety is part of all successful changes. The workshop gave information to participants how they respond to the inevitability of change in and on their organization and how to adapt the change effectively.

The objective of the workshop was to provide a forum for exchanging experience and information regarding the successful management of organizational change. The focus of the workshop was to identify common difficulties, possible solutions and good practices that will lead to an improvement in the overall performance regarding safety. The workshop enabled the participants to discuss, in a series of parallel working group sessions, their experiences in managing organizational change and their impact on the organization.

There were 84 participants from 21 Member States. An entire day was devoted to each of the key issues. In the morning, the sub-issues were addressed through directly-related lectures. In the afternoon, there were three working group sessions with facilitated discussion of the issues – including potential difficulties and opportunities. Summaries of working group discussions were presented and discussed in plenary sessions held at the end of each day. Contact P.Vincze@iaea.org.

Message from the Director

Welcome to the 2nd Newsletter of NENP for 2006.

In this Newsletter I would like to inform you that the Department of Nuclear Energy has started systematic activities to establish IAEA's Nuclear Energy Series documents. In the past, IAEA guidance documents on nuclear energy, proceedings of conferences and symposia, and others, have been identified only by the Agency's sequential numbering system applied to, for example, IAEA-TECDOCs and Technical Reports Series. That system was not "user friendly", because it did not provide a structure which a user could use for ease in finding documents on various topics, nor did it provide a consistent, systematic and effective overview of the Nuclear Energy Department's role in producing publications by identifying important gaps.

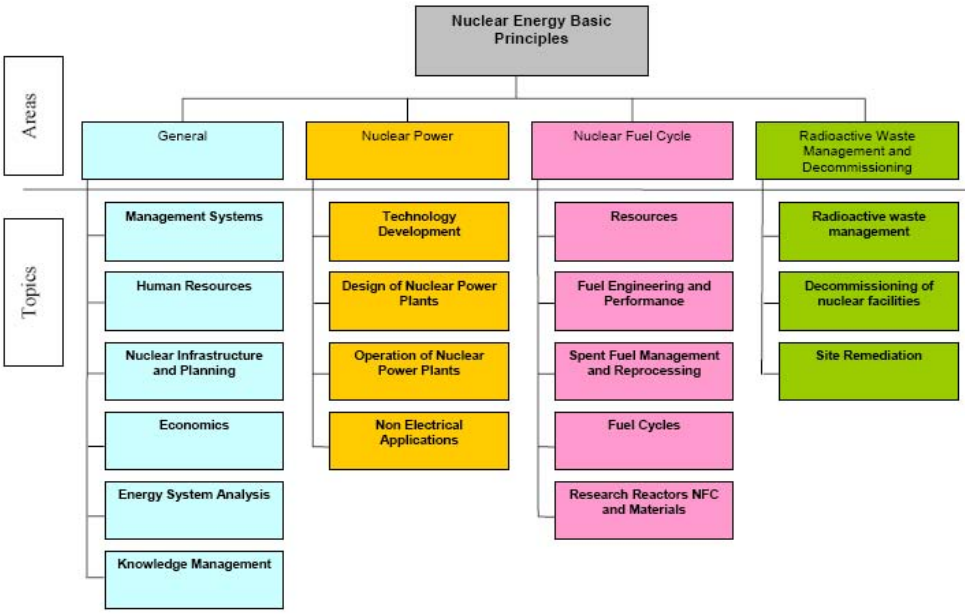
Therefore, the Nuclear Energy Department has carefully considered how its approach to planning and preparing documents could be improved. The Department concluded that establishing a hierarchy structure, improving the process including external review, and ensuring the relevance of documents through an established preparation, re-examination and periodic revision process, would lead to increasing visibility and credibility of the documents, and would provide a standard approach to document preparation. The Nuclear Energy Series of documents can be used as reference material providing a solid basis for the Nuclear Energy Department's technical advice to Member States.

The structure of the document is as shown here. A clickable map on the web would enable electronic access to all the documents on the specific topics. For the area of "Nuclear Power", four topics are specified: Technology Development, Design, Operation and Non-Electric Applications. Topics covered under the "General" area are: Management Systems, Human resources, Knowledge Management, Infrastructure Building.

Also, the Department of Nuclear Energy initiated Document Coordination Team (DCT) meetings, which have the functions listed below:

- To define the Nuclear Energy Series document structure
- To establish a document preparation/review process
- To review documents from their proposal to the final product
- To consider a plan for future document development including updating
- To ensure a standard approach in document production and a good interface with stakeholders outside of the Nuclear Energy Department.

Detailed structure of the Nuclear Energy Series Level 1 and Level 2



I hope as a result of the efforts, IAEA documents on Nuclear Energy are further improved in quality and that the Nuclear Energy Series structure will prove to be quite user friendly.

E-mail: A.Omoto@iaea.org

Nuclear Power Plant Operation

Instrumentation and Control

Three consultants meetings were held recently in the field of NPP instrumentation and control (I&C). The first meeting was held on 13-16 March in Vienna with 5 invited experts from 4 countries. The purpose of the meeting was to initiate a new technical document (IAEA-TECDOC) on **Integration of analog and digital I&C systems in hybrid main control rooms**. 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 main control rooms. The outline of the IAEA-TECDOC and its first draft version has been produced.

The second meeting was held on 27-30 March in Vienna with 8 experts from 7 countries. The purpose of the meeting was to initiate a new IAEA-TECDOC titled **Avoiding common-cause failures in digital I&C systems of NPPs. 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. 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. The IAEA-TECDOC describes techniques and tools used for preventing common cause failures in digital I&C systems. The outline of the IAEA-TECDOC and its first draft version has been produced.

The third meeting was held on 3-7 April in Vienna with 12 experts from 7 countries. The purpose of the meeting was to further develop the IAEA-TECDOC titled **On-line Monitoring for NPPs; Part 2 Process and Component Condition Monitoring and Diagnostics**. The goal of on-line monitoring is to verify the performance and availability of process systems and components in a non-intrusive passive way. The IAEA-TECDOC describes state-of-the-art technologies and proven monitoring and signal processing techniques that can be applied for diagnostic purposes while the plant and its instrumentation are “on-line”. The IAEA-TECDOC, which was initiated last June, is planned to be published within a year. All three IAEA-TECDOCs are intended to present guidelines and good practices to utilities, regulators, and technical support organizations. Contact: O.Glockler@iaea.org.

Nuclear Power Plant Maintenance

On 22-24 May 2006, a consultants meeting on **WWER Water chemistry guideline under development** was held in IAEA Headquarters, Vienna. Four international renowned experts from four countries participated in the meeting. Participants confirmed the high priority and timeliness of the IAEA-TECDOC on water chemistry of WWER. An agreed-upon outline of the technical document on water chemistry of WWERs was developed. A timetable for future activities was defined.

There are two other on-going activities at the IAEA in order to help the MS with regard to water chemistry. All these three activities are well coordinated and exactly positioned. The Safety Guide provides all the principle statements and act as a “check list” to verify the effectiveness of plant water chemistry program, especially during the OSART missions, for all types of reactors; The IAEA-TECDOC provides the detailed guideline (important issues, operational regimes, and parameter limits and conditions of water chemistry) for WWER reactors only; and the CRP is focused on issues of fuel reliability and performance under higher burn-up and ageing plant conditions, and applicability of some innovative techniques of one type reactor to the other types of reactors.

During this consultants meeting, a timetable for future activities was defined. In July, a TC workshop on water chemistry will be held in Karlsruhe for the Central and Eastern Europe. This will be a good opportunity for MS

to contribute to and comment about the IAEA-TECDOC; the 2nd consultants meeting will be organized in April 2007 in VIC; and finally, a TM in October 2007 in Moscow. Contact: H.Cheng@iaea.org.

Integrated NPP Life Cycle Management

As about half of all worldwide installed NPPs have over 20 years of operation, plant life management issues and activities for continued operation are a topic of great relevance to the future of nuclear power plant. To meet Member States' wishes, **the 2nd international symposium on plant life management(PLiM)** will be held on 15-18 October 2007 at Shanghai, China. In this connection the preparatory technical meeting was held on 4-6 April 2006 at VIC to prepare the structure and scientific programme for the 2nd international symposium on PLiM with following items with 28 technical committee members from 22 MS and 2 the international organizations.

The announcement and call of paper was completed by the TCMs and distributed to 22 MS. The second technical committee meeting will be held at Shanghai in May 2007 to fix the 2nd international symposium programme and check the preparation and real situation.

A consultants meeting on **Power Uprate and Side effects of Power Uprate** was organized to prepare the draft version on 9-12 May 2006 at VIC. The increase in the electricity produced in a NPP can be achieved in two ways. One way is to increase the thermal power in the reactor, and the other way is to improve the thermal conversion efficiency in the power plant by refurbishing or replacing the high-pressure or low-pressure turbine units or a combination of these actions.

The purpose of meeting was to collect national experience and discussion with following objective:

- To develop the extended outline of a new technical document;
- To identify the needs in specific data, and to collect country reports;
- To identify pre-conditions for power uprate;
- To discuss technical, economical and regulatory issue on power uprate;
- To plan further activities to develop a technical document.

A new IAEA-TECDOC-1503 on **Nuclear Plant Life Management Processes: Guidelines and Practices for Heavy Water Reactors** was published recently.

The IAEA-TECDOC provides an overview of the various PLiM methodologies, technologies and processes for HWRs to achieve life attainment for long term operation. Implementation of a systematic and comprehensive PLiM program, such as that outlined in the IAEA-TECDOC, goes a long way towards meeting the overall goal of HWR owners/operator to successfully achieve design life and long term operation. Additionally technical aspects to HWR PLiM are described on component specific technology considerations for condition assessment, example of a proactive ageing management program, and Ontario power generation experiences in appendices. Also country reports from Argentina, Canada, India, the Republic of Korea and Romania are attached in annex to share practices and experiences to PLiM programme.

A new technical proceeding on **Material Degradation and Related Managerial Issues at Nuclear Power Plants** was published.

The trend for NPPs to wish to operate in excess of their original license period is presented in terms of plant-life management for long-term operation. This underlines the fact that older NPPs may be in a better technological condition than when they first went into operation. In TECODC on **the flow accelerated corrosion (FAC), past and recent incidents** are presented here with the aim to highlight what operators, owners and regulators should do to prevent, decrease the risk of occurrences or enhance regulatory control in the future. The main results and lessons learned from incidents or accidents to material degradation and managerial issues of nuclear power plants are identified wherever weaknesses in the associated management processes of NPP operation have been involved. Contact: K.S.Kang@iaea.org.

Databases to Support NPP Performance

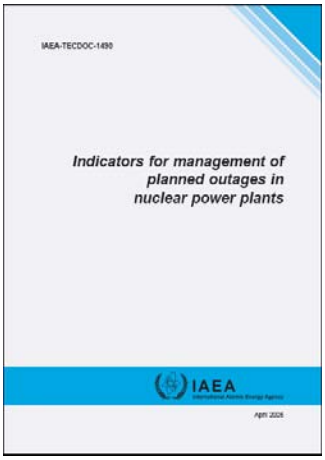
PRIS provides a wide range of information about nuclear power plant status and performance. To assist end-users as an efficient tool for nuclear power analyses and benchmarking the outputs from PRIS have to be easily achievable using predefined structures, forms and ranges. The outputs have to reflect both end-user needs and the latest development of PRIS and its external modules (non-electrical application, decommissioning).

The consultants meeting, which took place in the IAEA Headquarters on 24-27 April 2006, discussed the current structure of PRIS outputs and possibilities for improvement of their applicability in NPP operating performance analyses. This activity coordinates

developments in PRIS aiming to provide users with practical tools for relevant data analysis

The discussion on development and improvement of PRIS outputs was divided into three main topics:

- Set of performance indicators used in PRIS and proposed for its extension;
- Structure and scope of information on the PRIS web-site and in annual publications;
- Reporting system "PRIS-Statistics" and optimization of its filters and selection criteria for report generation.



A new IAEA-TECDOC-1490 on **Indicators for Management of Planned Outages in Nuclear Power Plants** was published.

Outage optimisation seeks to ensure that scheduled work is performed effectively, safely and within budget, while keeping the outage time at an optimum. The objectives for good and efficient outage execution are a safe status of the unit during outage, disturbance-free operation of the next cycle, and execution of the outage according to schedule and budget, with the minimum impact on personnel and the environment.

The IAEA-TECDOC-1490 presents principles and assumptions for outage monitoring using a set of quantitative indicators. It provides guidelines for plant specific outage monitoring system implementation and criteria for selecting outage performance indicators and their appropriate use. The document addresses outage performance indicators to:

- monitor progress during the pre-outage phase and adherence to the pre-outage milestones;
- assess the outage execution;
- evaluate the efficiency and quality of the work done.

Based on international practices, a set of potential indicators for an outage monitoring system has been selected and defined. The indicators chosen apply to all outage phases and follow the recommended selection criteria. The document provides also illustrations how various sets of indicators are used at nuclear power plants to efficiently monitor and assess outage processes. Management of NPP operating organizations can consider these recommendations and indicators for use in their own plant outage monitoring systems. Contact: J.Mandula@iaea.org.

Management System, Regional Infrastructure and Training

Strengthening National and Regional Nuclear Power Infrastructures

The development of a technical document providing guidance for **Restarting Delayed Nuclear Power Projects** was initiated during a Consultants Meeting on 28-30 March 2006. The new document will focus on assisting to strengthening the owner's function for completing delayed NPPs after the decision for restarting is adopted. The guidance will provide practical methodologies and examples of successful practices. It will address management issues of delayed NPPs including: preparation of restarting, structuring of the project, licensing, construction, commissioning and start of operation. Target users are managers and engineers from nuclear utilities, supplier and technical support organisations. The information will also be useful for decision makers and advisors from governmental organizations such as: regulatory bodies, ministries, research & development and others involved with restarting delayed NPP projects. The preparation schedule foresees the finalized document by the end of 2006.

A consultants meeting held on 23-26 May 2006 prepared the first draft document describing the Milestones in the Development of the Infrastructure necessary for a country deciding the first NPP project. The milestones and identification of related activities can serve to: a) Member States to assess their own status and progress, and determine the degree of preparedness for developing the first NPP; and b) Agency to decide when provision of training or other services are appropriate for efficient use of resources. Decision makers, advisers and senior managers for a country interested in developing nuclear power will use the document to determine the infrastructure necessary to start various activities on the road to planning, purchasing, building, operating and maintaining the first NPP. The finalized document is scheduled for early 2007. Contacts: I.Facer@iaea.org, N.Pieroni@iaea.org.

Strengthening and Harmonizing Quality Management System

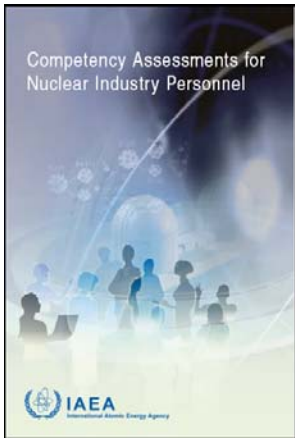
Draft Standard on **Application of Management System for Nuclear Facilities** was presented to the Safety Standard Committees

As a result of close cooperation between the Department of the Nuclear Energy and the Department of Nuclear Safety draft standard was presented to the Safety Standard Committees. The Committees reviewed the draft and gave numerous comments to improve the content of the document. All comments were resolved and addressed. The new draft will be submitted to the Safety Standard Committees for approval in August 2007.

The development of this standard is a very good example of the cooperation and "one-house approach" between the IAEA departments, and will serve as an example for the future activities. Contact: P.Vincze@iaea.org.

Effective Training to Achieve Excellence in Human Performance

The first consultants meeting to develop the new IAEA guidelines: **A Manager's Guide for Evaluating Training and the Work Environment to Increase Organizational Performance** was held from 12 to 16 of June 2006 at the IAEA Headquarters. Specialists from Canada, Sweden, USA and IAEA took part. The guidelines will be focused on improving human and plant performance through integration of training evaluation in the plant management processes; on providing guidance to the plant managers how to evaluate training effectiveness in measurable terms; and on reinforcing line managers' ownership for the result-based training. The guidelines will be prepared for publication in 2007 in the framework of the IAEA Nuclear Energy new document structure. A new approach for validation of the guidelines is suggested by the meeting participants: along with regular development and review activities (a technical meeting to review a draft is scheduled for 15-18 May 2007), it is suggested to 'pilot' the techniques and case studies of the guidelines at one or more NPPs. This may be a 'win-win' situation for both the quality of the document and the plant which the guidelines are 'piloted' at. Those who are interested in cooperation (hosting the 'piloting' or contribution to the document) please contact A.Kazennov@iaea.org.



In April 2006, a new IAEA document was published entitled, **Competency Assessments for Nuclear Industry Personnel**. The nuclear industry spends a significant amount of its resources conducting competency assessments of personnel for employee selection, trainee assessment, qualification and authorization. This document provides guidance in how to ensure that these resources are used effectively. Contact: T.Mazour@iaea.org.

Two workshops were conducted in Republic of Korea at the Nuclear Power Education Institute of the Korea Hydro & Nuclear Power Co. Ltd, under an IAEA regional technical cooperation project RAS/4/021 **Management of Change for Competitive Nuclear Power Performance**. The first workshop from 15 to 19 May was on good practices and lessons learned regarding operation and maintenance of NPP electrical generators. The second workshop from 22 to 26 May addressed management of human resources with focus on **age profile management and career development**. Totally 43 participants from 9 Member States and IAEA took part. Participatory approach, presentations by the participants focusing on the actual NPP needs and practices, case studies and alive discussions, competent facilitators, and excellent support by the hosting organization contributed to the success of the peer-to-peer exchange of experience.

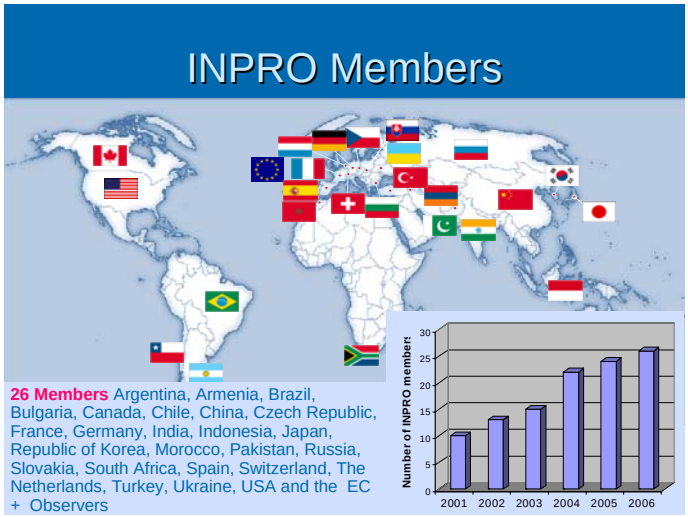
Assistance is being provided to Chernobyl NPP in establishing the integrated human resource management and effective training for decommissioning of units 1, 2 and 3, and for other site projects. Essential support has been demonstrated by the Chernobyl NPP senior and line managers. An expert mission under a technical cooperation project UKR/4/011 was performed from 6 to 10 March 2006 to assist in the development of a strategic document on human resource management and training.

Further transfer of know-how and support to the Chernobyl NPP on personnel issues will be provided during a workshop from 17 to 21 July 2006 in Slavutich. Participants represent the entire Ukraine's nuclear power industry. Experts from Lithuania, Russia, Slovakia, the UK, USA and IAEA are involved in transfer of know-how and coaching of the Ukraine's colleagues.

Continuous support is being provided to Ukraine under a technical cooperation project UKR/4/012 in improving NPP maintenance activities and maintenance personnel training. Recently two workshops (in March 2006 and May-June 2006) were held at Paks NPP Maintenance Training Centre. Know-how in maintenance personnel training was transferred to fifty-six Ukraine's colleagues representing both the plants and training departments through the workshops held at Paks NPP during 2005-06. A number of state-of-the-art multimedia computer-based training (CBT) systems are supplied to Zaporozhzhie NPP through the IAEA (contractors from various countries are involved). The CBT systems serve for training, assessment, knowledge preservation and pre-job briefings (recently the CBT systems on maintenance of Safety Valves, Steam Generator, Spent Fuel Storage and I&C were supplied). The IAEA also supports in improvement of project management for the establishing the Ukraine's Maintenance Training Centre (MTC) at Zaporozhzhie NPP. A meeting and from 5 to 9 June 2006 with the Zaporozhzhie NPP and operating organization ENERGOATOM management staff was the important activity to evaluate and improve project management of the Ukraine's national training development projects. The countries and organizations interested in support of and cooperation in the MTC for the WWER-1000 type reactors are welcomed. Contact A.Kazennov@iaea.org .

International Project on Innovative Nuclear Reactors and Fuel Cycles

The 21st century promises the most competitive, globalized markets in human history, the most rapid pace of technological change ever, and the greatest expansion of energy use, particularly in developing countries. For a technology to make a truly substantial contribution to energy supplies, innovation is essential. It will be the defining feature of a successful nuclear industry and a critical feature of international co-operation in support of that industry, co-operation that ranges from joint scientific and technological initiatives, to safety standards and guidelines, and to security and safeguard activities.



The International Project on Innovative Nuclear Reactors and Fuel Cycles (INPRO) was initiated in the year 2000, based on a resolution of the IAEA General Conference (GC(44)/RES/21). Thereafter, INPRO activities have been continuously endorsed by resolutions of the IAEA General Conference and corresponding United Nations General Assemblies.

INPRO has the following Members as of June 2006:

Members contribute to the project by providing funding, experts and studies. INPRO is an IAEA wide project, being co-ordinated by the Department of Nuclear Energy with contributions from all IAEA Departments and Divisions.

INPRO is characterized by a broad international effort to facilitate the development of innovative nuclear reactor and fuel cycle technology, recognizing that:

- A sustainable energy supply for humanity in the 21st century will require the large-scale deployment of nuclear energy as well as other energy sources;
- Nuclear power is an energy technology that offers practically unlimited energy resources whose deployment can reduce environmental pollution and

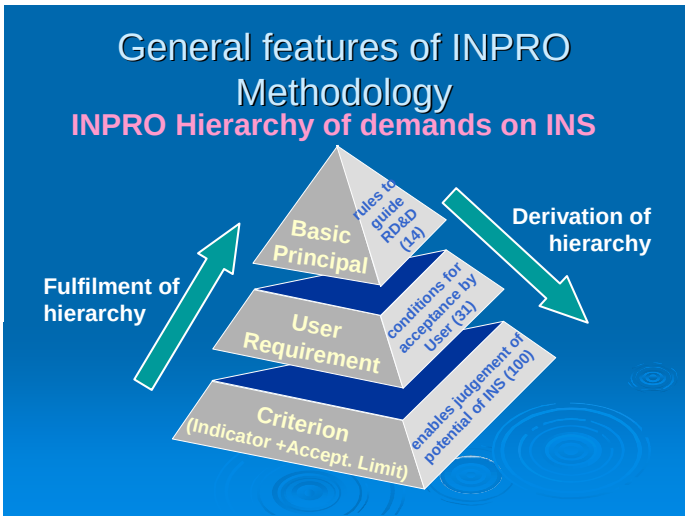
the volumes of waste needing management, including greenhouse gas emissions.

INPRO provides an open international forum for studying the nuclear power option, and associated requirements and application potential in IAEA Member States. INPRO is a tool for developing and preserving competence in the development and deployment of INSs and for assisting Member States in the coordination of related collaborative projects.

The INPRO methodology seeks to ensure that INS can contribute, in a sustainable manner, to the energy supply needs and the general objective of sustainable development, taking into account the four dimensions, namely, social, economic, environmental and institutional.

INPRO has developed a set of **Basic Principles**, **User Requirements**, and **Criteria** as a basis for the assessment of INS in the areas of economics, safety, environment, waste management, proliferation resistance, physical protection and infrastructure.

The INPRO methodology provides guidance on how to apply these requirements in evaluating a given INS, taking into account local, regional and global boundary conditions that would apply to both, developing and developed IAEA Member States.



The INPRO methodology, tested for consistency and completeness, has been reported in IAEA-TECDOC-1434 on **Methodology for the assessment of innovative nuclear reactors and fuel cycles**.

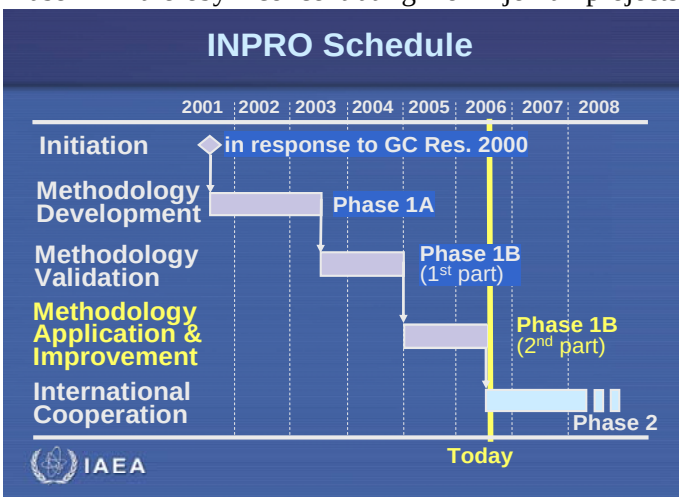
INPRO was requested to provide additional guidance to applicants of the INPRO methodology in form of an assessment manual for all INPRO areas.

The INPRO method of assessment provides tools that can be used to:

- Screen INS for their compatibility with the INPRO set of Basic Principles and User Requirements;
- Compare different INS or components thereof to find a preferred or optimum INS consistent with the needs of a given IAEA Member State;
- Identify the research and development needed to improve the performance of existing INS components and for the development of new components.

To assess an INS, based on the respective Basic Principles, User Requirements and Criteria, it is necessary to take into account a set of energy development scenarios. For the development of these scenarios modelling tools are used, which have been adapted for the specific requirements in INPRO.

INPRO is at the end of Phase 1 now and plans to start Phase 2 thereby concentrating on joint projects



determined by its members as outcome of ongoing assessment studies.

Major elements of the current activities include the finalization of the INPRO User Manual, which will assist users in the application of the methodology for INS assessments, defining and modeling of INS deployment scenarios, and the facilitation of INS assessments by Member States on a national or international basis.

Various tools to support INPRO activities are being developed. One of these is a collection of INS country profiles of research capabilities to support INPRO members in finding partners for collaborative projects. Another one is the so-called INPRO portal intended to assist and enhance communications among INPRO members; it includes a database of inputs and results of INPRO assessment studies. Additionally, Nuclear Power Development Modeling tools are available in the INPRO portal to assist INPRO members to establish energy scenarios for the introduction of nuclear power and to define and assess INS.

A workshop on the application of INPRO methodology for assessment of innovative nuclear energy systems was successfully convened on 26-30 June 2006 by attracting 34 participants from 28 countries including non-INPRO

members. The workshop played a strong role to disseminate INPRO achievements to IAEA MS, especially to those countries which are pursuing the option to introduce nuclear option in the near future.

The framework and implementation options for collaborative projects for INS developments within Phase 2 have been worked out by an ad-hoc meeting in April 2006. In this meeting potential topics for collaborative projects were presented by the INPRO MS.

At its 9th meeting in July 2006 the Steering Committee of INPRO is going to discuss the Terms of Reference for activities of Phase 2, which are expected to last until 2009, with the understanding that changes may be needed depending on findings within current activities.

Terms of Reference for the Phase 2 foresee that INPRO will continue in three directions: (1) further improvement of the INPRO methodology based on the feedback from INS assessments, (2) institutional/infrastructure oriented topics, and on collaborative project oriented activities.

Several assessments of INSs, performed by INPRO members on a national or international basis, are ongoing:

- Joint assessment based on a closed fuel cycle with fast reactors (Russian Federation, Canada, China, France, India, Japan, Republic of Korea, and Ukraine);
- Assessment of hydrogen generating INS in national energy mix (India);
- Study on the transition from the current fleet towards Generation IV fast neutron systems (France);
- Assessment of additional nuclear generation capacity in the country for the period 2010-2025 for the evaluation of NFC strategies (Argentina);
- Assessment of INS for countries with a small electricity grid (Armenia);
- Holistic assessment on complete DUPIC fuel cycle in the area of proliferation resistance (Republic of Korea);
- Two independent assessment studies on IRIS and FBNR (Brazil);
- Assessment study of NPP economics (Morocco);
- Assessment of advanced HTGR (China);
- Assessment of national INS (Ukraine); and
- Assessment of INS to meet energy demand during periods of raw materials insufficiency (Czech Republic, Bulgaria, Poland, Russian Federation, Slovakia).

The assessments performed are expected to contribute to identifying the needs and platforms for collaborative projects on an international scale and also to provide valuable feedback for further improvement of INPRO methodology. Contact: Y.Bussurin@iaea.org.

Technology Developments and Applications for Advanced Reactors

Common Technologies and Issues for SMRs

A new report on **Advanced Nuclear Plant Design Options to Cope with External Events** was published as IAEA-TECDOC-1487 addressing the issues of plant design, siting, safety assessment and component qualification regarding extreme external events. This report, produced with the participation of the designers of 14 advanced NPPs, including those with SMRs, is to assist the designers of advanced NPPs in the definition of a consistent strategy regarding plant protection from the impacts of extreme external events and, inter alia, outlines an important role of passive safety design options in such a protection.

A new report **Status of Innovative Small and Medium Sized Reactor Designs 2005: Reactors with Conventional Refuelling Schemes** was published as IAEA-TECDOC-1485. The objective of this report is to provide Member States, including those just considering the initiation of nuclear power programmes, and those already having practical experience in nuclear power, with a balanced and objective information on important development trends and objectives of innovative SMRs for a variety of uses, on the achieved state-of-the-art in design and technology development for such reactors and on their design and regulatory status. The main chapters of this report, addressed to a broad group of stakeholders, provide a summary of major specifications, applications and user-related special features of innovative SMRs. The annexes, intended mostly for designers and technical managers, provide detailed design descriptions of 26 innovative SMRs of various types focusing on their potential to provide solutions in the areas of concern associated with future nuclear energy systems.

A new project on examination of options to break the economies of scale for SMRs and to ensure their competitiveness under targeted market conditions has been started. The project will include preparation of a report on **Options to break the economies of scale for SMRs** and a Coordinated Research Project on **Identification of Competitive Technological Options for SMRs** (2006-2009). The objectives of these activities are to provide a framework to assist potential customers in their assessment of technical and economical performance of SMRs, to assist existing and potential stakeholders in the definition of a competitive strategy regarding design and deployment of SMRs, and to investigate the potential of SMR competitive applications. Contact: V.V.Kuznetsov@iaea.org.

Technology Advances in Water Cooled Reactors for Improvement in Economics and Safety

HWR User Requirements Document

The existing HWR based NPPs have accumulated more than 600 reactor years of operating experience. To assimilate and benefit from this experience, the IAEA Nuclear Energy Department's Technical Working Group on Advanced Technologies for Heavy Water Reactors (TWG-HWR) has taken the initiative to establish a HWR user requirements document (HWR-URD) to provide a set of user requirements for new, evolutionary, HWRs.

This consensus document, which is now nearly final, has been prepared by 51 experts from operating organizations and design and development organizations, especially from the seven IAEA Member States that have operating HWRs. It assimilates experience from design, construction, and operation into requirements and guidance for future HWRs. Specifically, it provides high-level (or top-tier) and overall requirements, plus detailed guidance and recommendations for horizontal pressure tube, heavy water moderated and cooled plants.

The requirements, guidance, methodologies and examples represent an integration of the overall requirements (safety design, performance design, structural design, materials, plant availability, construction and constructability, operability and maintainability, quality assurance, licensing, design process and documentation, mechanical equipment, instrumentation, control and electrical design, and balance of plant interfacing) that must be considered in developing an HWR NPP.

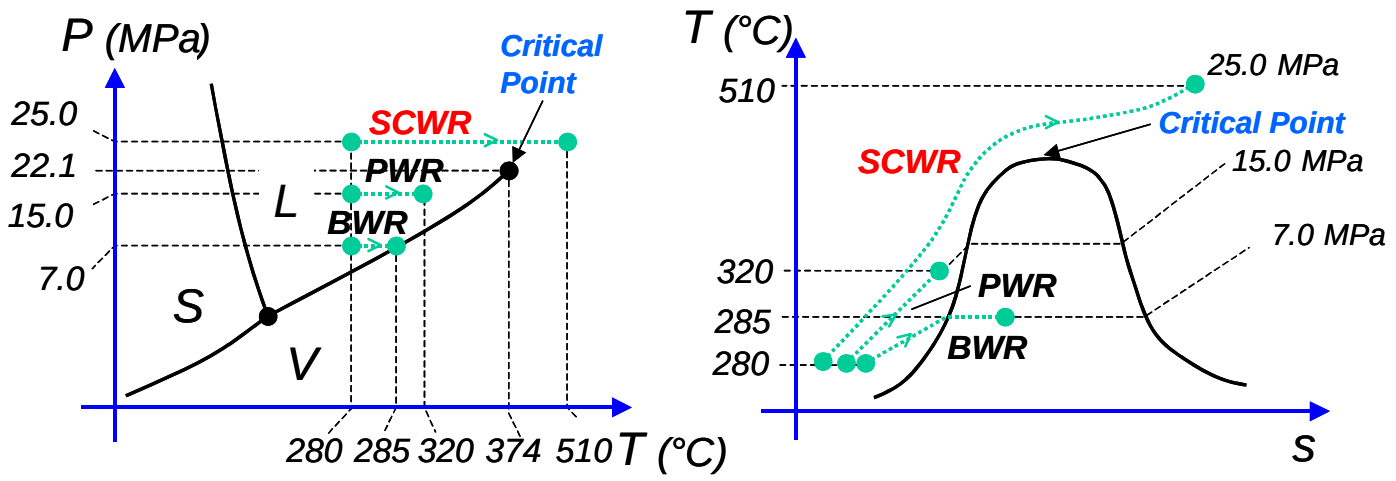
A small consultants meeting (with Consultants from AECL (Canada), Citon (Romania) and EdF (France) was convened in April to review the draft HWR-URD for balance, objectivity, neutrality and clarity, and to identify any further work needed before publication.

The IAEA intends the document may be used

- to provide requirements in support of beginning a full design effort for a real project, and to promote achievable evolutionary improvements;
- as an educational tool for managers, technical experts and young professionals and students showing the full range of requirements that must be integrated into a design;
- as a tool for identifying and selecting R&D items;
- to facilitate the development of standard designs that can be used by several operators; and
- as a guide in developing bid specifications for new evolutionary HWRs.

Co-ordinated Research Programme (CRP) on Heat Transfer Behaviour and Thermo-hydraulics Code Testing for Super-Critical Water-cooled Reactors (SCWRs)

SCWRs, operating thermodynamically above the critical point of water, promise to achieve improved economics



through higher thermal efficiency and compact systems.

A consultants meeting was convened in May to finalize the plan for this CRP by bringing together key institutes to discuss their potential contributions, and the means of collaborating, in order to proceed in such a way that all key institutes will participate. The consultants were from the following organizations: IPPE (Russia), KAERI (Rep. of Korea), CIAE (China), Shanghai Jiao Tong Univ. (China), Univ. of Wisconsin (USA), BARC (India), Toshiba (Japan), AECL (Canada), and PSI (Switzerland). The OECD-NEA also participated in the meeting.

The CRP is being initiated on the advice of the IAEA Nuclear Energy Department's Technical Working Groups for Advanced Technologies for LWRs and HWRs (the TWG-LWR and TWG-HWR). The CRP is expected to have duration of 4-5 years. Coordination of the CRP with the OECD-NEA (the Technical Secretariat of the Generation IV International Forum) has been agreed. Also, the CRP will be conducted in coordination with IAEA's Division of Nuclear Installation Safety.

The specific objectives of the CRP are:

- to establish a base of accurate data for heat transfer, pressure drop, blowdown, natural circulation and stability for conditions relevant to super-critical fluids;
- to test analysis methods for SCWR thermo-hydraulic behaviour, and to identify code development needs.

The consultants presented the status and plans for work at their institutes, their interests in the activities planned within the CRP, and jointly prepared the objectives and the list of activities to be conducted within the CRP. Following approval of the CRP within the IAEA, the schedule foreseen is to officially announce the CRP (in Q3.2006) and invite proposals for Research Agreements and Contracts for participation in the CRP. A CRP can have a maximum of approximately 15-17 institutes, and it is possible to have more than one institute from any given country, if the institutes contribute to different aspects of the research. Contact: J.Cleveland@iaea.org.

Technology 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 conducted the sixth (last) Research Coordination Meeting (RCM) of the IAEA Coordinated Research Project (CRP) on "Updated Codes and Methods to Reduce the Calculational Uncertainties of the LMFR Reactivity Effects" in Vienna on 3-7 April 2006. The status of the actions from the previous meeting was reviewed, and the results of the participants discussed and inter-compared. The work plan for the remaining CRP task was defined. It is planned to publish the final report by the end of 2007.

The 39th Annual Meeting of the Technical Working Group on Fast Reactors (TWG-FR), hosted by the China Institute of Atomic Energy (CIAE), was held in Beijing, from 15 to 19 May 2006. The meeting 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 possible future activities in view of IAEA's Programme and Budget cycle 2008 – 2009 (and beyond).

The TWG-FR representatives emphasized the fact that, on a world-wide level, the share of nuclear power in the primary energy consumption is relatively small (approximately 6%). In view of both the demographic and the rapid economical growth in the developing countries, this share will further decrease, if future deployment of nuclear energy is not substantially increased. It is clear that such a modest nuclear energy share will not have a real impact on the reduction of fossil fuel use, and hence will not noticeably affect CO_2 problem.

The TWG-FR recognized that nuclear power is a proven technology that can ensure, safely and reliably and without air pollution or emission of greenhouse gases, abundant supply of electricity. In view of the statement made in the previous paragraph, it is obvious that, in addition to electricity production, the development of non-electric applications of nuclear power must also be pursued vigorously.

The TWG-FR meeting clearly showed a growing understanding and consensus among the Member States of the need, firstly, for innovation in developing nuclear technologies and, secondly, for closure of the nuclear fuel cycle. Moreover, the TWG-FR representatives stressed that economic aspects of future nuclear systems are a key issue for the public acceptance of such systems, together with safety, nuclear waste, and non-proliferation.

The TWG-FR recognized that, in addition to national programmes, there are various international initiatives addressing numerous aspects of the development and deployment of innovative nuclear energy systems,

including fast reactors and transmutation systems. These initiatives include the Generation IV International Forum (GIF), the International Project on Innovative Nuclear Reactors and Fuel Cycles (INPRO), the European Commission's European Framework Programmes (FP), and the recently announced Global Nuclear Energy Partnership (GNEP). The TWG-FR representatives underlined the importance of enhancing the synergies between these initiatives and maximizing collaboration between them.

Participants in the 39th Meeting of the TWG-FR, Beijing, 15-19 May 2006

Visit: http://www.iaea.org/inis/aws/fnss/.
Contact: A.Stanculescu@iaea.org.

Technology Advances for Gas Cooled Reactors

An IAEA Coordinated Research Project (CRP-7) on **Potential of High Temperature Gas Cooled Reactors (HTGRs) in Process Heat Applications** has recently been launched. Research proposals are being accepted for the new CRP, which will focus on process heat applications such as hydrogen production and seawater desalination.

A Research Coordination Meeting (RCM) for CRP-5 on HTGR core physics and thermal-hydraulics code benchmarks is scheduled for September 25-29. The meeting will review final results obtained by the various institutes participating in the project. A final project document is expected to be published following the meeting.

A workshop on the physics and applications of HTGRs is scheduled for July 4-7 in Trieste, Italy. Hosted by ICTP and funded by the IAEA Technical Cooperation Department, the workshop will overview core and fuel design, safety aspects, economics as well as process heat and transmutation applications. About 20 participants, mostly from developing countries, are expected to attend.

Visit: http://www.iaea.org/htgr
Contact: M.Methnani@iaea.org.

Support for Demonstration of Nuclear Seawater Desalination

Workshop on Nuclear power and seawater desalination in the framework of TC project UAE/4/002 was conducted at ADWEA, Abu Dhabi on 8-10 April 2006. The progress of the feasibility study was reviewed.

A training course on **Desalination System Modelling-Technology and Economics** was held on 24-28 April 2006 at ICTP, Trieste. 22 participants from developing countries attended the course.

Two papers were accepted for oral presentation at the Euromed 2006 held on 22-24 May 2006 at Montpellier, France.

Pre-project mission for the Jordan TC project INT/0/080 was held at JAEC, Amman, Jordan on 6-7 June 2006. The project concept for TC project 2007-08 was discussed.

A technical meeting on **Socio-economic and environmental aspects of nuclear desalination** was held on 12-14 June 2006 at VIC, Vienna. 7 MSs participated in the meeting.

The final draft of the status report on **Nuclear desalination activities in IAEA Member States** was ready for sending to the publication committee.

The fourth and final RCM of CRP on **Economic research on, and assessment of, selected nuclear desalination projects and case studies** is planned for 9-12 October 2006 at Vienna.

A technical meeting on **Integrated nuclear desalination systems** is planned for 11-14 December 2006 at Cadrache, France. Contact: B.M.Misra@iaea.org.

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