IAEA International Atomic Energy Agency

Nuclear Power Newsletter

News from the Division of Nuclear Power
Vol. 8, No. 1, March 2011

ISSN 1816-9295

http://www.iaea.org/NuclearPower/

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Making Progress toward Nuclear Power

Participants to the workshop on Introduction of Nuclear Power Programmes: Management and Evaluation of a National Nuclear Infrastructure

Countries have improved their understanding of the issues of a nuclear programme and are making progress in their infrastructure development. This was a main conclusion from an annual workshop entitled Introduction of Nuclear Power Programmes: Management and Evaluation of a National Nuclear Infrastructure, held in Vienna from 8-11 February 2011.

Since the first workshop in 2006, countries have been participating in annual workshops to share their experiences and find solutions to common challenges. This year, 89 participants from more than 45 countries discussed the development of a national position, their experiences with self-evaluation of infrastructure status and Integrated Nuclear Infrastructure Review Missions. Many countries made presentations on their infrastructure status. They also exchanged views on becoming an intelligent customer, international cooperation, and received updates on IAEA activities related to the introduction of nuclear power. A highlight of the agenda was a keynote address by Ambassador Al-Kaabi of the United Arab Emirates.

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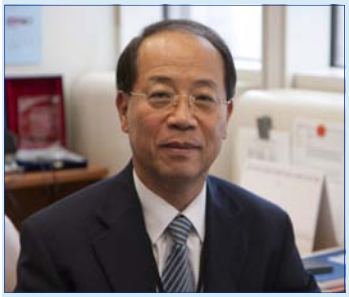
Message from the Director



Welcome to the March 2011 Newsletter of the Division of Nuclear Power. I hope every reader of this Newsletter enjoyed the holiday season.

In this issue, I would like to welcome our new Deputy Director General, Head of Nuclear Energy Department, Mr. Alexander Bychkov, the former Director General of State Scientific Centre Research Institute of Atomic Reactors in the Russian Federation.

An INIR (Integrated Nuclear Infrastructure Review) mission to UAE was conducted during 16-23 January 2011 by a team of 12 in house and international experts. It was the 5th INIR mission, however this was the 1st INIR mission to a country that has signed a contract for construction of nuclear power plants. It was concluded that the development of the UAE's nuclear infrastructure is progressing well and in line with the IAEA guidelines. Among other activities of the NENP, the meeting of the plant life management TWG during 7-10 February, the Workshop on the Management and Evaluation of a National Nuclear Infrastructure which was held during 8-11 February and the Interface Meeting between IAEA/INPRO and the Generation IV International Forum (GIF) during 3-4 March are the major ones in this Quarter of the year.

The 3rd NENP Divisional retreat was held for two days in the 4th week of January 2011. Thirteen staff selected from each Section/Group participated in the retreat and had very valuable discussions on 8 special topics including team building, human resource development and performance metrics for project management to improve the services to Member States.

Mr. Alexander Stanculescu who has been working on Fast Reactor Technology Development is leaving us at the end of March 2011 after long years of good services. He will continue his professional career at the Idaho National Laboratory as Director of Nuclear Engineering and Science. I would like to thank Mr. Stanculescu for his great contribution to the IAEA and the Member States. I wish Mr. Stanculescu all the best and hope to start close cooperation in his new capacity.

In this issue of hometown, Mr. Viacheslav Lysakov from the Russian Federation and Ms. Heawon Park from the Republic of Korea, and will introduce their home towns.

I would like to introduce Mr. Brian Molloy from the United Kingdom who joined our Division at the beginning of this year. Mr. Molloy is working on human resource development and management system in the Nuclear Power Engineering Section (NPES).

All the best.

Jong Kyun Park
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Infrastructure

IAEA Reviews Progress of UAE Nuclear Power Programme

A comprehensive review of the United Arab Emirates (UAE) programme for the introduction of nuclear power carried out under the IAEA Integrated Nuclear Infrastructure Review (INIR) mission found that the country understands the long-term commitments and responsibilities of nuclear power and is implementing its programme in line with the IAEA "Milestones" approach.

When a country is embarking on introducing nuclear power into its national energy mix, the IAEA advises that it takes a comprehensive *Milestones* approach, integrating all aspects of their government, industry and educational institutions.

International Team Finds Country's Programme Progressing Well

An INIR mission is a holistic review of a country´s nuclear power programme conducted by a team of international experts. "The UAE considers the INIR mission an important milestone for its civil nuclear energy programme," said Ambassador Hamad Al Kaabi, the UAE´s Permanent Resident Representative to the IAEA.

"I believe this mission once more highlights the nature and progress of the UAE programme: We are open, we are transparent, we are developing a peaceful nuclear programme with the highest international standards. And we are eager to continue in our cooperation with the IAEA and follow its guidance," he added.

The IAEA mission leader, Jong Kyun Park, Director of the IAEA Division of Nuclear Power , agreed that the mission was a success. He observed that no major gaps in the UAE´s nuclear power infrastructure were identified. "The INIR Mission was conducted in a cooperative and open atmosphere with participation from the various organizations in the UAE involved in nuclear power´s introduction. The team concluded that the development of the UAE´s nuclear infrastructure is progressing well and in line with the IAEA guidelines. This was the first mission to a country that has just signed a contract for constructing nuclear power plants."

While INIR missions have already been carried out in several states, this mission was a review of one of the most developed nuclear infrastructures among the IAEA Member States currently planning their first nuclear power programmes. The mission identified several areas where the UAE approach can be good practices for other countries starting nuclear power programmes to consider. Areas of good practices include cooperation without compromising their independence between the regulatory bodies and utility, human resource development, a well-structured management system, and a strong safety culture. For future development of the UAE programme, the mission team made suggestions in several areas and offered continued IAEA support. The mission team noted that there were no major gaps in the 19 areas covered by the review. It also noted the adoption of relevant international instruments and recommended accelerating the adoption of international instruments for civil liability on nuclear damage.

The IAEA supports nuclear newcomers by providing standards, guidance, reviews and assessments, missions, and assistance. INIR is a recently-established tool designed to complement the IAEA Milestones document launched in 2007. An INIR mission is conducted upon request from a Member State. By providing a comprehensive assessment of all facets of a nuclear power programme, spanning the regulatory body, utility and all relevant Government stakeholders involved, INIR is a valuable tool for promoting transparency and openness.

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Integrated Nuclear Infrastructure Review (INIR) Mission in Thailand

An objective review mission on the status of nuclear infrastructure development in Thailand was held in December. Mr. Park, Director of NENP, led the IAEA team that conducted the objective review mission.

Thailand launched a plan to finish the pre-project activity phase by the end of 2010, and expects to have a government decision on proceeding to the project implementation stage early in 2011. The IAEA team reviewed the self-evaluation report which was prepared and submitted to the IAEA in advance of the mission and which summarizes the result of pre-project activities.

Thailand has thoroughly studied the steps needed to proceed based on IAEA documents, involved the key organizations under the Nuclear Power Infrastructure Establishment Coordination Committee (NPIECC), and has knowledge of the required nuclear infrastructure. The team did find several areas that should be addressed either in phase 1 or early in phase 2, to sustain overall progress in developing nuclear infrastructure. The team also made specific recommendations and suggestions to address these areas.

This INIR Mission is the first mission based on the revised INIR guidelines and the INIR team noted several good practices, which are more than just fulfilment of the conditions and worthy of the attention of other countries as a model for their infrastructure development.

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GCC Milestone Workshop: Considerations Related to the Building of Nuclear Power Infrastructure

The Cooperation Council for the Arab States of the Gulf (GCC) Milestone Workshop was held in Vienna, Austria in December 2010. This IAEA workshop, under the overall coordination of the Integrated Nuclear Infrastructure Group (INIG), was held to discuss the needs of GCC States that includes Bahrain, Kuwait, Oman,

Qatar, Saudi Arabia and UAE, and to address a number of specific issues. The main objectives were to (i) provide a forum for discussions between high level professionals from the GCC Member States about the considerations, issues and challenges related to the sustainable introduction of nuclear power in new Member States; (ii) sensitize GCC States on the IAEA guidelines and milestones for considering the nuclear power option in the national energy mix and provide information related to IAEA assistance; (iii) sensitize participants on specific processes, organization and management systems related to the nuclear power business, and (iv) promote further regional cooperation in the field, strengthen the networking among emerging nuclear power countries and share international experience on the subject matter.

The Workshop was attended by 20 participants from the six GCC States and three external experts specializing in managing radioactive waste. Most countries were new to nuclear power, with some, such as UAE, more advanced than others. Because the UAE is the only GCC country actively preparing the construction of its first nuclear power plant, they made several presentations related to the implementation of the country's nuclear power programme.

The workshop was a useful forum for learning the IAEA approach to nuclear power introduction and networking among the participating countries. The GCC countries expressed the need for more information and support on issues related to nuclear power desalination, construction technology and management, as well as for the IAEA to arrange future visits to nuclear power facilities under construction. GCC countries further along in the process were able to share their experience with others, as well as with the IAEA. The workshop was a success in enabling GCC countries to further strengthen relationships among themselves, allowing them to work together in the future, and also to strengthen avenues of information sharing and support in developing their nuclear power programmes.

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2nd Regional Conference on Energy & Nuclear Power In Africa

"A forum for developing & promoting common ground in advancing nuclear energy systems in Africa"

Lack of access to affordable energy services remains one of the largest obstacles to socio-economic development, especially in Africa. African countries are seeking affordable, environmentally compatible and secure supply options, while the large, populous urban areas and emerging industrial centers demand stable base load electricity.

Many African countries have begun to revisit the nuclear option over recent years with a view to establishing long-term sustainable energy supplies. A number of them have requested IAEA's assistance to better understand key aspects of the planning of a nuclear power programme, including assessments of the energy situation, legal and regulatory framework requirements, human resources needs, optimal siting conditions, safety, and public acceptance.

In this regard, the *2011 African Energy and Nuclear Power Conference*, organized by the IAEA in cooperation with the South Africa Department of Energy, will provide a forum to openly debate and discuss regional priorities and concerns related to energy and nuclear power, and help foster a common understanding on major issues related to nuclear power. It is also planned to offer an opportunity for many countries considering the potential costs and benefits of introducing nuclear power in their national energy mix to deepen their thinking about their own national conditions, environment and strategies for a viable nuclear power option.

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Human and Organizational Factors in New NPP Projects

The technical meeting on considerations of human factors in new NPP projects was held in November 2010 at IAEA Headquarters in Vienna. Fifty-six participants from 22 countries and the IAEA exchanged their experience. Member States were represented by universities, nuclear facilities and NPP operating organizations, ministries, regulatory bodies, R&D organizations, technical support and training organizations, NPP vendors, and suppliers of automated process control systems and training tools. Countries who are operating NPPs, expanding their nuclear power programmes or those who are embarking on new nuclear power programmes took part.

The impact of human and organizational factors (HOF) on the safety and efficiency of nuclear power plants; on the NPP engineering, procurement and construction projects; and on the entire nuclear power programme cannot be overestimated. Consideration of HOF requires a systemic and integrated approach, and incorporation of multidisciplinary knowledge and experience. The following topics were addressed at the meeting: consideration of human factors in the design process; decreasing dependency of NPP designs on human factors; 'operator -friendly' designs; approaches, methods and practices of the design optimization which considers human factors at an early phase in the conceptual design; designing working environments for reducing human errors; consideration of human factors in the design of a human

machine interface; increasing reliability of human-machine interfaces; use of research and test facilities, modeling complexes and simulators for studies in the field of human factors, and in optimization of NPP human-machine systems, and for designing and testing a human-machine interface; improvement of safety and organizational culture within the projects for the new builds, including construction and commissioning phases; methods of improving organizational, process and individual performance; attitudes and personal features required for a successful undertaking of NPP projects in a safe and efficient manner; methods for psychological and psycho-physiological assessment of personnel; and related training practices.

This meeting was a good example of a 'one-house approach' and the cooperation of the Departments of Nuclear Energy and Nuclear Safety and Security.
All materials of the meeting may be found in the ENTRAC's Library, at http://entrac.iaea.org.

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Supporting Nuclear Power Plants

Pressurized Thermal Shock Analysis for the Paks Nuclear Power Plant

Paks NPP Units 1–4 will reach the end of their design lifetime during the period 2012–2017. In order to justify the planned new operation period, an extension of the timeframe to complete the Time Limited Ageing Analyses (TLAAs) is requested by the regulatory authority. Among the identified TLAAs, the most significant analysis relates to pressurized thermal shock (PTS) for reactor pressure vessels (RPV). The scope of the expert mission conducted from 14–17 December 2010, in Budapest, was to review the PTS analysis summary report.

The peer review team found several examples of good performance, including:

- Support for selection of PTS transients was performed using a probabilistic safety assessment approach to find out the potential scenarios with a high frequency of occurrence;
- Uncertainties of instrumentation and control were taken into account and applied in a conservative manner in thermal-hydraulic calculations;
- Neutron fluence calculations were compared with the experimental data;
- Sensitivity and uncertainty analyses were carried out as a support for the neutron fluence calculations;
- Application of the most recent formulae for calculations of stress intensity factor K_I for underclad cracks.

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Surveillance Specimen Programme for Long Term Operation of the Rivne Unit 1 Nuclear Power Plant

Reaching the end of their design lifetime during the period 2010- 2012, the Rivne Unit 1&2 and South Ukraine NPP Unit 1 are the pilot units for the NPP lifetime extension programme in Ukraine.

A meeting in Vienna in January 2011 was focused on discussion of results from several reviewed reports, and on discussion of further steps that are needed to be taken in order to implement the proposed surveillance specimen programme, including testing and evaluation of test results from the Rivne Unit 1 reactor pressure vessel (RPV). The proposed surveillance specimen programme to support Rivne NPP Unit 1 RPV operation for the period after recovery annealing is being prepared on the basis of requirements in the Ukrainian national regulations for nuclear power plants with WWER reactors, taking into consideration best international experience and practices. The programme includes a wide range of RPV core weld materials with different contents of copper and phosphorus. Due to the lack of sufficient amount of materials, the number of specimens is limited and thus a double reconstitution technique shall be applied to obtain a necessary level for good test data.

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TWG on Plant Life Management in Nuclear Power Plants

The IAEA organized a technical meeting for the Technical Working Group (TWG) on Life Management of Nuclear Power Plants. A total of 23 members from 18 Member States and one international organization attended the meeting. The main objectives of the meeting were: 1) To provide a forum for the exchange of information on nuclear power plant life management (PLiM) for long term operation (LTO), 2) To provide technical support to the 2012 – 2013 programme on PLiM for (I will add photo here) LTO, and 3) To suggest future activities in this field in relation to the IAEA programmes for 2014 - 2015. During the meeting, the structure and scientific programme for the 3rd international conference on PLiM for LTO, to be held in 2012 in the USA, was also discussed with the TWG members.

In 2011, 442 nuclear power plants will be operating with, on average, 78% of the capacity factor of 2009. Of

these 442 operational nuclear power plants, 358 have been operating for more than 20 years. Most plants are believed to be able to operate for 60 years, or beyond, although it was originally thought that the design life of a nuclear power plant would typically be 30 to 40 years. The IAEA has already been addressing various aspects of ageing management, optimization of maintenance and plant life management for long term operation during the last several years.

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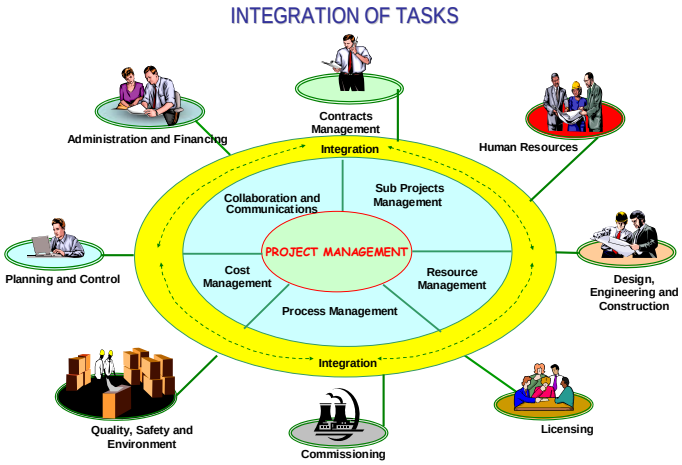
Construction Management of Nuclear Power Plants: Guidelines and Experiences

IAEA held a consultants' meeting in Vienna, Austria on March 1- 4 2011, to finalize a nuclear energy series on construction management of nuclear power plants. As of December 2010, there were 441 nuclear power reactors in operation worldwide, with a total capacity of about 374.7 GW(e). After a slowdown in the construction of new nuclear power plants, there has been a marked increase in recent years in the number of Member States with operating nuclear plants that are interested in building new plants. Currently 23 countries are planning to expand their existing nuclear programmes and 65 units are under construction in 'expanding' countries, the largest number since 1992.

In 2010, construction started on fifteen new nuclear power reactors, the largest number since 1987, and projections of future nuclear power growth were, once again, revised upwards. Investment costs and their amortization make up the predominant part of the future



power generation costs and effectively determine the competitiveness of the nuclear power option versus power from fossil fuels or hydroelectric stations. High interest rates have made nuclear power plants particularly vulnerable through the steep cost escalation that results from unforeseen changes or delays. Although additional licensing requirements, public intervention and funding problems have been blamed for most of the delays and cost increases, there is growing recognition that lack of proper project management has been a major factor. Project management is a management specialty primarily concerned with the defini-tion, coordination and control of large undertakings, from the points of view of technical quality, schedule and costs.

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Modernization of NPP I&C Systems Using Digital Technologies

The workshop of the Technical Cooperation Project for Latin America (RLA/4/021) on Modernization of NPP Instrumentation and Control (I&C) Systems Using Digital Technologies was held in Buenos Aires, Argentina, in November 2010. 45 participants from 6 countries attended the workshop, which included 22 presentations, 5 panel discussions and a technical tour of the Atucha-2 NPP construction site.

The second Independent Engineering Review of I&C Systems (IERICS) Mission in 2010 was held in December 2010, at the Research and Production Corporation Radiy in Kirovograd, Ukraine. The purpose of the mission was to review the design and implementation process of new digital FPGA-based I&C platforms and systems, installed for reactor protection, control, and monitoring functions in all Ukrainian NPP sites and also in the Kozloduy NPP in Bulgaria. The mission report produced 2 recommendations, 5 suggestions and 10 good practices.

The following five meetings were held in February and March 2011 in Vienna with the aim of producing the final drafts of documents:

- Consultants meeting to finalize a publication on Assessing and Managing Cable Ageing in NPPs (NP-T-3.6), 1-4 February.

- Consultants meeting to finalize a publication on Results of the Coordinated Research Project on Advanced Surveillance, Diagnostics, and Prognostics Techniques Used for Health Monitoring of Systems, Structures, and Components in NPP, Nuclear Energy Series Report (NP-T-3.14), 7-10 February.

- Consultants meeting to finalize a publication on Interfacing Nuclear Power Plants with Electric Grids (NG-T-3.8), 14-17 February.

- Consultants meeting in February to prepare a technical meeting on newly arising threats in cyber security of nuclear facilities to be held in May.

- Consultants meeting to serve as the final follow-up/ close-out meeting of the IERICS Mission on the Radiy FPGA system was held in March. All outstanding issues have been resolved and the final version of the mission report was produced.

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INPRO
Steering Committee Plans for the Future

In charting the way forward, the INPRO Action Plan for 2012 and 2013 is being developed in close cooperation with the INPRO Steering Committee which consists of representatives of INPRO's 32 members (31 Member States and the European Commission). Observer countries and international organizations, such as GIF and OECD/NEA, are also contributing.

Welcoming Mr Bychkov as Chair of the 16th INPRO SC Meeting, 17-10 November 2010

The first step is to consolidate the current 6 programme areas into four projects for the next biennium:

Project 1: Long-range nuclear energy strategies;

Project 2: Global nuclear energy scenarios;

Project 3: Innovations (technical and institutional);

Project 4: Policy and Dialogue.

Detailed activities within these project areas will be developed over the next six months and the action plan will be finalized towards the end of the year. These were among the key decisions of the 16th meeting of the INPRO Steering Committee, held at the end of 2010 and chaired by Mr Alexander Bychkov of the Russian Federation, who assumed the position of IAEA Deputy Director General, Head of the Department of Nuclear Energy, and INPRO Project Manager in February 2011.

As part of the transparent and systematic approach to the strategic planning process over a five-year timeline, which will lead to an INPRO vision for 2016, INPRO Members have also identified national priorities in sustainable nuclear energy system development and deployment and presented proposals for INPRO activities relevant to their national priorities. Also, a high international profile, connected to sustainability of nuclear energy systems, is one of the goals to be achieved by 2016. Continued coordination and collaboration with other international institutions and initiatives, such as the European Commission, GIF, WNA, OECD/NEA, and SNE-TP are encouraged to support INPRO's objectives .

For Mr Sokolov, who left the IAEA at the end of 2010, this was the last Steering Committee Meeting he attended as INPRO Project Manager and Head of the Department of Nuclear Energy. "I see the future of INPRO as one with many opportunities brought to us by the growing interest in nuclear power expressed by many countries", said Mr Sokolov in closing the meeting. "INPRO has to be a dynamic project looking at the future and providing support to INPRO Members and more importantly, all IAEA Member States in their long term nuclear power activities." The Steering Committee members thanked Mr Sokolov for his guidance and leadership with standing ovations.

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Conducting a NESA in Kazakhstan

One of the main goals for sustainable energy development in Kazakhstan is to create an integrated and innovative nuclear sector in the country which will ensure long-term generation of electricity in the most economical, safe and environmentally clean manner and will integrate, if possible, all elements of the nuclear fuel cycle.

In August 2010, the Atomic Energy Committee of Kazakhstan requested the IAEA to conduct an assessment of the existing and potential nuclear power technologies, using the INPRO methodology. The aim of this Nuclear Energy System Assessment (NESA) is to confirm that Kazakhstan's strategic plans to develop nuclear power are focused on and capable of ensuring the availability of adequate energy resources for the country's sustainable development in the future.

In September 2010, welcoming the 10th anniversary of the establishment of INPRO, the Chairman of the Atomic Energy Committee, Mr T. Zhantikin, indicated that Kazakhstan is especially interested in developing nuclear power systems based on small and medium-sized reactors.

In anticipation of performing a NESA, senior officials from Kazakhstan participated in the 2010 Workshop on Long-Range Nuclear Energy Programme Planning and Strategy Development at the IAEA. This was followed

NESA Workshop in Kurchatov, Kazakhstan, 27-29 October 2010

by a kick-off meeting between a member of the INPRO group and several specialists from the Institute of Atomic Energy, held at the end of October in the city of Kurchatov. The intention is to perform a full-scope NESA in all seven INPRO assessment areas (nuclear safety and security, economics, environmental protection, radioactive waste management, proliferation resistance and infrastructure) to investigate the various options for the country's nuclear energy system, nuclear power plants and the nuclear fuel cycle. The Terms of Reference for this NESA are similar to those of others conducted in countries such as Argentina, Armenia and Ukraine.

As a result of the meeting, it was agreed that national experts will prepare a national report based in the results of the NESA, which will be included in the INPRO database for use by other IAEA Member States. The report will contain detailed information on the results of the assessment and conclusions and recommendations regarding an optimal nuclear energy system structure in Kazakhstan that complies with the principles of sustainable development. It will be used as one input to decision making on the nuclear power development strategy in Kazakhstan.

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INPRO Collaborative Project PRADA Concluded

The collaborative project (CP) on Proliferation Resistance: Acquisition/Diversion Pathway Analysis (PRADA) was concluded as planned at the end of 2010. The last meeting took place on 8-10 November 2010 at the IAEA with a review of the final report and its approval for publication.

The overall objective of the PRADA CP was to provide guidance on enhancing proliferation resistance of innovative nuclear energy systems and contribute to strengthening the assessment area of 'proliferation resistance' of the INPRO methodology. The PRADA CP focused on identifying and analyzing high level pathways for the acquisition or diversion of fissile material for a nuclear weapons programme, using the DUPIC fuel cycle as a case study with an assumed diversion scenario. The project made recommendations for assessing the multiplicity and robustness of barriers against proliferation, including institutional, material and technical barriers as well as barriers resulting from the implementation of international safeguards.

The main conclusions of the collaborative project were:

- The assessment should be performed at the State level, the innovative nuclear energy system level, and the facility level including facility specific pathways.
- The robustness of barriers against proliferation depends on the State capabilities; the relevance of each barrier is dependent on the assessment level.
- The robustness of barriers is not a function of the number of barriers or of their individual characteristics but is an integrated function of the whole, and is measured by determining whether the safeguards goals can be met.
- The INPRO assessment methodology requires information regarding proliferation risks from more quantitative analyses performed jointly by technology developers (supplier), safeguards experts, and experts in proliferation resistance.

The detailed application of the GIF pathway concept to the DUPIC fuel cycle to identify and analyze acquisition/diversion pathways for nuclear materials also demonstrated the feasibility of merging the methodologies to form *a holistic approach*. Consequently, the CP participants already recognized the concept of a 'GIF/INPRO coordinated set of PR and safeguardability assessment tools'. This set of tools would bring together the complementary strengths of the GIF and INPRO methodologies.

The PRADA study recommended that an expanded test of the methodology be applied to a new example study to demonstrate its usefulness and validate the approach, and this study should address the complete nuclear energy system of a country. Such a test should include transportation as well as multiple facilities including a reactor and waste disposal. Proposed example studies include: (1) an open fuel cycle in an emerging nuclear state, i.e. a country interested in starting a commercial nuclear power program, and (2) a generic pre-processing fuel cycle not attached to any state but building on the GIF ESFR study, and using an INPRO based approach.

The PRADA CP, which started in 2008, was led by the Republic of Korea; Canada, China, the USA and the European Commission participated while Japan and the Russian Federation were observers. Within the IAEA, the PRADA project established close cooperation with the Department of Safeguards.

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INPRO Collaborative Project on the Thorium Fuel Cycle Concluded

In December 2010, INPRO completed a three-year CP on Further Investigation of the U-233/Thorium Fuel Cycle (ThFC). Thorium-based fuel cycles may provide an opportunity for using vast deposits of this nuclear material to supply future large-scale deployment of nuclear energy systems and enhance the sustainability of nuclear power. In the course of the project, three consultants meetings were held to coordinate efforts, consider salient issues (e.g. the cost of some fuel cycle services), and share results and visions of the potential of thorium as a nuclear fuel. The main achievements are:

- An overview of activities in Member States on introducing Th into nuclear fuel cycles, and results of R&D on reactors potentially utilizing Th (based on contributions from Canada, the European Commission, India, the Republic of Korea, Norway and the Russian Federation);
- Definition of a number of global scenarios of Th introduction into different nuclear energy systems including thermal and fast reactors and an analysis of the necessary resources and of waste to be produced;

  Description of economic aspects of Th-based fuel cycles, including calculations of energy cost for specific reactors (in line with the INPRO methodology in the area of economics, IAEA-TECDOC-1575, Vol. 2) and economic optimization of scenarios;
- Considerations of proliferation resistance of thorium fuel cycles, by assessing proliferation resistance with the INPRO methodology (see IAEA TECDOC-1575, Vol.5).

Ten INPRO Members, i.e. Canada, China, the European Commission, France, India, the Republic of Korea, Slovakia, the Russian Federation, Ukraine and the USA participated in the CP. In addition, Thor Energy (Norway) and the Institute of Energy Research (Germany) were observers. Within the IAEA, the Department of Nuclear Security and Safety (Office of Nuclear Security), the Planning and Economic Studies Section and the Division of Nuclear Fuel Cycle and Waste Technology also contributed to the project.

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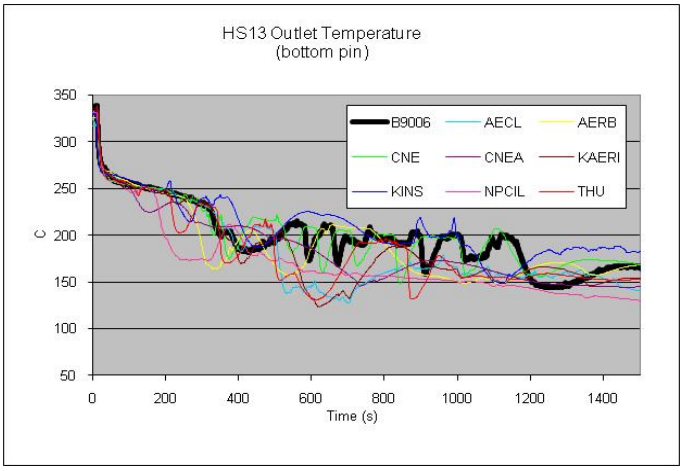
Technology Development of Nuclear Power Reactors

ICSP on Comparison of HWR Thermal-hydraulic Codes for SBLOCA

With the recommendation and advice from the Technical Working Group on Advanced Technologies for Heavy Water Reactors (TWG-HWR), an International Collaborative Standard Problem (ICSP) on comparison of HWR thermal-hydraulic code predictions with SBLOCA experimental data has been conducted since 2007. The kick-off meeting was convened in November 2007 at IAEA-HQ with eight participants from six Member States: AECL (Canada), AERB (India), CNE (Romania), CNEA (Argentina), KAERI and KINS (Rep. of Korea), NPCIL (India) and Tsinghua Univ. (China).



Comparison of Sheath Temperature Predictions

The objectives of ICSP are to improve the understanding of important phenomena expected to occur in SBLOCA transients, to evaluate code capabilities to predict these important phenomena, their practicality and efficiency, by simulating an integrated experiment, and to suggest necessary code improvements or new experiments to reduce uncertainties. AECL volunteered to host this ICSP and provided experimental data collected from RD-14M experiment for SBLOCA scenario. The ICSP was conducted with two phases: blind and open calculations. Four different system codes (ATMIKA, CATHENA, MARS-KS, RELAP5) with different versions used in HWR system thermal-hydraulic analysis were compared against two SBLOCA experiments.

The fourth meeting was convened in November 2010 in Rep. of Korea. The ICSP offered a constructive platform giving unique opportunity to code developers/ experts and experimentalists to jointly verify and validate their thermal-hydraulic codes. The direct technical interaction among experts was helpful to improve/ enhance understanding of important thermal hydraulic phenomena observed in a parallel channel facility under SBLOCA transients. The experience gained by ICSP has been fruitful in identifying code strength and areas requiring improvement.

The lesson learned from the blind as well as open calculation in various important areas that are generic in nature, such as user effects, code deficiencies and need for capability improvement, experimental considerations and ICSP specification, are documented in the technical report summarizing the ICSP activities.

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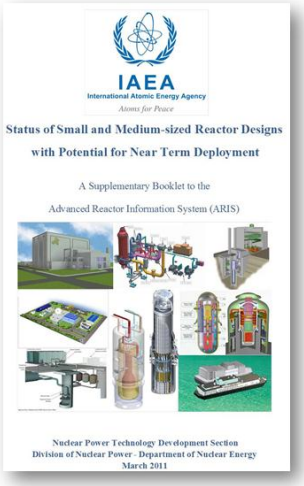
Small and Medium-Sized Reactors

Currently, there are increasing global activities in the development of small and medium-sized reactor (SMR) technologies aiming for near-term deployment, not only in the developed-countries, but also in developing countries with constraint electricity grids and/or remote areas. At present, more than 35 SMR designs of various types (i.e. integrated PWR, liquid-metal cooled fast reactors, gas-cooled reactors, and heavy water reactors) are under development globally in different stages. Some of them are under construction. Considering that the SMRs are those having net electric capacity up to 700 MW(e) up to date, there are 133 units in operation, 12 under construction, and 28 countries use SMR with a total generating capacity of 60.3 GW(e).



Building partnership and expanding international network with international organizations are also necessary to address the issues and challenges in implementing SMR technology. Earlier in January, the IAEA was invited by the World Nuclear Association (WNA) to discuss a viability to establish an international Task Force on SMR licensing and deployment within a framework of cooperation in reactor design evaluation and licensing WG (CORDEL). The key objectives of the efforts are to develop a common roadmap of global SMRs deployment and a rationale for establishing a standardized and regulatory regime for SMRs. The Task Force is expected to work in harmony and synergetic with the IAEA roles on SMRs.

A a supplementary booklet to the web-database on Advanced Reactor Information System (ARIS) is being finalized. The booklet contains the status, design descriptions and main features of 35 selected SMR designs sorted by type of coolant and country of origin. In addition, the IAEA published in 2010 IAEA-TECDOC-1652 on Small Reactors without On-site Refuelling: Neutronic Characteristics, Emergency Planning and Development Scenarios was published and downloadable from the IAEA website.

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Gas Cooled Reactors

A meeting of the Technical Steering Committee for the IAEA International Knowledge Base on Nuclear Graphite took place on 31 January – 01 February 2011. This ongoing project, having already spent a number of years 'harvesting' a very large amount of numerical data on irradiated nuclear graphite properties from numerous sources, has expanded into a fully interactive Knowledge Base intended to preserve the experience and technical basis of the technology for future generations of nuclear engineers who may engage in the design and construction of high-temperature reactors (such as HTR-PM, NGNP and the development of VHTR through Gen IV International Forum) as well as continuing to assist the process of life extension of existing plant such as the United Kingdom Advanced Gas Cooled Reactors.

A particularly valuable source of information comes from the series of International Nuclear Graphite Specialists Meetings (INGSM) which was initiated by the same committee, and all presentations from these meetings are already included in the Knowledge Base. The next INGSM will take place in the Republic of Korea in September 2011 and all interested parties are welcome to register.

The main business of the recent TSC meeting was to prepare a 'five-year plan' for the population of the Knowledge Base under the technical topic areas identified as most significant by the participating members states, which currently include USA, UK, Germany, The Netherlands, Lithuania, Japan, The Republic of Korea and China, with Ukraine intending to join formally within the next year. Acquisition of additional numerical data, especially in support of other ongoing IAEA activities such as the CRP on Irradiation Creep in Graphite, will continue.

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Fast reactors and accelerator driven systems

IAEA's activities in the field of advanced fast neutron systems research and technology development are implemented within the framework of the Technical Working Group on Fast Reactors (TWG-FR). The current TWG-FR Scientific Secretary will retire from IAEA at the end of March, which makes this his last NENP Newsletter contribution. Hence – a brief look at where fast reactors stand right now.

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

Acceptance of nuclear energy with large scale contributions to the world's energy mix depends on satisfaction of key drivers to enhance sustainability in terms of economy, safety, adequacy of natural resources, waste reduction, non-proliferation and public acceptance. Fast spectrum reactors with recycle significantly enhance the sustainability indices. This is why fast reactor and associated fuel cycle research and technology development is, in many countries, back on the agenda of research and industrial organizations, as well as academia.

China has met the first essential milestone in its fast reactor technology development [first criticality in July 2010 of the 65 MW(th) China experimental Reactor (CEFR)]. The conceptual design of the 600-900 MW(e) China Demonstration Fast Reactor (CDFR) is ongoing. The next concept, currently under consideration, leading to the commercial utilization of fast reactor technology around 2030 is the 1000-1500 MW(e) China Demonstration Fast Breeder Reactor (CDFBR). By 2050, China foresees to increase its nuclear capacity up to the level of 240-250 GW(e), to be provided mainly by fast breeder reactors.

To meet the stipulations of Frnace's Parliament Acts, the Commissariat à l'Énergie Atomique (CEA) and its industrial partners (EdF and AREVA) are implementing an ambitious research and technology development programme aiming at the design and deployment of the 300-600 MW(e) sodium cooled fast reactor prototype ASTRID. Within the framework of Euratom projects, CEA is also pursuing conceptual design studies for a 50-80 MW(th) experimental prototype gas cooled fast reactor called ALLEGRO.

India is completing construction of the 500 MW(e) Prototype Fast Breeder Reactor (PFBR) in Kalpakkam, with first criticality planned by 2012. The next step foresees the construction and commercial operation by 2023 of 6 additional mixed uranium-plutonium oxide fuelled PFBR-type reactors (a twin unit at Kalpakkam and four 500 MW(e) reactors at a new site to be determined). Beyond 2020, the Indian national strategy is centered on high breeding gain ~1000 MW(e) capacity reactors, and on the collocation of multi-unit energy parks with fuel cycle facilities based on pyro-chemical reprocessing technology.

The Japanese fast reactor design and deployment activities are expected to lead to the introduction of a demonstration fast reactor around 2025 and to the commercial operation of fast breeder technology around 2050. These goals will be achieved on the basis of operation experience to be gained with the prototype fast reactor Monju (restarted in May 2010) and on the basis of the results of the Fast Reactor Cycle Technology Development Project (FaCT), started in 2006.

The fast reactor development activities of the Republic of Korea are performed within the framework of the GEN IV International Forum. Currently, R&D activities are focused on core design, heat transport systems, and mechanical structure systems. Design work on innovative sodium cooled fast reactor and fuel cycle concepts is pursued. The Republic of Korea is planning to develop and deploy a demonstration fast reactor by 2025 – 2028.

The Russian Federation is currently constructing the sodium cooled, mixed uranium-plutonium oxide fuelled BN-800 with planned commissioning in 2012 – 2013. The Russian fast reactor development program includes life extension of both the experimental reactor BOR-60 and the industrial reactor BN-600 (the latter ending in April 2010), and the design of the new experimental reactor MBIR. Within the framework of the program, fast reactor technologies based on sodium, lead, and lead-bismuth eutectic alloy coolants (i.e. SFR, BREST-OD-300, and SVBR-100, respectively) will be developed simultaneously, along with the respective fuel cycles.

For more information see www.iaea.org/inisnkm/nkm/aws/fnss/index.html

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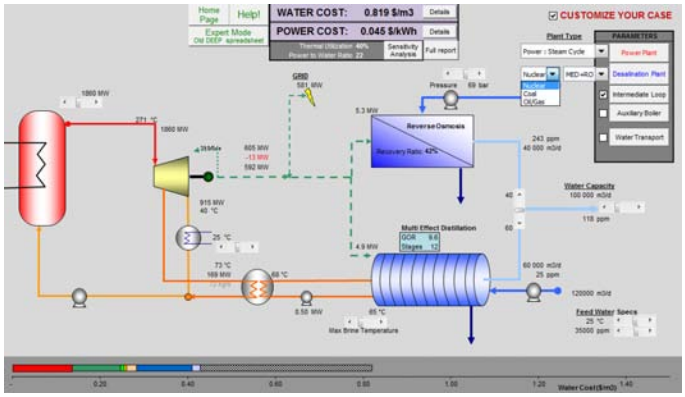
Non-Electric Applications of Nuclear Power

A new version of DEEP-4.0 has been released in February 2011. This version presents new features and easier usability for both newcomers and experts. All 37 different templates (including 4 power plant types, 3 fuel types and 4 desalination plants were combined in one) allowing easier comparison between different technologies and configurations, as well as the instant overview of the designed system. Beginners will become immediately familiar with the friendlier interactive user interface. Experts will be able to use a more polished version of the previous DEEP spreadsheets, and enhance their prefeasibility reports with the new reporting and analysis tools provided by this version.

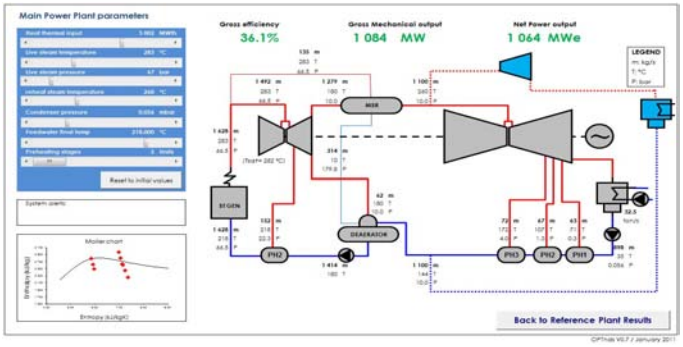


Graphical user interface of new DEEP –4.0

Along with this release, a new tool named DEsalination Thermodynamic Optimization Programme DE-TOP has been released. DE-TOP is a complimentary to DEEP and helps to analyze the thermodynamics of cogeneration systems with emphasis on water desalination.

Main features of DE-TOP are:

- Quick thermodynamic analysis of the secondary loop for several water cooled reactors.
- Customizable plant parameters.



Graphical user interface DE-TOP

- Different configuration options for the coupling of the non-electric application.
- Comparison analysis between reference plant and cogeneration system.
- Built-in water/steam properties based on the IAPWS -IF97 industrial formulation

These new tools will assist Member States in education and training on nuclear power and non-electric applications, offering a wider overview and underlining the viability of nuclear cogeneration.

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Message of the Retiring TWG-FR Scientific Secretary

Technological innovation is a key for maximizing the benefit from the use of nuclear energy for sustainable development. Technology to fully utilize natural resources by fast neutron systems and recycling of used fuel is being revisited globally for innovation.

For 44 years now, the IAEA is offering to all countries wishing to pursue fast reactor development the only worldwide forum for information exchange and collaborative R&D through its TWG-FR (previously called IWG-FR). The TWG-FR ensured that newcomers like India and China were not left in isolation, but enjoyed a forum to ask technical and scientific questions, exchange information, and hone their skills (both human resources and methodologies, i.e. data and codes).

It is expected that Nuclear Power Technology Development Project Section's (NPTDS) fast reactor project will continue facilitating collaborative activities and information exchange. On a mid-term basis, worldwide developments are diverging with one group developing the fast reactor looking primarily at its recycling capabilities (geared towards alleviating the problems of the backend of the fuel cycle), and another group looking at it primarily as securing energy needs while enhancing resources utilization by a factor of ~70. Both these aspects are strongly responding to sustainability requirements. Consequently, Member States' activities over the next 20 – 30 years will focus on different objectives and produce a variety of results and experiences. A wide range of scientific and technical areas will have to be covered (e.g. nuclear data, reactor physics, engineering design, methods validation and qualification, etc). By the same token, Monju in Japan and the fleet of 7 PFBRs in India will produce a wealth of physics and performance, as well as operational experience data – all of which is asking for a substantially higher

involvement (and effort) from the future NPTDS fast reactor project. Moreover, new experimental and prototype fast reactors will be built in France (ASTRID), the Russian Federation (MBIR), and possibly the Republic of Korea and the USA. Within this context, it is expected that a strengthened NPTDS fast reactor project, centered on the solid support of and leverage offered by the TWG-FR community, will also play an important role in support of, the development and realization (and later also utilization as R&D tools) of such facilities through international collaboration.

Retreat: The Future of NENP

For the third time, staff of the Division of Nuclear Power (NENP) joined Director J.K. Park for a one and half day meeting to brainstorm and discuss topics and issues that are important to ensure that the work of the Division is carried out in the most effective and efficient way and meets the objective of supporting Member States. The small town of Neusiedl in Burgenland, a province south of Vienna, was chosen as location, to help participants resist the temptations of sneaking away to do some work at the office as well. "I've initiated retreats when I joined the IAEA over a year ago, since I consider them to be a valuable tool in management and teambuilding", says Mr. Park. "A retreat offers the opportunity of discussing issues of importance in our work and allows staff members to contribute their ideas and suggestions in an informal, relaxed environment", he adds.

Facilitated by Brian Molloy of the Nuclear Power Engineering Section, the 12 participants and Mr. Park discussed topics such as human resource development in Member States as well as training needs within the Division, particularly for new staff, identifying publications for the NE Series, and how to invigorate collaboration among the Sections and Groups of NENP. This was preceded by a short presentation on future plans for INPRO. A better integration and making good use of the expertise that cost free experts (CFEs) bring to the IAEA were also addressed. Split into two groups, our colleagues engaged in intensive discussions to identify potential performance metrics or indicators for project management, for example internal, absolute ones such as managing a project on time and within its budget, and external indicators, measuring the effectiveness of the project and 'customer' satisfaction. Long- and short-term indicators were also proposed. As a bottom line, a common approach to project management and tools to support these efforts were felt to be essential. It is

Group discussion during NENP Retreat, 28-29 January 2011

expected that the new AIPS (IAEA-wide Information System for Programme Support) could be used to this respect Since effective teams who work well together are key to any organization's success, team building through social activities was also on the agenda, and as a first step, two such 'outside of work' events, e.g. a picnic and a sports event, will be organized in June and September.

At the end of the retreat, ten action items were identified related to the above topics and individual participants were given the responsibility to implement them. Since information sharing is one way to support good internal communication, Mr Park will give a detailed report on this retreat and its outcome at the forthcoming Divisional meeting at the end of February.

NENP at the IAEA ball

Strains of the waltz, swirling gowns and lively steps—NENP staff showed off their dance moves at the IAEA ball on 5 February 2011. The IAEA Staff Association Ball attracts local dignitaries, diplomats and Vienna residents and the staff, of course, for an evening of music, dancing and entertainment. The ball was held this year at the Hofburg Palace in Vienna, the Imperial home of the Hapsburgs. Ms Laura Rockwood served as the master of ceremonies and welcoming remarks were made by Director General Amano and the staff association president.

Attending this event gives the international workforce at the IAEA a reason to dust off their tuxedos and gowns and to experience a true Viennese ball –a staple of the winter social scene. This year's extravaganza featured music for every taste—from the traditional Viennese waltz, big band and swing, to Latin, pop, disco, club and Celtic. What makes the IAEA ball unique compared to other balls is the international crowd—many people wore national costumes, which added to the atmosphere.

My Hometown

Podolsk, Russian Federation,

*By **Viacheslav Lysakov***

I have known the city of Podolsk for many years. In 2003, I took a job in Podolsk and since then, the city has become my second home, since originally I am from Moscow. Podolsk is located at the banks of the Pakhra river (a tributary of the Moscow river), about 36 km from the center of Moscow. With a population of 183 000 inhabitants, it is the largest industrial, scientific and cultural town of Moscow's suburbs and the informal capital of the Moscow region. This green and picturesque city originated from the village Podol which under Catherine II was granted the status of city in 1781.

As settlements started to appear on the Podolsk land, the main occupation of inhabitants was extraction of rubble and white stone "the Podolsk marble". This stone was used for construction of houses and paving roads and that's why the city's coat of arms is decorated with picks of stonemasons. Most of the stone was delivered to Moscow. Since it served as excellent raw material for manufacturing lime and cement, in 1875 the first industrial enterprise, a cement factory, was established on Podolsk land. Architectural monuments, orthodox temples and country manors turned into magnificent museums can be found around the city.

The Podolsk region is also known as the birthplace of the famous Russian 'matreshka' dolls.

Podolsk continues to grow and develop. There are about 230 industrial enterprises of all sizes, producing a variety of goods ranging from equipment for thermal and nuclear power engineering, to food and process industry products, building materials and many others.

More than 28 000 people work at the enterprises of the scientific and industrial complex of the city. Podolsk is the city of hi-tech science. It is also the center of nuclear research and nuclear mechanical engineering. I joined one of the major enterprises of Podolsk, the Experimental and Design Organization OKB "GIDROPRESS" in 2003. OKB is the key company of the Russian State Atomic Energy Corporation "Rosatom" engaged in designing nuclear power plants that feature increased safety, reliability, efficiency and are competitive both in the Russian Federation and abroad.

Experimental work at OKB

More than 1500 employees are implementing innovative engineering designs for modern nuclear power plants. It is the only company in the world where reactor plant designs of the WWER-1000 and WWER-1200 type are simultaneously under construction at six Units in Russia and five Units in other countries. Besides the well known design of the experimental fast reactor BOR-60, OKB also constructs other fast reactors such as multi-purpose lead-bismuth fast reactors SVBR-100 and SVBR-10. Steam generators are being designed also for reactor plants with sodium fast reactors. I am proud to be a part of OKB and of the city of Podolsk.

Viacheslav Lysakov *is a cost-free expert from the Russian Federation and works in the INPRO Group.*

Old and New in Seoul , Republic of Korea

*By **Haewon Park***

On a usual manic Monday morning, I was standing on the busy streets of urban Seoul, hearing the local mantra of "bbali bbali!" (hurry! quickly!) which echoed through the vibrant and energetic atmosphere. People were rushing on their way to work, greeting friends and running past street vendors shouting out to sell their foods. Roads, streets and lanes are filled with the spirits of busy but happy Seoulites. I was encircled by long rows of high rise modern architecture jostling for space with each other, creating a labyrinth of buildings. These scenes are the first impression of Seoul for most travellers. It may look like many other Asian megacities, but the harmonization of this city separates Seoul from most others. There are many hidden values which make the city so special and now I am going to show some of the special values of my hometown, the metropolis of Seoul.

At a glance, Seoul resembles the other fancy modern Asian cities, but Seoul's most unique and attractive quality is the way in which tradition and modernity coexist in perfect harmony. From old royal palaces to sky high state of the art buildings, this 600 year old city is rich in both historical heritage and rich modern culture. Especially well designed are the wide roads and

buildings built according to a detailed plan. The fact that ten of the top companies in the world are based in Seoul tells us that it is the capital of Korean business.

To escape the feel of the modern city, take just a couple of steps to Gyeongbok-gung, the royal palace. This famous palace has a long history and is located at the very heart of Seoul. This palace represents the sovereignty of the kingdom and dates back to the 1300s, when it was the main seat of power for Korean kings during the Joesun dynasty. You will forget about the deafening noise from the town, as you enter through the main gate which separates you from the busy area of the city. There, you will enjoy an overwhelming scenic haven unfolding before your eyes. Take your time to wander from place to place around the complex and discover its six main gates, inner and outer courts, throne halls, reception hall, king's residence and several pavilions constructed in a style that is aesthetically harmonious with the nature surrounding it.

After relaxing along the scenic walk in the royal gardens, you will step out of the palace and back into the busy streets, where you will have to quickly shift your time machine back to 21st century modern Seoul, which seems like a brand new dimension after the palace. You are back again on a manic Monday morning in the heart of Seoul, leaving behind ancient palaces and old historical architecture, and stepping into the sharply contrasting atmosphere of the decidedly modern designed city. Unconventional narrow lanes and well paved and regulated streets are full of surprises and quite dynamic. Fancy cafes along the tree-lined boulevards please the eyes and palate. You may stop for nibbles by one of those street snack parlours and try the famous Deokbokki, the nation's most be-loved snack, pieces of rice cake in an addictive chili pepper paste, and its sweet and spicy flavor leaves your mouth wanting more. Centrally located traditional markets are packed with antique dealers. Of course Insa-dong is the place where most visitors come to experience the traditional images of Korea, and is place where I bring my foreign friends first.

Interestingly enough Seoul conjoins its past, present and future, and is definitely a futuristic place. It is difficult to adjust to the city because of its full varied vibrant spirit, ever-changing atmosphere and how animated the people are. The city is always evolving and changing constantly, which makes it hard to predict what can come up next, but it preserves its ancient traditions at the same time. This is my hometown, the city of yesterday and today, where old and new coexist in perfect harmony.

Park Haewon *is a consultant in the Nuclear Power Engineering Section.*

Countries Are Making Progress toward Nuclear Power

..... continued from page 1

As in past years, the participants appreciated the opportunity to discuss common challenges and to share their experiences in smaller groups in breakout sessions.

Participants identified that engaging all political parties and the public in the development of a national position can lead to a stable Government policy over a multi-year planning timeline. The relationship between the technical community performing studies on nuclear power and the policy-makers (Government bureaucrats) together with media, public and decision-makers at the political level all contribute to the development of a national position. A clear position on how nuclear power will be introduced will form the foundation for the planning and implementation of the national infrastructure and nuclear power plant project.

The use of self-evaluations to support continuous improvement was recognized. Countries gave their experiences that they can be in one Phase for some of the Milestones issues, and in another Phase for other issues. The self-evaluation report can contribute to prioritizing international assistance.

Experience of the five countries who have received INIR missions was also discussed. INIR missions are international expert reviews of the infrastructure status organized by the IAEA. They identified the benefits of the INIR mission as confidence building, as identifying gaps and ways to fill the gaps, and in making the best use of international assistance. The workshop concluded that self-evaluations are essential to the success of INIR missions. In general the evaluation methodology was found to be very useful, and some areas for improvement were identified.

Workshop materials, interviews with some participants and other resources are available at the following website: www.iaea.org/NuclearPower/Infrastructure.

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Upcoming Events

Date	Contact	Title	Venue	Country
16-20 May 11	K.S.Kang@iaea.org M.maeoka@iaea.org, B.Pagannone@iaea.org	International Workshop on Public Information and Understanding to introduce a new nuclear power plant	Seoul	Republic of Korea
17-20 May 11	b.molloy@iaea.org , b.pagannone@iaea.org	TM on Management of Organizational Change for Nuclear Power Projects	Vienna	Austria
23-27 May 11	A.Stanculescue@iaea.org	TM of the Technical Working Group on Fast Reactors (TWG-FR)	Beijing	China
24-26 May 11	O.Glockler@iaea.org	TM of the Technical Working Group of Nuclear Power Plant Instrumentation and Control (TWG-NPPIC),	Vienna	Austria
23-26 May 11	M.Aoki@iaea.org	Technical Working Group on Nuclear Infrastructure	Vienna	Austria
25-27 May	R.Beatty@iaea.org	17th INPRO Steering Committee Meeting	Vienna	Austria
25-27 May 11	B.m.tyobeka@iaea.org	Workshop on Construction Technology for New NPP– Europe and Africa	Paris	France
30-31 May 11	V.Nkong@iaea.org	2nd Regional Conference on Energy and Nuclear Power in Africa	Cape Town	South Africa
13-18 June 11	I.Khamis@iaea.org	Advanced School on Development and Characterization of Materials for Hydrogen-Based Energy Systems: Role of Nuclear Technology	ICTP, Trieste	Italy
23-25 June 11	b.m.tyobeka@iaea.org	Workshop on Construction Technology for New NPP– Asia	Shanghai	China
20-24 June 11	A.stanculescue@iaea.org	TM on Fast Reactor In-service Inspection and Repair: Status and Innovative Solutions	Vienna	Austria
21-23 June 11	j.h.choi@iaea.org	Technical Meetings of TWG-LWR and TWG-HWR	Vienna	Austria
27 June – 1 July 11	K.Yamada@iaea.org	Joint ICTP/IAEA Course on Science and Technology of SCWRs	ICTP, Trieste	Italy
27 June-01 July	A.stanculescue@iaea.org	TM on Innovative Heat Exchanger Designs for Fast Reactors	Vienna	Austria
7-19 August 11	P.Gowin@iaea.org F.Depisch@iaea.org A.Jalal@iaea.org	TC Workshop on Developing National Long-Range Nuclear Energy Strategies INT/4/142	Argonne, IL	USA

Impressum

Nuclear Power Newsletter
Vol. 8, No. 1, March 2011

The Nuclear Power Newsletter is prepared by the Division of Nuclear Power, Department of Nuclear Energy

Vienna International Centre, PO Box 100, 1400 Vienna, Austria
Printed by the IAEA in Austria, March 2011

10-06151