

# Nuclear Power

## Objective

To enhance the capability of interested Member States, in a rapidly changing market environment, to improve nuclear power plant operating performance, life cycle management including decommissioning, human performance, quality assurance and technical infrastructure, through good practices and innovative approaches consistent with global objectives on non-proliferation, nuclear safety and security. To enhance the capacity of Member States for the development of evolutionary and innovative nuclear system technology for electricity generation, actinide utilization and transmutation and for non-electric applications, consistent with sustainability goals. To encourage the improvement of public understanding of nuclear power.

## Nuclear Power Plant Operating Performance and Life Cycle Management

To assist Member States in improving the operation and life cycle management of existing nuclear power plants, the Agency disseminates operating experience, knowledge and best practices in the areas of instrumentation and control (I&C), life cycle management, organizational performance, and excellence in the performance of nuclear power plant personnel.

With regard to I&C modernization, three technical meetings were held in 2006 covering: on-line condition monitoring of equipment and processes in nuclear power plants using advanced diagnostic systems; the impact of modern technology on I&C in nuclear power plants; and implementation and licensing of digital I&C systems and equipment in nuclear power plants. A workshop, jointly organized by the Agency and the Electric Power Research Institute, was held on the modernization of I&C systems in nuclear power plants to share expertise and experience.

Six publications were issued in 2006 in the area of integrated life cycle management of nuclear power plants covering: nuclear power plant life management process guidelines and practices for heavy water reactors (IAEA-TECDOC-1503); material degradation and related managerial issues of nuclear power plants; principles and guidelines on plant life management for the long term operation of LWRs (Technical Reports Series No. 448); embrittlement

and interpretation of reactor pressure vessel and internal material (published jointly with the Joint Research Centre of the EC); nuclear power plant life management and longer term operation (published jointly with the OECD/NEA); and indicators for management of planned outages in nuclear power plants (IAEA-TECDOC-1490). The Agency also extended its series of CRPs on optimal measurement of irradiation fracture parameters – using relatively small test specimens – to assess reactor pressure vessel structural integrity.

In the area of organizational performance, the Agency published *The Management System for Facilities and Activities* (GS-R-3) in 2006. This publication, issued in the IAEA Safety Standards Series, replaces earlier reports on quality assurance and reflects the evolution of the field shown conceptually in Fig. 1. The Agency and FORATOM organized a workshop in Romania on management and organizational change, a topic of particular interest in the nuclear power area given the current unprecedented pace of organizational change. The critical factors for success that were identified are: strong leadership; involvement of the workforce throughout the change process; and effective regulation. It was emphasized that both nuclear organizations and their regulators understand that enhancing safety is an essential part of all successful change.

The nuclear industry spends a significant amount of its resources conducting competency assessments of personnel for employee selection, trainee assessment, qualification and authorization. To promote the achievement of excellence in the performance of nuclear power plant personnel, the Agency published *Competency Assessments for*



FIG. 1. Evolution of quality management systems.

*Nuclear Industry Personnel*, which provides guidance to ensure that these human resources are used effectively. Three further publications were issued in 2006: *Human Resource Issues Related to an Expanding Nuclear Power Plant Programme* (IAEA-TECDOC-1501); *Guidelines for Upgrade and Modernization of Nuclear Power Plant Training Simulators* (IAEA-TECDOC-1500); and *Authorization of Nuclear Power Plant Control Room Personnel: Methods and Practices with Emphasis on the Use of Simulators* (IAEA-TECDOC-1502).

## Strengthening National and Regional Nuclear Power Infrastructures

In his statement to the 61st regular session of the United Nations General Assembly, the Director General stated that “As a sophisticated technology, nuclear power requires a correspondingly sophisticated infrastructure.” In 2006, the Agency issued two publications on infrastructure: *Basic Infrastructure for a Nuclear Power Project* (IAEA-TECDOC-1513) and *Potential for Sharing Nuclear Power Infrastructure between Countries* (IAEA-TECDOC-1522). Work also began on a publication defining milestones in the development of the infrastructure necessary for a country to introduce its first nuclear power plant. All of these publications will help Member States in: assessing their own status and progress, determining their degree of preparedness for developing their first nuclear power plant, and determining the infrastructure necessary for planning, purchasing, building, operating and maintaining the first power plant. They will also assist the Agency in deciding when training or other services are appropriate for the efficient use of resources.

A workshop on issues for the introduction of nuclear power — co-sponsored by Canada, China, France, India, Japan, the Republic of Korea, the Russian Federation and the USA — was held in December in Vienna. Representatives of countries that do not currently operate nuclear power plants also attended this workshop, which focused on a wide range of infrastructure issues and provided an opportunity to better understand the needs

and concerns of countries interested in initiating a nuclear power programme.

## Technology Development

The Agency seeks to foster innovation in nuclear power and fuel cycle technologies. Its work programme covers three major areas: the Agency’s Technical Working Groups (TWGs) on light water, heavy water, fast and gas cooled reactors; the International Project on Innovative Nuclear Reactors and Fuel Cycles (INPRO); and activities on small and medium sized reactors (SMRs), and on seawater desalination using nuclear power.

The TWGs bring together experts from developing and industrialized Member States to: identify key areas for scientific and technical information exchange; provide assistance, documentation and training; and pool R&D resources from national organizations towards agreed common goals. Work in 2006 included the publication of *Theoretical and Experimental Studies of Heavy Liquid Metal Thermal Hydraulics* (IAEA-TECDOC-1520), training workshops on nuclear power plant simulators for education, and CRPs on a range of nuclear reactor technology issues.

Other work included a regional training course on high temperature gas cooled reactors (HTGRs) and the organization in South

Africa of the 3rd International Topical Meeting on High Temperature Reactor Technology. Both meetings reviewed the technical and economic feasibility of HTGRs for high efficiency electricity generation and for process heat applications, as well as hydrogen production and coal conversion. HTGR designs are attractive for these applications because they produce outlet temperatures of around 1000°C due to the absence of metallic material in the reactor core.

INPRO facilitates innovation by providing an open forum for nuclear system supplier countries and potential new users of nuclear power to study problems associated with introducing innovative nuclear energy systems. Its approach is holistic, incorporating economics, safety, proliferation resistance, resource use, waste minimization and infrastructure. In addition, it places special emphasis on the needs of developing countries. Further

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details on INPRO's work in 2006 can be found in the introductory chapter of this report, 'Issues and Events in 2006'.

## Small and Medium Sized Reactors

Large reactor designs benefit from economies of scale but are not necessarily suitable for countries with limited investment capacities or small electricity grids. The Agency's assistance in the development of SMRs is concentrated on Member States that could benefit from incremental additions to nuclear power capacity with a relatively small initial capital investment (Fig. 2). The focus is on economic competitiveness for different applications (electricity, district heat, desalination and combinations), passive safety design, and reactors without on-site

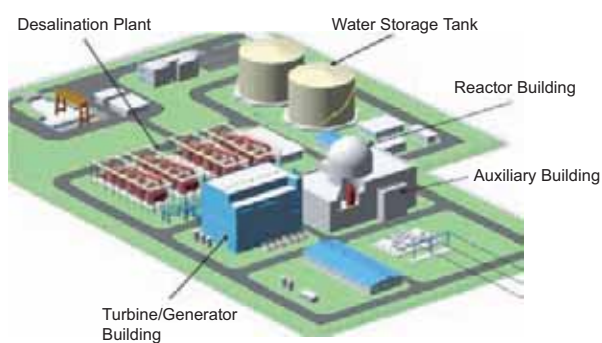


FIG. 2. An example of an SMR — the System Integrated Modular Advanced Reactor (SMART) in the Republic of Korea (photo credit: KAERI).

refuelling. Two publications were issued in 2006, one on the *Status of Innovative Small and Medium Sized Reactor Designs 2005: Reactors with Conventional Refuelling Schemes* (IAEA-TECDOC-1485) and the other on *Advanced Nuclear Power Plant Design Options to Cope with External Events* (IAEA-TECDOC-1487). The latter publication took a broader approach to address advanced plants of various capacity, not just SMRs. In the area of nuclear desalination, the Agency convened the 8th meeting of the International Nuclear Desalination Advisory Group (INDAG) in Vienna, and conducted a training course on the technology and economics of desalination system modelling at the Abdus Salam ICTP in Trieste.

## Databases in Support of Nuclear Power Operations

The Agency maintains a number of widely used databases to support the operation of nuclear power operations in Member States that are easily accessible on the Internet. Several of these are supplemented by print or CD-ROM versions. The latter include *Nuclear Power Reactors in the World* (Reference Data Series No. 2) and *Operating Experience with Nuclear Power Stations in Member States in 2005*, both issued in 2006. These publications, as well as *Country Nuclear Power Profiles*, are based on the *Power Reactor Information System* (<http://www.iaea.org/programmes/a2/index.html>). Other databases supporting operations include the *Electronic Nuclear Training Catalogue* and the *Nuclear Economic Performance Information System*. ■