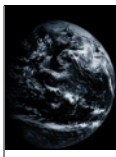
NUCLEAR POWER

PROGRAMME OBJECTIVE

To assist Member States, at their request, in planning and implementing programmes for the utilization of nuclear power, as well as to support them in achieving improved safety, reliability and economic cost effectiveness of their nuclear power plants by promoting advanced engineering and technology, training, quality assurance and infrastructure modification.



OVERVIEW

Internal and external reviews led to a reformulation of the programme in 1999. There was greater emphasis on the planning of nuclear power programmes using small and medium size reactors in developing countries. Work on the erosion/corrosion of plant components, and on the effects of energy market deregulation on nuclear power plant operation and performance improvement was rationalized in order to make more efficient use of resources. And there was a new focus in the training of power plant personnel on the need to maintain important capabilities and skills in the light of an ageing workforce. In the field of technology development, there was increased emphasis on status reviews and the dissemination of information. Elements of a strategic plan for an international R&D project on innovative nuclear fuel cycles and power plants were developed. Sharing and preservation of technical data received increased attention, and educational workshops and training in specific aspects of nuclear power development and applications were carried out.

NUCLEAR POWER PLANNING, IMPLEMENTATION AND PERFORMANCE

Work in this area seeks to facilitate the exchange of experience and provide assistance to Member States in nuclear power programme planning and in economic analyses, including cost–benefit analysis of upgrades to nuclear

plants and plant life extension. In particular, assistance was provided to Bangladesh, Egypt, Morocco, Turkey and Viet Nam in the areas of nuclear power planning, feasibility studies and infrastructure development.

A database for the Nuclear Economic Performance Information System (NEPIS) was developed. NEPIS contains information on several aspects of economic performance, including operation and maintenance (O&M) costs, safety, and economic and operational indicators. The first pilot project to collect and validate an initial set of data was completed in June. Related to this, a technical document was prepared on the development of a nuclear economic performance information system to enhance nuclear power plant competitiveness. This document addresses transformations in electricity markets and the business environment, and provides guidance to utilities on optimizing economic and technical performance.

"The Agency's Power Reactor Information System (PRIS) seeks to promote improvements in the operating performance of nuclear power plants."

A new CRP was initiated on national approaches to correlate performance targets and O&M costs. The focus is on optimizing these costs, identifying high and low cost areas in O&M activities, establishing the financial impact of extended outages and identifying refuelling costs. The relevance of this CRP is that if analyses at a national level of historical cost data can be translated into an international database, it can facilitate the communication of trends and best practices in the industry and help build up a set of international economic indicators.

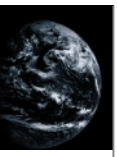
The Agency's Power Reactor Information System (PRIS) seeks to promote improvements in the operating performance of nuclear power plants through the collection, assessment and dissemination of: utility experience and practices; information on the operating performance of nuclear power plants; and analyses of subject areas affecting performance. To facilitate this process, a CD-ROM version of PRIS was developed. Currently, the Agency's two PRIS services, MicroPRIS and PRIS-PC (the connection to PRIS through the Internet), are distributed to more than 600 users in Member States and international organizations.

In addition, implementation of a 'virtual office' has begun for PRIS. Virtual office is an Internet forum to exchange information and improve the efficiency of Agency interaction with its Member States. One of its major advantages is the capability to maintain an integrated and up-to-date view of project information.

A new data module, the International Database on Piping of Nuclear Power Plants, was completed. This module includes information on piping material properties, non-destructive examination of pipelines and piping failures. With the software having been prepared, first data input from Member States is expected to be provided by the end of 2000.

In the area of nuclear power plant life management, a CRP on assuring the structural integrity of reactor pressure vessels (RPVs) was completed. A number of recommendations for further activities were proposed. For example, the 18 Member States participating in the CRP recommended the use of Agency reference steel as the basis of comparison for future international studies on RPV materials. In addition, further research was recommended on the application of surveillance programme results to RPV integrity assessments and on the mechanism of the nickel effect in the radiation embrittlement of RPV steels.

A key area in nuclear power plant performance is instrumentation and control. In order to provide guidance and information, a database was developed on operator support systems (OSSDB) containing the most pertinent characteristics of such systems. The database focuses on users, their needs and the benefits of using OSS.



The aim of the Agency's 'Strategy for Technical Co-operation' is to promote socioeconomic development by contributing in a cost effective manner to activities that address key welfare priorities. As part of this strategy, technical support was provided in such areas as the implementation of first or new nuclear power projects, and national nuclear infrastructure development, including personnel training, infrastructure, plant life management and improved operations management. Most of these technical co-operation efforts were concentrated in the Europe and Asia–Pacific regions.

NUCLEAR POWER REACTOR TECHNOLOGY DEVELOPMENTS

The International Working Group on Advanced Technologies for LWRs met in Vienna in May and advised that priority continue to be given to information exchange on technology advances for improving the economics of current and future LWRs. Greater emphasis was also recommended on technologies for achieving a high level of safety, and on the sharing and preservation of technical data. In addition, the involvement of young engineers in nuclear power technology development was seen as priority.

A CRP on the establishment of a thermophysical properties database for LWR and HWR materials was initiated. The objective is to foster the exchange of non-proprietary information on the thermophysical properties of these materials to achieve improvements in design and safety. A peer reviewed database of properties under normal, transient and severe accident conditions will be established on the Internet. Efforts are also under way to critically assess available thermophysical property data and make recommendations for experiments where data are currently lacking, or uncertainties need to be reduced. The LWR and HWR materials that will be studied include fuels, cladding, pressure tube and calandria materials, absorbers, structural materials, and the behaviour of liquids and mixtures under severe accident conditions.

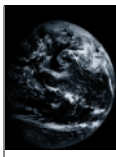
The use of efficient technologies for improving nuclear power plant O&M is an important element in ensuring their economic competitiveness with other means of generating electricity. Furthermore, as currently operating plants age, proper management requires the development and application of better technologies for inspection, maintenance and repair. In designing future plants, various features that facilitate efficient inspection, maintenance and repairs can be incorporated at the outset.

The technologies for improving current and future LWR operation and maintenance were investigated at a Technical Committee meeting hosted by the Nuclear Power Engineering Corporation at the Kashiwazaki-Kariwa Nuclear Power Station from 24 to 26 November. Convened within the framework of the Agency's International Working Group on Advanced Technologies for Light Water Reactors, the topics that were addressed included:

- Programmes for extending plant lifetime and or improving performance and reliability;
- Equipment and techniques for component inspection, maintenance, repair and replacement;
- Methods for reducing fuelling cost and refuelling outage duration;
- Advances in design to achieve improved operation and maintenance.

The third meeting of the International Working Group on Advanced Technologies for Heavy Water Reactors was held in Vienna in June. One of the recommendations was that work in this area have two tracks: activities directed towards a long term strategic vision, and technical activities. It was also recommended that greater attention be devoted to safety aspects of HWR technology development.

Small reactors are those that have electrical power (or equivalent thermal power) of less than 300 MW(e), while medium reactors have electrical power between 300 and 700 MW(e). Such small and medium reactors (SMRs) are a suitable option for electricity generation in countries with small electricity grid capacities, or in remote areas. They can also be used for non-electrical and cogeneration applications,



including the desalination of seawater and district heating, as well as for the production of high temperature process heat. Work on SMRs in 1999 included the convening of an Advisory Group meeting in October in Vienna on the development of a strategic plan for an international R&D project on innovative nuclear fuel cycles and power plants. The outcome of this meeting was a set of recommendations for Agency support in this area and the identification of nine candidate projects. Operating experience from small size reactors used for the propulsion of icebreakers and freight carriers was reviewed at an Advisory Group meeting and by consultants. There was agreement that with some design modifications, these reactors could be used either for electricity supply or for non-electrical applications such as district heating and desalination, particularly in remote areas. The results of the various meetings are being consolidated and will be presented in a technical document.

"A study on the economics of nuclear desalination highlighted the conditions under which nuclear desalination would be competitive with fossil alternatives."

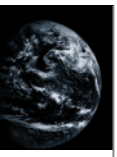
Gas cooled reactors (GCRs) are capable of high temperature operation, offering increased efficiency in the production of electricity and the potential for high temperature process heat applications. Increasing international interest in GCRs is evident from construction and startup activities at two high temperature gas cooled research reactor facilities in Japan and China, as well as two international reactor design projects.

The International Working Group on Gas Cooled Reactors met in the United Kingdom in September to review activities in the field and provide recommendations for future efforts. The group noted that the gas turbine high temperature reactor (HTR) designs currently under development are well suited for nuclear desalination in a cogeneration mode and recommended that they be included in Agency nuclear desalination activities. The IWG also recommended that future GCR meetings be directed toward the establishment of modular HTR safety and licensing criteria and related safety analysis and equipment classification.

The final Research Co-ordination meeting for a CRP on the design and evaluation of heat utilization systems for the High Temperature Engineering Test Reactor (HTTR) was held in October in Japan. The focus of this meeting was on heat utilization systems, including steam reforming of methane for the production of hydrogen and methanol, use of a gas turbine for electricity generation, carbon dioxide reforming of methane for the production of methane or syn-gas, hydrogen production by thermochemical water splitting, and coal conversion and enhanced oil recovery. A technical document on the results of this CRP is currently being prepared.

A Technical Committee meeting on the prospects of non-electrical applications of nuclear energy was held in Beijing. The meeting reviewed information on the prospect, design, safety and licensing aspects, and development of non-electrical applications of nuclear heat for industrial use. This included seawater desalination and hydrogen production.

The International Nuclear Desalination Advisory Group (INDAG), at its third meeting in June, reviewed national programmes and projects in Member States and stressed the importance of facilitating international co-operation in nuclear desalination demonstration activities. The outcome of the first meeting of an interregional technical co-operation project on integrated nuclear and desalination system design, held in May in the Republic of Korea, was also reviewed. In addition, recommendations on further analyses of country needs and follow-up actions by the Agency were made. Related work in this area included a comprehensive study co-ordinated by the Agency on the overall economics of nuclear desalination as compared with the use of fossil energy. The study highlighted the conditions under which nuclear desalination would be



competitive with fossil alternatives. The conditions were identified using as examples three typical regions, a wide range of nuclear and fossil power options and two economic scenarios. Some of the parameters included seawater salinity and temperature, water plant capacity, construction cost and the interest rate applied.

The Agency's activities in the area of liquid metal cooled reactors and emerging nuclear energy systems for energy generation and the transmutation of actinides included the initiation of a CRP on updated codes and methods to reduce the calculational uncertainties of liquid metal fast reactor reactivity effects. The objective is to verify, validate and improve methodologies and computer codes for the calculation of reactivity coefficients in plutonium and minor actinide burning reactors through the intercomparison of methods, nuclear data and codes, and experimental results developed and used by different institutes. This activity is of particular relevance in view of the eventual utilization of weapons grade plutonium in fast reactors.

A comprehensive review at an Advisory Group meeting of national R&D programmes on accelerator driven systems (ADS) was carried out. The purpose was to review the status of such programmes and assess progress in the development of hybrid concepts, as well as their potential role relative to both the current status and the future direction of nuclear power worldwide. At the same time, the review provided options and guidance for Agency activities in the area of ADS.