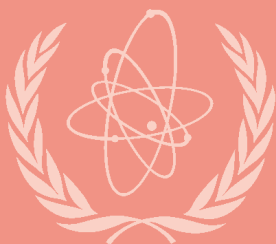


Nuclear Safety Review for the Year 2003



IAEA

International Atomic Energy Agency

***Nuclear Safety Review
for the Year 2003***

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for the Year 2003

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FOREWORD

The *Nuclear Safety Review* reports on worldwide efforts to strengthen nuclear, radiation and transport safety and the safety of radioactive waste management. In line with the suggestions made by the Board of Governors in March 2002, the first part is more analytical and less descriptive.

This short analytical overview is supported by a second part, which describes significant safety related events and issues worldwide during 2003.

A *Draft Nuclear Safety Review for the Year 2003* was submitted to the March 2004 session of the Board of Governors in document GOV/2004/3. The final version of the *Nuclear Safety Review for the Year 2003* was prepared in the light of the discussion by the Board.

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ANALYTICAL OVERVIEW

INTRODUCTION

The Nuclear Safety Review for the Year 2003 presents an overview of the current issues and trends in nuclear, radiation, transport and radioactive waste safety during 2003. This overview is supported by a more detailed factual account of safety related events and issues worldwide during the same period.

In January 2003, the Agency implemented an organization change and developed an integrated approach to reflect a broader assignment of nuclear safety and nuclear security and to better exploit synergy between them. The Office of Physical Protection and Material Security, renamed as the Office of Nuclear Security, was transferred from the Department of Safeguards to the Department of Nuclear Safety, which became the Department of Nuclear Safety and Security to reflect the change. This Review provides information primarily on nuclear safety; nuclear security will be addressed in a separate report.

INTERNATIONAL SAFETY STANDARDS AND THEIR APPLICATION

Establishing nuclear safety standards and providing for their application are statutory functions of the Agency, essential for a global safety regime that provides for protection of people and the environment. Notable achievements have been made in 2003 using the Agency standards to enhance nuclear safety in Member States. Central to the worldwide outreach and application of the Agency safety standards is, however, the need to ensure an effective process to take into account the practical experience feedback of the application of Agency safety standards in Member States.

In November 2001, the Commission on Safety Standards proposed to the Director General a strategy for the safety standards programme aimed at enhancing the standards and their global application. The strategy was prepared in consultation with the various safety committees and submitted to the Board of Governors in September 2003 and to the 2003 session of the General Conference. The relevant documents are:

An overview of the IAEA safety standards: a brochure explaining the philosophy, structure, scope and means of application of the corpus of safety standards.

Overall structure of the IAEA safety standards: a document showing that all necessary activities and issues are appropriately covered in the standards and that there is an appropriate combination of 'thematic' and 'facility specific' standards.

An action plan for the development and application of safety standards is being submitted to the Board of Governors in March 2004.¹ The action plan pays special attention to collecting experience feedback on the use of safety standards and to the review of Agency safety related publications developed outside the Agency's safety standards programme.

The overview and the overall structure of the safety standards were presented at the Scientific Forum held during the 2003 session of the General Conference. There was general agreement that the Agency safety standards reflect a high level of safety and should serve as the global reference for the protection of people and the environment. Many regulatory bodies of Member States are using the Agency standards as reference for national regulations. In

¹ This Action Plan has been submitted for the Board's consideration in document GOV/2004/6.

other Member States, regulators are called upon to ensure that their regulations are in agreement with the Agency standards and the levels of safety expressed in them.

The Agency continued to place considerable emphasis on pursuing the worldwide application of the IAEA Safety Standards. The Agency's safety standards are being used by some countries as a reference in the preparation of national reports and for the peer review under the Convention on Nuclear Safety and the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management.

International and national standards organizations develop industrial standards that complement the Agency safety standards by specifying detailed requirements for design and operation of components and for procedures. Arrangements exist between the IAEA and standards organizations such as the International Organization for Standardization (ISO), and the International Electrotechnical Commission (IEC) to use a common structure and share glossaries of terms. Professional societies, as for example, those in the medical area, are also involved in the development and review of Agency safety standards.

Among the safety standards published in 2003 were two safety requirements entitled *Site Evaluation for Nuclear Installations* (Safety Standards Series No. NS-R-3) and *Remediation of Areas Contaminated by Past Activities and Accidents* (Safety Standards Series No. WS-R-3). The safety requirements on site evaluation for nuclear installations is an update of an earlier publication on site selection. The focus of the new publication is primarily on the evaluation of existing sites rather than on the selection of new ones. Requirements for site evaluation are intended to ensure adequate protection of site personnel, the public and the environment from the effects of ionizing radiation arising from nuclear installations. It provides specific requirements for the evaluation of external natural events (such as earthquakes, flooding, extreme meteorological conditions and geotechnical hazards) and human induced events (such as aircraft crashes and chemical explosions). The publication also covers the potential effects of the installation on the region (such as uses of land and water, population distribution in the region and dispersion of radioactive material in the atmosphere, surface water and through ground water). The safety requirements on remediation of areas contaminated by past activities and accidents establishes, for the first time, requirements in relation to protective actions and remedial measures intended to reduce actual prolonged exposure, to avert potential prolonged exposure or to reduce the likelihood of occurrence of such exposures due to contamination. It includes remedial measures such as removal or reduction of the source of exposure as well as other long term protective actions such as restrictions on the consumption of foodstuff, grazing by livestock and the use of fodder, and restrictions on access or on land use. In addition, nine Safety Guides were published in 2003: seven on various aspects of nuclear power plants; and two on management of radioactive waste.

SAFETY OF NUCLEAR INSTALLATIONS

The safety of nuclear installations has shown substantial improvement over the past decades which continued in 2003. Traditional measures of safety (e.g. reactor protection and safety system actuations; safety related equipment and component availability; unplanned plant shutdowns) show that nuclear installations have become less susceptible to events that challenge their safety and are better prepared to mitigate the consequences of such events, should they occur. While the rate of improvement is levelling off as some performance indicators approach their realistic maximum values, significant efforts continue to be invested in securing the marginal improvements that are still attainable. Notwithstanding these

apparent successes, there are numerous opportunities to improve safety margins and provide a greater assurance that the nuclear option is being pursued in a safe and responsible manner.

Design safety

Design considerations associated with nuclear installations continue to receive attention. Worldwide, design changes and plant modifications continue to be made to improve the safety and efficiency of in-service nuclear installations. Equally as important, significant changes are being incorporated into the new designs that are being proposed and built throughout the world.

Despite the improvements that have been made, there are several areas in which continued attention is needed. These include: the concerns associated with older designs; the implications of long term operations and power uprating at all types of installations; seismic vulnerabilities; and the need to incorporate design concepts into security upgrade strategies.

Safety at nuclear power installations whose inherent design assumptions have, in the past, raised questions, continues to be an area that attracts international attention. The Agency and the World Association of Nuclear Operators (WANO) continue to conduct experts' missions, design reviews and peer reviews of safety (including design considerations) at nuclear power plants. An Agency review at the Metsamor nuclear power plant (Armenia) confirmed that significant safety upgrades had been implemented within the power plant. In 2002, a similar review confirmed the safety improvements that had been made at Kozloduy, Units 3 and 4 (Bulgaria); in addition, the European Commission (EC) conducted its own review of the Kozloduy plants as part of its assessment of the readiness of Bulgaria for accession to the European Union. Consideration and review of design concerns for such installations must, of necessity, continue to be handled individually, on a case-by-case basis.

For most of the existing plants in the world, however, the foremost design safety issues relate to ageing and long term operations. Ageing management is a concept that begins with the initial design of a nuclear facility, is incorporated into operational practices, such as in-service testing programmes, and manifests itself in subsequent modification and design improvement efforts. Many Member States that have operating plants have begun to consider plant operations beyond the 'original design lifetimes'. This has resulted in the recognition that this consideration is not limited to any unique nuclear steam supply system design. As a result of the more global implications of this challenge, numerous Member States are working with the Agency to refocus efforts in this area. The previous concentration on high power, channel type reactors (RBMKs) and water cooled, water moderated power reactors (WWERs) has been expanded to encompass all pressurized water reactor designs, and includes considering how best to address the inherent need of resolving significant design issues as part of the life extension process. This will allow the lessons that can be learned in this area to be more effectively shared throughout the nuclear community.

There also continues to be a demand for the re-evaluation of the impacts of external events, especially at seismic sites. These re-evaluations have been triggered either by modifications in safety requirements, or by new evidence in the site hazard assessments arising, for example, during periodic safety reviews or licence extension proceedings. Examples of this demand were demonstrated by the safety reviews at the nuclear power plants in Armenia and the Islamic Republic of Iran, which have identified the need for significant seismic review in the near future.

A particular challenge in effectively addressing seismic issues is the fact that internationally accepted standards for such re-evaluations are, generally, lacking;

consequently, upgrading measures are not uniformly implemented. In most Member States, the consideration of seismic issues has been concentrated on existing nuclear installations, the evaluation of which are very complicated. Seismic hazard assessments for nuclear sites have indicated a need for benchmarking and establishing homogenous national practices. In response, an International Symposium on Seismic Evaluation of Existing Nuclear Facilities was held in Vienna. It confirmed the need to develop an international safety standard addressing this issue, and it identified the following specific items of concern: seismic considerations for safety assessments, such as the significance of high-acceleration records and the treatment of uncertainties; there remain unresolved issues in the assessment of structures and components; preparedness in case of a seismic event needs to be encouraged; and, nuclear installations other than nuclear power plants deserve attention.

Finally, the significant efforts that continue to be expended, internationally, on future near term designs and future long term designs must be mentioned. The pebble bed modular reactor (a high temperature gas cooled design) demonstration project continues to be a major initiative. The environmental impact assessment for the demonstration project was completed this year and licensing activities in South Africa continue. The safety issues associated with its construction and operation will be significant topics for future consideration. The development of inherently safe reactor designs for long term utilization continues under the International Project on Innovative Nuclear Reactors and Fuel Cycles (INPRO). In the near term, a major joint research programme has been initiated by several countries for developing new concepts of nuclear reactors in the frame of the Generation IV International Forum project. This research programme, envisioned as a vehicle to develop innovative reactors that can be deployed in the next few decades, has a significant safety focus. Inherent to the design of new reactors is the premise of their safety, and this is the foundation upon which this programme is built.

Operational safety

Overall, the nuclear industry's commitment to improving the safety of its nuclear installations continues to be confirmed by the Agency's operational safety reviews. Follow-up missions find that, on average, the percentage of issues which are satisfactorily addressed has been increasing steadily for several years. The wide availability of findings through the open distribution of the Agency's Operational Safety Review Team (OSART) mission results continues to contribute to a heightened awareness of both good practices and potential pitfalls.

Even with the improvements noted in daily operational activities, the nuclear industry continues to be challenged by significant internal and external pressures. These pressures, in turn, have been found to be important and consistent factors in operational events. These challenges have manifested themselves in operating organizations, regulatory bodies and nuclear contracting firms. The lessons from these challenges must be identified, analysed and shared if continued improvements are to be expected.

Operational experience feedback

In general, the industry continues to improve the safety and reliability of nuclear power generation. The number of significant events remains low and additional emphasis has been given to further analyse operating events for human performance enhancements. This is shown by the incorporation of the operational experience review module into the Agency's OSART mission and the launching of the Peer Review of Operational Safety Performance Experience (PROSPER), a safety review programme uniquely focused on this topic.

Of great relevance for nuclear regulators and plant operators are also the lessons learned from the incident which occurred in April 2003 at the Paks nuclear power plant in Hungary.

On a broader scale, several common issues were identified during the past year, when factors such as privatization, market deregulation, and downsizing in the nuclear industry challenged installation safety. Insights from events that occurred in 2003 can be summarized as follows: minor modifications to equipment or procedures, if not properly reviewed before implementation, may cause serious safety consequences; despite abundant operating experience information, events with similar root causes continue to reoccur; incorrect performance testing, maintenance and modification procedures continue to be relevant to events; human factors, organizational and communication deficiencies, unexpected structural defects and loss of corporate knowledge contribute to causes of events. Finally, the absolute delegation of responsibility to a contractor, with an ensuing failure to sufficiently assess contractor competence and an inadequate oversight of contractor activities, were additional factors noted during 2003.

The most significant insights from significant design implications of operational events that have occurred during the past year centred around the challenges experienced in the materials integrity area. The discovery of circumferential cracks in pressurized water reactor vessel bottom head penetrations and pressurizer heater sleeves has led to a detailed review of the susceptibility assumptions for this area of the reactor and the associated materials. It is fortuitous that these cracks were discovered as part of proactive monitoring programmes as opposed to being responses in reaction to significant materials failures. These events continue to reinforce the premise that the maintenance of system integrity requires proactive attention and aggressive monitoring programmes.

Finally, the effective feedback of operational experience requires active and functional information sharing systems. The Incident Reporting System (IRS) is jointly operated by the Agency and the Organisation for Economic Cooperation and Development's Nuclear Energy Agency (OECD/NEA). Both Agencies expressed an increasing concern that, worldwide, experience related to nuclear power plant operations was not being adequately shared through the IRS. The Agency and the OECD/NEA are particularly concerned by the lack of reporting coverage of significant events and by the substantial decrease in the overall reporting rate. Moreover, recent events, and the recurrence of commonly known problems, show that an increased vigilance is required to ensure that lessons learned in the past are retained in the knowledge of nuclear organizations. It is, therefore, particularly important that the necessary measures be implemented to assure that complete, timely and high quality event reports are submitted to all experience sharing systems.

Safety management and safety culture

During the previous safety review, it was noted that a small but persistent number of events that had not seriously jeopardized overall safety suggested that there were safety culture deficiencies in countries with long established nuclear power programmes. During the past year, this premise was tested at several workshops.

The Agency and the OECD/NEA jointly sponsored a workshop in June 2003 entitled Nuclear Safety Management and Safety Culture: Lessons learned from Recent Events. It was recognized that there are differences among Member States in their regulatory approaches to safety culture. Clearly, there is much work to be done to fully understand the appropriate role of the regulator in regulating safety culture and the management of safety; additionally, there is a need for clear criteria for regulatory intervention. The Agency also presented the conclusions and recommendations from this workshop at the Senior Regulators' Meeting

during the 47th session of the General Conference. There was consensus that the workshop's objective — to share lessons learned from operational events — should be pursued further and that the Agency, in collaboration with the OECD/NEA, should play a leading role in that endeavour.

This workshop emphasized the need to integrate the concepts associated with a vibrant safety culture into the entire spectrum of the Agency's nuclear installation safety services. It is essential to realize that not all problems are embedded in cultural differences; equipment malfunctions, technical misjudgements, and human errors do occur. Learning from such mistakes, working to minimize their recurrence, and ensuring that safety considerations are pre-eminent throughout the workforce are the safety culture challenges of the future.

Risk informed decision making

The integration of risk into the normal decision making processes inherent to the nuclear industry has been evolving for a long period of time. It is a concept that has been embraced by both the operators of nuclear power plants and the national regulatory bodies. International organizations, such as the Agency and the OECD/NEA, have, likewise, seen the benefits of including risk insights into the complex decisions that are part of the operation and regulatory oversight of nuclear installations.

The inclusion of risk insights, however, brings with it the potential of losing some of the benefits of deterministic regulations and decision making that is based on a criterion. When 'risk informed' decision making becomes 'risk based', the safety margins associated with the concept of 'defence in depth' can be compromised. Even more importantly, it is essential to ensure that regulatory predictability and public transparency are retained when regulatory infrastructures that are based upon deterministic criteria have to integrate risk into the decisions that are promulgated to facility operators.

Safety of research reactors

During this year, there were no events that significantly challenged operational safety of research reactors. Challenges remain to long term successful operations, especially those regarding the establishment of effective utilization programmes, the maintenance of safety related systems and the continuance of staff competence; however, these are being dealt with. In addition, developmental efforts for new research reactors (e.g. the Australian Replacement Research Reactor) are focusing on providing safe and effective platforms for research and testing applications in the future.

One part of the international research reactor safety enhancement plan is the preparation of a *Code of Conduct on the Safety of Research Reactors*². The objective of the Code is to achieve a high level of safety in research reactors worldwide through enhancement of national measures and international cooperation. The Code provides guidance to States for developing and harmonizing policies, laws and regulations; additionally, it provides recommendations for 'best practices' in management of research reactor safety. The technical provisions in the Code are based on international consensus documents, primarily IAEA Safety Fundamentals and Requirements.

In November 2003, research reactor designers, operators, managers, users and regulators shared experiences, exchanged opinions and discussed options and priorities

² This Code has been submitted for the Board's consideration in document GOV/2004/4.

relating to research reactors at the International Conference on Research Reactor Utilization, Safety, Decommissioning, Fuel and Waste Management held in Santiago, Chile. This Conference resulted in several significant recommendations for the research reactor community: all countries with at least one research reactor should adopt the Code of Conduct; the physical security of research reactors and their associated fuel cycle facilities should be strengthened; regional and international networks for knowledge preservation and experience sharing should be pursued; to facilitate smaller research reactors in performing periodic safety reviews, a guideline for use in International Safety Assessment of Research Reactors (INSARR) missions should be developed; regional strategic plans for the utilization and the promotion of regional 'centres of excellence' should be prepared.

Security of nuclear installations

Member States have given increased attention to the security of nuclear installations in relation to sabotage. Some considerations involve assessment of the robustness of the installations against extreme malicious events. In parallel to the efforts being expended to address extreme events, a great effort is also being made to apply the principles of defence in depth (in a graded approach) to protect nuclear facilities against malicious acts. The more comprehensive and coherent techniques to protect nuclear installations against sabotage would include: protecting the nuclear control processes; ensuring the maintenance of measures to regain control; and providing provisions to mitigate the consequences of a loss of control. This requires extensive cooperation between safety and security experts.

Another development that evolved from the coordinative efforts of the safety and security specialists was in the area of International Physical Protection Advisory Service (IPPAS) missions. Whenever these Agency missions involved the sabotage of nuclear facilities, nuclear safety specialists were included in the teams. The inclusion of safety experts in the IPPAS team has been welcomed by concerned Member States and has led to a better understanding and acceptance of recommendations to improve the protection against sabotage. More improvements are needed and planned to further this coordinated approach next year. A great majority of the tasks surrounding the development of documents, methodology development and the delivery of services will include such coordinated efforts.

SAFETY OF TRANSPORT OF RADIOACTIVE MATERIAL

The safety of transport of radioactive material in all forms, domestically within States and internationally between States, and by all modes of transport — road, rail, water and air — is vital to the peaceful uses of these materials. The Agency, as part of its statutory mandate and at the request of the United Nations Economic and Social Council, has worked for decades with its Member States and applicable international organizations to foster the development and application of sound safety standards for the transport of radioactive material.

The excellent safety record for transport results, in no small part, from the efforts that have gone into developing and maintaining the *Regulations for the Safe Transport of Radioactive Material*. The 2003 amended edition of the Agency's Transport Regulations has been prepared for adoption into the International Maritime Organization (IMO) and International Civil Aviation Organization (ICAO) regulatory documents. To assist in determining the extent to which the Agency's Transport Regulations are adopted at the State level, the Agency undertakes an annual survey of Member States' infrastructures for transport regulation. To date, 44 Member States have provided that information, which is available on the Agency's website. The appraisal of a State's transport operations is another of the necessary tools for assisting States in discharging effectively their regulatory responsibilities.

During 2003, two Transport Safety Appraisal Service (TranSAS) missions were completed in Panama and Turkey. These reviews identified good practices as well as areas for improvement.

A significant International Conference on the Safety of Transport of Radioactive Material, hosted by the Austrian Government, was held in Vienna, from 7 to 11 July 2003. It was co-sponsored by ICAO, IMO and the Universal Postal Union and held in cooperation with the International Air Transport Association and the ISO. The Conference addressed many topics that contribute to maintaining the good record for transport safety including radiation protection, compliance and quality assurance, emergency preparedness and response, packaging for radioactive materials and regulatory issues. There were also discussions on liability and communication with the public and between governments. The summary and findings were submitted to the 47th session of the General Conference, and in response, the General Conference requested the Agency to draft an international action plan³ for approval by the Board.

SAFETY AND SECURITY OF RADIOACTIVE SOURCES

International concern related to the safety and security of radioactive sources remains high, particularly with respect to orphan source accidents and the malevolent use of radioactive sources. The 2003 session of the General Conference adopted a resolution welcoming the revised *Code of Conduct on the Safety and Security of Radioactive Sources* and urging Member States to write to the Director General stating that they were moving towards following the guidance contained therein.

A major International Conference on Security of Radioactive Sources involving 751 participants from 123 countries and 12 organizations was held in March 2003. This was organized by the Agency, hosted by the Austrian Government, co-sponsored by the Governments of the Russian Federation and the United States of America, in cooperation with the European Commission, the European Police Office (Europol), the International Criminal Police Organization (Interpol) and the World Customs Organization. The findings from this conference were incorporated into the Agency's new International Action Plan for Safety and Security of Radioactive Sources⁴ which was endorsed by the 2003 session of the General Conference.

The Tripartite Initiative, between the Agency, the Russian Federation (Ministry for Atomic Energy of the Russian Federation) and the USA (Department of Energy), on securing and managing radioactive sources, has been proceeding rapidly: altogether 14 missions to determine what actions are necessary to secure sources have been completed as of the end of October 2003. These missions have identified significant numbers of sources that are regarded as vulnerable. Some of these have been secured, but much further work still needs to be done.

Interim guidance on the security of radioactive sources was published in June 2003 and a revised *Categorization of radioactive sources* in July which is finding use in a range of applications. Work has also continued on the development of guidance, national strategies for improving control over radioactive sources, including orphan sources. There has been progress in the development of a new, inherently understandable warning label for dangerous sources and discussions have been held with source manufacturers regarding their contribution towards increasing the safety and security of radioactive sources.

³ This Action Plan has been submitted for the Board's consideration in document GOV/2004/2.

⁴ See document GOV/2003/47-GC(47)/7.

Direct assistance to render sources safe had been provided to Cote D'Ivoire, Ethiopia, Haiti, Mozambique, Sudan and Thailand. Over 20 000 curies of radioactivity in the form of sealed radioactive sources have been recovered and rendered safe by either conditioning for long term storage or return to their supplier. A conceptual design for a mobile infrastructure to condition disused high activity sources in a systematic fashion had been finalized in 2003. Agreements have been put in place with a number of Member States to test this design. It is expected that the mobile infrastructure will be operable by 2005.

Progress has been made on the borehole disposal concept of disused sealed radioactive sources under a regional technical cooperation (TC) project for Africa. Currently, the Agency is organizing an international peer review of the concept developed by the South Africa Nuclear Energy Corporation (NECSA). Following this peer review, a field demonstration of the concept by NECSA has been planned in 2004.

RADIATION PROTECTION

Occupational radiation protection

The International Conference on Occupational Radiation Protection: Protecting Workers Against Exposure to Ionizing Radiation, which was held in August 2002 at the International Labour Organization (ILO) in Geneva, Switzerland, was the first international conference to cover the whole area of occupational radiation protection. Based on the findings and recommendations of the Conference an *International Action Plan for Occupational Radiation Protection*⁵ was developed in cooperation with ILO. A steering committee is being established to monitor and advise on the implementation of the Action Plan.

The findings and recommendations of the Conference highlighted successes, as well as issues needing further attention. A lot of effort is being put into establishing more practically oriented guidance and supporting activities tailored to particular naturally occurring radioactive material (NORM) industry sectors. The Information System on Occupational Exposure (ISOE), operated jointly by the OECD/NEA and the Agency and covering about 93% of the world's commercial nuclear power plants, provides an effective means of information exchange on occupational exposure and has contributed to the downward individual and collective dose trends in this industry. For the ISOE system, for any international dose comparison and for the control of compliance with dose limitation requirements, it is crucial that internationally agreed quantities and assessment methods are harmonized. For this purpose the Agency is continuously organizing intercomparison exercises for harmonization of radiological quantities and monitoring methods for assessing occupational exposure.

Radiation protection of patients

Ionizing radiation is used extensively in medicine; worldwide, about 2000 million diagnostic X ray examinations and 32 million nuclear medicine procedures are carried out annually, and of about 10 million cancer patients 40%–50% receive radiotherapy. Moreover, the use of ionizing radiation in medicine is increasing, as the benefits for patients far exceed the risks. The United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR), has stated that medical applications of ionizing radiation represented by far the largest man-made source of ionizing radiation exposure. Therefore, radiation protection in this area deserves increased attention.

⁵See document GOV/2003/47-GC(47)/7 Annex 2.

In September 2002, the General Conference endorsed the decision of the Board of Governors to approve an International Action Plan for the Radiological Protection of Patients⁶ and requested the Secretariat to implement it, subject to the availability of resources. Work on over half of the actions in the Action Plan has been implemented. A group of senior experts in various fields — the Steering Panel on the International Action Plan for the Radiological Protection of Patients — has been established for the purpose of keeping the various activities under review, maximizing synergy and minimizing duplication.

Three practice specific guidance documents on the application of the *International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources* in radiology, nuclear medicine and radiotherapy have been finalized. These documents have been developed with input from professional bodies, international organizations and national authorities responsible for the radiological protection and medical care of patients.

Standard syllabuses and packages for training in the application of safety standards in medicine have been developed and tested. The feedback from a number of training courses and two ‘train the trainers’ workshops, and from the World Health Organization (WHO), the Pan American Health Organization (PAHO) and the relevant international professional bodies has been taken into account and the material will be made available in the Agency’s six official languages.

Guidance levels for diagnostic examinations have proven to be a useful tool for optimizing the protection of patients. The role of international organizations is to encourage countries to develop their own guidance levels and to provide them with a methodological approach. A draft methodology for establishing guidance levels for diagnostic radiology through simple surveys taking into account image quality has been developed to serve as the basis for technical assistance in this area. The methodology will first be used in an ARCAL project involving ten Member States.

The development and application of guidance levels for complex procedures such as interventional procedures are less straightforward and further research is required. A pilot study, launched in 2002, has provided preliminary results in 2003, which indicates that it is feasible to establish guidance levels for coronary angiography procedures. However, establishing guidance levels for therapeutic interventional procedures is proving much more complex and may require the use of complexity indexes associated to the values of guidance levels. Similarly, research has been initiated on optimizing radiation protection in the areas of digital radiology and computer tomography.

RADIOACTIVE WASTE

An important step forward in the field of radioactive waste management has been the holding of the first Review Meeting of the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management. It establishes an international legal mechanism for improving the safety of radioactive waste and spent fuel management worldwide. Also in 2003, there have been a number of significant events and developments relevant to particular areas of radioactive waste management, namely, discharge control, decommissioning, and the disposal of radioactive waste.

⁶ See document GOV/2002/36-GC(46)/12.

Joint Convention

The Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (the Joint Convention) is the only legally binding international instrument in its field. The first Review Meeting of Contracting Parties was held in November 2003. One of the conclusions was that it is important for all countries to have in place a long term strategy for managing spent fuel and radioactive waste, recognizing that, at present, only a few have firm plans for the disposal of spent fuel and high level waste. A linked issue is the growing recognition of the need for countries to plan for integrated decommissioning and waste management, with schemes for managing all of the various types of waste resulting from the decommissioning process. Of particular relevance in this context is the absence, at present, of agreed international criteria for the clearance from regulatory control of materials containing very low activity levels.

The emphasis in national reports and in the discussions at the Review Meeting was on spent fuel and radioactive waste from the nuclear fuel cycle. Comparatively little attention was given to the issue of managing disused sealed radioactive sources, an issue of principal interest for some of the smaller non-nuclear power countries. This together with the subject of effluent discharge control was identified as needing more consideration at the next meeting.

Public consultation is seen as being increasingly important in relation to long term radioactive waste management. The old policy of ‘decide, announce and defend’ is no longer seen as tenable and, in several countries, the public is involved through consultation processes in decision making with regard to decisions on the siting of repositories, options for decommissioning and policies for effluent discharge.

An issue of general concern to the participants of the Review Meeting is the comparatively small number of Contracting Parties — currently it is 33 — especially when it is considered that the Joint Convention is relevant to all countries with radioactive waste. The Secretariat was mandated to publicize and bring the Joint Convention to the attention of States that have not already ratified. In the intercessional period before the next review meeting in 2006, the Secretariat will, inter alia, work with the General Committee of the first Review Meeting to improve procedures for the review process, based on lessons learned at the first Review Meeting, and introduce a new electronic process for submission of National Reports and for managing the process of questions and answers.

Radioactive discharges to the environment

Governmental policies on the control of discharges of radionuclides to the environment are coming under increasing scrutiny. This has arisen from the changing attitudes of the public, of experts and of governments to the environment which is now widely seen as being under threat. There have been several international initiatives over the last two decades which reflect the shifting policies in this area, notably the Rio Declaration on Environment and Development in 1992.

One practical example of this changing policy can be seen in the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR Convention) through which more restrictive discharge controls are being introduced on all potential pollutants.

Policies on the control of discharges to the environment are also expected to be influenced by new considerations related to ensuring that the environment is protected from the effects of ionizing radiation. This has been recognized as a ‘gap’ in the international radiation protection system and work is currently under way by the relevant international

organizations to remedy the situation. An International Conference on the Protection of the Environment from the Effects of Ionizing Radiation organized by the Agency in Stockholm in October 2003 has identified the roles of the various international organizations in consolidating the present approach to controlling radioactive discharges to the environment by taking explicit account of the protection of species other than humans. At present a major role is being played by the International Commission on Radiological Protection (ICRP) in developing specific recommendations for the protection of non-human species; at a later stage it is expected that the established mechanisms for developing international safety standards will be used to convert the recommendations of the ICRP into a practical framework which can be applied by national regulatory authorities. At the same time it will be necessary for the new policy proposals to be widely disseminated to Agency Member States in order to ensure that the new standards have broad international support.

Decommissioning

There is an increasing awareness of the issue of decommissioning in many countries because of the increasing numbers of nuclear facilities entering this phase and because of the special national policy and strategy issues raised. In the United Kingdom, for example, the Nuclear Decommissioning Authority has been created to ensure that the UK's civil nuclear legacy is managed safely. Information from an Agency global survey report in preparation indicates that there are hundreds of research reactors and nuclear power plants that have been 'shut down' and are awaiting or undergoing decommissioning.

International conferences organized by the Agency in Berlin, Germany in 2002 and in Santiago, Chile in 2003 have highlighted the issues associated with nuclear power plant and research reactor decommissioning. The common problems are in providing appropriate funding for implementing the decommissioning, in establishing facilities for disposing of the associated radioactive waste and in preserving knowledge of the facility if there are delays in implementing the decommissioning. The funding issue is relevant to almost all countries. If funding arrangements had not been made in advance of the decision to decommission there is often a reluctance to provide such funds for facilities that are no longer productive. Funding is a particular problem in the context of research reactors located in developing countries where resources are often scarce. In recognition of the increasing importance of decommissioning issues in its Member States, the Agency has established a technical expert group on decommissioning. At its first meeting, the Group discussed the issues mentioned above and established subgroups on 'Strategy' and 'Funding'. The Group has the role of assisting the Agency in the development of harmonized policies and strategies for decommissioning and of providing technical guidance on the Agency's programmatic activities in this area. A draft International Action Plan on Decommissioning Activities is to be presented to the Board of Governors for approval in 2004.

Radioactive waste and spent fuel management strategy

An important conclusion from the Agency's International Conference on Storage of Spent Fuel from Power Reactors held in June was that spent fuel storage can be considered as a well-understood and rapidly maturing technology. Preliminary results of probabilistic safety analyses of dry storage systems by the US Nuclear Regulatory Commission have shown extremely low levels of risk.

A position paper of international experts, *The Long Term Storage of Radioactive Waste: Safety and Sustainability*, was published by the Agency. This document addresses the ethical, safety, security, economic, and societal aspects of the subject. It concludes that a passively safe waste management option such as geological disposal should be preferred to

surface storage mainly because the necessary active controls needed for a storage facility cannot be guaranteed in perpetuity because there is no guarantee that the necessary societal infrastructure can be maintained in perpetuity. Security considerations also favour geological disposal over surface storage, and at the Stockholm International Conference on Geological Repositories: Political and Technical Progress held in December, it was clear that this had become an important part of the rationale for the planned Yucca Mountain repository in the USA.

In Canada and the UK, new committees or organizations have been established with the task of determining the most appropriate course of action for managing the country's radioactive waste. In both countries, the issue is being approached in a completely 'open-minded' way and all possible options will be considered. Another common feature of the new approaches is that the public and the relevant stakeholders will have a prominent role in establishing the policy.

Regional repositories

The progress being made towards establishing geological repositories in Finland, Sweden and the USA continues to be encouraging. In smaller countries, without a large legacy of wastes, the concept of regional repositories is appealing for various reasons, not least those of an economic nature. The concept has been discussed for almost two decades but has not moved forward to implementation mainly because of the difficulty in finding host countries for such repositories. Over the years, new potential host countries have been proposed with favourable geographies and geologies for radioactive waste repositories only for them to be rejected, usually because of the difficulty in obtaining acceptance of the concept by the public of the country and the authorities concerned. At the same time, countries with advanced programmes for establishing national repositories have expressed concern about such developments since they potentially undermine their own national programmes. Nevertheless, discussions continue among groups of interested countries, and in 2003, the European Commission established a project aimed at bringing together Member States of the EU and candidate countries wishing to explore the feasibility of potential regional European disposal solutions.

In 2003, the Director General of the Agency proposed that consideration be given to multinational approaches to the management and disposal of spent fuel and radioactive waste, referring to advantages in cost, safety, security and non-proliferation. The Director General also proposed that the merits and feasibility of such approaches be evaluated.

EMERGENCY PREPAREDNESS AND RESPONSE

There is a continuing need to maintain emergency response arrangements and to ensure that they are comprehensive in their scope. This issue was highlighted at a conference⁷ held in Salzburg, Austria, on off-site nuclear emergency management. Many countries continue to enhance emergency centres and decision support systems. However, it appears that some developments are not focused on real needs nor tested adequately under simulated emergency conditions before their formal introduction into standing emergency arrangements. In particular, there is a need to establish some level of harmonization internationally for communication and assistance among States that will allow for the best use of these technologies and capabilities. This same issue was raised at the second meeting of competent authorities identified under the Early Notification and Assistance Conventions, who agreed to

⁷See <http://www.salzburg-symposium.at> for more details.

work with the Agency Secretariat to develop a long term action plan for the strengthening of the international response system for nuclear and radiological emergencies.

Since the attacks on the United States of America in September 2001, many countries have been reviewing their arrangements for response to deliberate attacks that might involve radioactive material. Some countries have already run tabletop and field exercises to test updated national arrangements. Key lessons identified include: the importance of coordination of the emergency services, technical support and security/law enforcement personnel, both during the response itself and at the planning stage; and the importance of having radiation protection criteria that are not overly conservative. Coordinated, timely and effective public communication was emphasized as a crucial factor to avoid confusion. Experience has shown that after the theft of dangerous sources, prompt public communication is effective to obtain intelligence for their successful recovery.

The Early Notification and the Assistance Conventions place specific obligations on the States party to them and confer obligations upon the Agency. In order to meet these responsibilities, the Agency established in 1986 the Emergency Response Centre (ERC), to which States and relevant international organizations can promptly and effectively direct initial notification, advisory messages, requests for emergency assistance, requests for information, etc.

In 2003, the ERC received reports on 19 events that resulted in further actions to verify, provide information or advice and/or offer the Agency's good offices. Three field response team missions were carried out under the Assistance Convention in Ecuador, Nigeria and Qatar.

INFRASTRUCTURE FOR NUCLEAR SAFETY

National infrastructures

In the area of safety of nuclear installations, progress continues to be made in Member States to address issues identified in national and international peer reviews such as those contemplated in the Convention on Nuclear Safety. Within the framework of the Agency's TC activities, more than 80% of the 89 Member States participating in Model Projects on Upgrading Radiation Protection Infrastructures have promulgated their legislation or an action plan to this end is in the final stage of implementation. Around 70% have adopted regulations compatible with the Basic Safety Standards.

On the whole, national regulatory authorities were effective in assuring the safe implementation of nuclear applications in 2003. However, work continues to address challenges related to the effectiveness of national regulatory authorities and the independence of regulatory authorities from the organizations that are undertaking or promoting nuclear activities.

An International Conference on National Infrastructures for Radiation Safety: Towards Effective and Sustainable Systems was organized by the Agency in September 2003, hosted by the Moroccan Government in Rabat, and held in cooperation with the ILO, WHO, EC and OECD/NEA. The Conference brought a large representation of senior government officials, decision makers, experts and national counterparts dealing with radiation and waste safety programmes and activities in Agency Member and non-Member States. Nearly 400 participants, from 108 countries (including 11 non-Member States), ICRP, ISO, the PAHO and the International Radiation Protection Association (IRPA) attended the Conference. This

Conference provided an opportunity to review the overall situation with respect to the establishment and maintenance of safety and security infrastructures.

The General Conference⁸ welcomed the findings of the Morocco Conference, and requested the Secretariat to convene a group of experts to advise the Secretariat on their implementation. In March 2004, in response to the General Conference resolution GC(47)/RES/7, the Secretariat convened a Technical Meeting to formulate an international action plan on the basis of the findings, conclusions and recommendations of this Conference.

Education and training in nuclear, radiation, transport and waste safety

Sustainable programmes of education in training are essential elements for ensuring adequate nuclear safety infrastructure.

The strategic plan on education and training in nuclear radiation and waste safety for sustainable education and training programmes in Member States continues to be implemented by the Agency. As part of the strategic plan, a steering committee for education and training representing regional, collaborating and national training centres and international organizations was formed in 2002 to advise on policy development, the maintenance of the Agency's training programme and the monitoring of the long term action plan in education and training.

A considerable amount of work has been completed in 2003 and made available to Member States. This work includes networking training centres, developing training modules and various mechanisms of training modalities (e.g. e-learning) and providing training to trainers.

As part of the strategic plan on Education and Training, the inter-centre network is considered essential to facilitate implementation of the long term action plan at the working level and to improve the effective information exchange and communication among the training centres.

The Agency has been working with the Asian Network for Higher Education in Nuclear Technology, the European Nuclear Engineering Network and the OECD/NEA, and will be working with the World Nuclear University, established in 2003, and other institutions.

KNOWLEDGE MANAGEMENT AND NETWORKING

The issue of maintaining competence has been identified before as a problem facing the operating organizations, the regulatory bodies and their technical support organizations. During the past couple of years, it has become evident that this challenge is not limited to countries where nuclear power is stagnant or declining but, instead, is an issue for the entire nuclear community. Nuclear safety knowledge is needed for the safe regulation and utilization of nuclear energy. It is essential for the safe operation of nuclear facilities and further for their safe decommissioning and for managing and disposing of radioactive waste.

In response to this challenge, the Agency established knowledge management as an Agency-wide cross-cutting activity since all Major Programmes are engaged in activities to address preservation and enhancement of knowledge and maintaining competence in nuclear science and technology.

⁸See General Conference resolution GC(47)/RES/7.

There is a great body of safety knowledge that is not fully utilized, therefore nuclear safety networks are being established to pool, analyse and share nuclear safety knowledge and experiences at national, regional and international levels. Prominent examples are the establishment in the frame of Agency's programmes of the Asian Nuclear Safety Network and the Ibero-American Radiation Safety Network. The first is entering full operation in 2004 after completion in 2003 of a pilot project focused on education and training. The latter was launched during the General Conference by the Government of Spain and will be closely associated with the activities of the Ibero-American Forum of Nuclear Regulators.

Training in nuclear safety and networking is also mentioned as a cornerstone of the Centre for Nuclear Safety in Central and Eastern European countries.

Moreover, as a further step to provide a clear linkage between the Agency safety related statutory functions and activities, an integrated safety approach has been developed. It aims at integrating the Agency's safety standards and all aspects of their application bearing feedback mechanisms in mind. Further, the integrated safety approach aims at using a knowledge base and networking to share existing knowledge and to create new knowledge.

Seeking creative techniques, either via education, training and process driven applications to ensure the effective transfer of knowledge, skill, and abilities from the experienced nuclear workforce that currently exists to the workforce of the future must be a community-wide priority.

SAFETY RELATED EVENTS AND ISSUES WORLDWIDE DURING 2003

This report aims to identify those safety related events or developments during 2003 that:

- were of particular importance
- provided lessons that may be more generally applicable
- had potential long term consequences or indicated trends.

It is not intended to provide a comprehensive account of all events during 2003.

INTERGOVERNMENTAL AGREEMENTS

The Convention on Nuclear Safety entered into force on 24 October 1996. At the second Review Meeting of the Convention on Nuclear Safety in 2002, Contracting Parties (CPs) requested the Agency to develop a secure web site for the electronic submission and distribution of national reports.

The work was undertaken in 2 phases:

Phase 1 was the development of a password protected web site for the submission of national reports and was completed in April 2003.

Phase 2 was initiated immediately upon completion of Phase 1 and will be completed early in 2004. The objectives of Phase 2 were to expand the capabilities of the web site to allow CPs to submit and access questions and answers to the national reports and to generate the various types of statistics (e.g. by country, by group and by article of the convention) required to identify any trends in order to streamline the review process.

All the development work was conducted at the Agency. Key users identified by the CPs have been closely involved in the definition of system requirements, system testing and acceptance.

The 2002 Review Meeting also requested the Secretariat to prepare a report presenting generic information, not identifying any specific country, about the significant issues, developments and trends in enhancing nuclear safety, based on the results of its safety related missions and services. The report will be available by March 2004.

The preparation of the report was initiated in 2003 by the Secretariat and involved the identification of issues and trends from the review services performed between 2001 and 2003. The significant issues and trends were compiled and grouped by topical areas.

The benefit of the report to the review process will be determined at the third Review Meeting in April 2005.

The Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (the Joint Convention) entered into force on 18 June 2001. The first Review Meeting of the Joint Convention was held in Vienna in 2003. It signalled that the Joint Convention, the only internationally binding legal instrument in this field, is now fully operational.

The Joint Convention's main objective is "to achieve and maintain a high level of safety worldwide in spent fuel and radioactive waste management". The Joint Convention shares the same basic mechanism as that of the Nuclear Safety Convention for achieving its objectives. The mechanism consists of the preparation of national reports explaining how the country is

complying with, or planning to comply with, the 25 technical articles of the Convention. This is, in itself, a form of self-assessment by the relevant organizations with responsibilities for radioactive waste management in the country concerned. The reports are then subjected to written questions by other CPs to which answers are provided in advance of the Review Meeting. At the Review Meeting the National Reports, the questions and answers are presented orally and form the basis of discussion between groups of CPs.

It was concluded that the process had already contributed significantly to achieving the objectives of the Convention. Firstly, as a result of being prompted by the forthcoming Review Meeting in 2003, several CPs had made improvements to the management of spent fuel or radioactive waste in the period leading up to the Meeting. Secondly, others acknowledged that the process of preparing the National Report had been beneficial since it had identified needs and deficiencies in the national arrangements for radioactive waste management and thirdly, still others had identified improvements for the future and volunteered to report on progress in their implementation at the next review meeting.

At the end of 2003, only 33 countries were CPs to the Convention, and at the Review Meeting this was considered to be an issue of great concern. The Convention is relevant and potentially important to all countries in which there is radioactive waste, even to those where the only waste generated comes for the use of radioactive materials in medicine and research. Proposals were put forward on ways to increase the membership, for example, by holding regional meetings at which the benefits to countries in the region could be explained by representatives of existing CPs. The outcome of the discussions at the Review Meeting in 2003 was recorded in a publicly available summary report agreed upon by the CPs.

The Convention on Early Notification of a Nuclear Accident (the Early Notification Convention) and the Convention on Assistance in the Case of a Nuclear Accident (the Assistance Convention) entered into force on 27 October 1986 and 26 February 1987, respectively, as a direct result of international initiatives following the Chernobyl accident. These two Conventions are the prime legal instruments that establish an international framework to facilitate the exchange of information and the prompt provision of assistance in the event of a nuclear accident or radiological emergency, with the aim of minimizing the consequences. By the end of October 2003, they had 91 and 88 CPs, respectively. Albania and Kuwait have ratified both the Early Notification and the Assistance Conventions, and Bolivia and Colombia have ratified the Early Notification Convention in 2003. The Assistance Convention was formally invoked during 2003 in relation to events involving radiation sources in Nigeria, Qatar and Ecuador, which are described later in this report.

In June 2003, the Agency convened the Second Meeting of Representatives of the Competent Authorities identified under the Early Notification and Assistance Conventions. Eighty-six representatives from 55 Member States attended the meeting. Two representatives from international organizations party to the two Conventions also attended, namely the World Meteorological Organization and the Food and Agriculture Organization of the United Nations. An observer also attended from the Nuclear Energy Agency (NEA/OECD) and two from the European Commission (EC). The representatives from the competent authorities agreed to establish a regionally balanced National Competent Authorities' Coordinating Group (NCACG) to coordinate the execution of tasks assigned to competent authorities at the Second Meeting and to develop an Action Plan for this work in coordination with the Agency's Secretariat.

Work on two Codes of Conduct continued during 2003. A Code of Conduct is a non-binding, stand-alone, international legal instrument. A State may make a non-binding political commitment to apply the guidance offered in a Code of Conduct.

A major milestone was the approval of the revised Code of Conduct for the Safety and Security of Radioactive Sources. A technical and legal expert group met in March and July of 2003 to finalize the revised Code to address previously unresolved issues and strengthen the Code. The revised Code contains several additional components including those related to security, to national registries and import/export controls. The revised Code was approved by the IAEA Board of Governors in September 2003 and endorsed by the following IAEA General Conference. In addition, the IAEA General Conference urged “each State to write to the Director General that it ... is working toward following the guidance contained in the IAEA Code of Conduct on the Safety and Security of Radioactive Sources, and encourages other countries to do the same”.

A draft Code of Conduct on the Safety of Research Reactors, developed at two Open-ended Meetings of Legal and Technical Experts, was discussed at the March 2003 IAEA Board of Governors meeting, and comments made from the Board meeting and Member States were addressed by an expert Working Group in an October 2003 revised draft. Following resolution of the points raised in the comments on the revised draft, it was submitted to the Board of Governors for consideration at their March 2004 meeting⁹.

The purpose of this Code is to assist civil research reactors worldwide in achieving and maintaining a high level of safety through enhancement of national measures and international cooperation. The technical provisions in the Code are based on international consensus documents, primarily IAEA Safety Fundamentals and Requirements.

Recommendations regarding application of the guidance provided in the Code include: application through national regulations, a graded approach based on the hazard potential, and appropriate use of IAEA Safety Standards. The Code provides guidance for the State, the regulatory body and the operating organization. In addition, it defines the role of the Agency in assisting Member States with the application of the guidance provided in the Code and advising and assisting in all aspects of the management of research reactor safety.

COOPERATION BETWEEN NATIONAL REGULATORY BODIES

There are a number of forums in which regulators can exchange information and experience with their counterparts in other countries. Some of these are regional or linguistic, some deal with particular reactor types and others are based on the size of the nuclear power programme. All such forums meet regularly to exchange information of common interest and some are developing exchange mechanisms involving the internet for more rapid communication. In addition, there is a meeting of Senior Regulators held in association with the General Conference each year.

Activities of these forums in 2003 include:

Western European Nuclear Regulators Association (WENRA)

In March 2003 the Western European Nuclear Regulators Association¹⁰ (WENRA) published an abstract of a Pilot Study on Harmonization of Reactor Safety in member countries. Already in 1999 WENRA decided to set up a Working Group for investigating how

⁹ See GOV/2004/4

¹⁰ WENRA earlier consisted of the heads of the nuclear regulatory bodies in Belgium, Finland, France, the Netherlands, Germany, Italy, Spain, Sweden, the UK and Switzerland. In March 2003, Bulgaria, the Czech Republic, Hungary, Lithuania, Romania, Slovakia and Slovenia joined WENRA.

to proceed towards a harmonized view on reactor safety in EU countries with nuclear programmes.

The Pilot Study included six safety issues for existing reactors:

- Safety policy
- Operating organization
- Verification and improvement of the design
- Beyond design basis accident management
- Probabilistic safety analysis
- Periodic safety review.

On the basis of national requirements, the Pilot Study developed common reference levels for the six issues and has systematically, through a panel procedure, compared the formally issued requirements and implementation in the different countries with the reference levels. Differences in relation to the reference levels were documented. Differences that could not be justified were recommended to be addressed for harmonization. Before finalizing the reference levels, which were selected to reflect the “highest quartile” of existing requirements, they were also compared with the most recent IAEA Safety Standards for the six issues. The introduction of the IAEA Safety Standards in the study proved to be helpful and provided confidence in the scope and strictness of the reference levels.

The results show that all WENRA countries which were involved in the study have differences to a varied extent in relation to the reference levels. A number of differences could be justified according to pre-established criteria, but in a number of cases measures should be taken to bring the national situation up to the reference level. WENRA has agreed on a policy to deal with these results.

In February 2003 a main study was started dealing with 14 additional safety issues for existing reactors. The final results are expected in 2006.

International Nuclear Regulators Association (INRA)

INRA comprises the most senior officials of a number of well-established independent national nuclear regulatory organizations who wish to exchange perspectives on important issues on nuclear safety with the purpose of influencing and enhancing nuclear safety from a regulatory perspective.

INRA has reviewed a number of concepts of safety culture and approaches to the development of models, criteria and indicators to assess the performance of licensees in this area. The review extended to consideration of allied safety management measures that can be adopted. While the practices differ in each country, sometimes because of differences in legislative or regulatory framework, there was general agreement, among the INRA members, that the role of the regulator should not be prescriptive or directing in terms of imposing a particular management or organizational model on licensees.

In a discussion on the scope of regulatory programmes, the INRA members addressed the main objectives of their programmes, the different types of inspections that are undertaken and the measures that are taken to improve the effectiveness and consistency of regulatory oversight activities. They also discussed the rotation of inspectors, recourse to multidisciplinary inspection teams and the use of third party inspection organizations.

INRA members exchanged views on how the regulator can build trust and confidence with key stakeholders and with the general public. There was general agreement that this trust must be earned. In this context, they identified some of the key attributes of an effective

regulator as being competence, objectivity, transparency, sound scientific basis in decision making, and independence from the promoters of nuclear energy and from government bureaucracy. The importance of effective communications and of understanding who are the key audiences was also emphasized.

INRA discussed the question of the revision cycle of the Agency regulations for the safe transportation of nuclear materials. The two-year revision cycle was considered to be a significant burden on the regulators and as a consequence the revision of transport regulations in some countries lagged behind the Agency regulation revisions.

INRA members reviewed the situation in their countries with respect to nuclear waste disposal and clearance criteria. Several member countries indicated a strong support for international standards and guides in this area.

Network of Regulators of Countries with Small Nuclear Programmes (NERS)

In September of 2003, NERS held its sixth annual meeting in Budapest, Hungary. Topics of discussion included:

- Regulatory control of operating organization use of contractors and use of Technical Support Offices for regulatory decision making
- Maintaining corporate knowledge within the regulatory body
- The April 2003 event at the Paks nuclear power plant
- Qualification of non-destructive testing inspection, and
- Quality management of regulatory bodies.

Pakistan's membership in NERS was agreed.

The Ibero-American Forum of Nuclear Regulators

During its meeting in Buenos Aires in May 2003, the Ibero-American Forum of Nuclear Regulatory Organizations, which historically included the Ibero-American regulatory bodies with interest in nuclear power only (namely: Argentina, Brazil, Cuba, Mexico and Spain), was extended to cover regulatory issues related to radiation safety, and therefore all other countries of the region. The announcement was made in connection with a meeting organized by the Agency in Montevideo, Uruguay, also in May 2003. One of the main purposes of the enhanced Forum is to strengthen radiation safety in the Ibero-American region.

While the strengthening process in the Ibero-American region includes many topics, at the above meetings, it was agreed that one of the highest level priorities for the Forum is knowledge management in radiation safety. To address this topic, the Forum intends to collect, structure, systematize and disseminate relevant information on radiation safety.

Both the Forum and the Agency feel that one important element for the management of radiation safety information within Ibero-America is the establishment of an Ibero-American Radiation Safety Network. The Network would be under the responsibility of the Forum and the Agency would act as facilitator. It will be financially supported by extrabudgetary contributions and contributions in kind by Forum countries, notably Spain. Other countries outside the Ibero-American region have expressed interest in supporting such a network.

Cooperation Forum of State Nuclear Safety Authorities of Countries which Operate WWER Reactors

The annual meeting of the Forum was organized by the authorities of the Slovak Republic in 2003. The meeting exchanged information on significant events and regulatory practices. The meeting focused on four main topics.

The Working Group, “Regulatory Self-assessment of the Independence and Technical Competence” prepared and distributed a report summarizing the situation regarding the elements that contribute to the independence of regulatory bodies and included a table regarding self-assessment in the area of technical competence.

The Working Group, “Joint Inspection Practices”, was approved to conduct further joint inspection activities in such areas as personnel training, operation and fire protection to continue to provide a very useful and unique opportunity for the exchange of practical experience and knowledge.

Since the Agency and the United States Department of Energy (DoE) had already started projects dealing with comparison of WWER 440 PSAs and plant modifications based on PSA, the Working Group, “Regulatory Use of PSA Methods”, proposed to redefine its goals to avoid duplicating completed work and ongoing work by the Agency and DoE. It refocused on analysis of existing information and identification of areas where additional information for comprehensive comparison of PSAs and plant modifications was needed. It was agreed to put emphasis on thoroughly analysing the reasons for differences and providing recommendations for regulatory bodies regarding analysis findings and PSAs.

The annual meeting established a new Working Group, “Evaluation of Operating Experience from WWER Reactors”, to develop means for more efficient use of operating experience when striving for an improved level of safety at nuclear power plants.

The Group of Senior Regulators from Countries which operate CANDU Type Nuclear Power Plants

At their annual meeting in 2003, senior regulators from countries operating CANDU-Type nuclear power plants agreed to finalize an IAEA-TECDOC on Generic Safety Issues for Nuclear Power Plants with Pressurized Heavy Water Reactors. Other items discussed included:

- Monitoring, controlling and documenting the safe operating envelope for plants which operate CANDU reactors
- Definitions, terminology and safety goals for the PSA for the CANDU Type of nuclear power plants;
- Design changes for plants which operate CANDU 6 Type reactors
- Public information (especially by the regulatory body).

ACTIVITIES OF INTERNATIONAL BODIES

Several international expert bodies issue authoritative findings and recommendations on safety related topics. The advice provided by these bodies is an important input to the development of the Agency’s safety standards and other international standards and is frequently incorporated in national safety related laws and regulations. The recent activities of a number of these bodies are reviewed in this section.

United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR)

UNSCEAR is a committee of the UN General Assembly that reviews basic science on the sources and effects of ionizing radiation. The last major comprehensive review of Sources and Effects was published in the year 2000 and was followed in 2001 by a specific report on the risks of hereditary effects from exposure to radiation. It has not published any new reports since then. The Committee met in January 2003 and is due to meet again in April 2004. Work is continuing to develop reports on a number of topics dealing with both the physical and biological aspects of exposure to radiation. In addition to updating the overall review of sources of exposure and linking these to the effects expected, the Committee is planning to deal with some more societally important issues including radiation exposures from waste disposal and from cosmic radiation in aircraft and in space, and is continuing to examine the health effects from the Chernobyl accident. It is also examining the matter of protection of the flora and fauna in the environment. The work on biological impacts of radiation, although continuing to review statistical studies, is moving to endeavouring to understand more precisely the processes that act at a cellular level, including the initial radiation damage at DNA helix stage, the cellular response to this damage and the mechanisms of radiation tumorigenesis at low radiation doses. Other important new topics include the so-called bystander effects, genomic instability and novel aspects of apoptic response.

International Commission on Radiological Protection (ICRP)

The ICRP is an independent group of experts that provides recommendations on all aspects of protection against ionizing radiation. Their recommendations have provided the basis for national and international standards including the International Basic Safety Standards.

The main focus of the work of ICRP over the past year has been the further development and elaboration of the proposals for revised basic recommendations, which are intended to be published in 2005. A first internal draft was extensively reviewed during a meeting of the Main Commission of ICRP with its four committees in Buenos Aires, Argentina in November 2003, followed by a meeting of the Main Commission in San Carlos de Bariloche, Argentina. The draft took account of the many important comments received during the first consultation through IRPA on conceptual ideas and built on valuable input from many experts and organizations. The draft will now be amended in the light of the discussions in Argentina and will be reviewed again by the Main Commission at its next meeting, which will take place in Vienna, Austria in April 2004. The updated draft will then be released to the public, and it is scheduled to be presented to the radiation protection community at the special session of the IRPA-11 Congress in Madrid in May 2004. The current revised recommendations will not change the fundamental basis for radiological protection. However, they will consolidate in a single document and within a unified scheme a number of recommendations that have been made in individual publications over the period since Publication 60 was issued.

The Main Commission established a new Committee for the protection of non-human organisms against deleterious effects of radiation, thereby, showing its commitment to this rapidly developing area. This new Committee 5 will commence work in 2005, in phase with the other Committees. The other four committees continue to work in their specific areas, yet much of this work is dependent on the final content of the revised recommendations and how much consequent revision of other subsidiary recommendations will be needed. The exception is Committee 3 on medical aspects, which continues an ambitious programme of producing documents dealing with specific modalities. An important report on managing

patient dose in digital radiology, ICRP Publication 93, has been approved for publication in the spring of 2004. In addition, three draft reports on radiation safety in the context of therapy with unsealed sources, release of patients after therapy with unsealed sources and doses to the infant from radionuclides ingested in mother's milk have been cleared for public comment using the ICRP web site.

During the meeting, several additional draft reports were discussed and guidance was provided to the Task Groups developing those reports. Topics addressed in those reports included: inter alia, 'foundation documents' providing insight into biological and physical bases of radiological protection, an overview of low dose and dose rate responses to radiation, a model for the human alimentary tract, dose management for air crews and doses from new radiopharmaceuticals.

Another current issue being addressed by a Task Group of the Main Commission is protection against radiation exposure in the aftermath of a terrorist attack. The proposed report will first deal with the matter of identifying potential terrorist scenarios and realistically quantifying the radiological impact. It will also propose measures for the protection of first responders and for members of the public, with specific attention to pregnant women and children, and to the psychological aspects involving information and communication.

International Commission on Radiation Units and Measurements (ICRU)

The ICRU, a sister organization of the ICRP, provides recommendations regarding relevant quantities and units, measurement procedures and data. It published two reports in 2003 on Direct Determination of the Body Content of Radionuclides (Report 69) and on Image Quality in Chest Radiography (Report 70).

Previous ICRU reports have dealt with the formulation and properties of tissue substitutes and phantoms that are used to calibrate in vivo measurement systems. Report 69 provides guidance on the overall process of the direct measurement of radionuclides in the human body for radiation protection and medical applications. It addresses the detectors and electronics used for the measurement; methods of background reduction and control; measurement geometries for whole body, partial body or organ counting; physical and mathematical calibration methods; data analysis; and quality assurance. It is directed to readers who need practical advice on the establishment and operation of direct measurement facilities.

Report 70 recognizes that image quality in chest radiography is an important, but complex subject. This report describes many issues that are related to the quality of chest radiographic images. In so doing, it relies upon the very extensive literature on this topic, a topic that has been one of the most thoroughly studied in all of radiography. Strategies that are generally agreed to improve the quality of chest radiographs are described, as are approaches to the assessment of image quality.

Protection of personnel working with radiation relies on careful measurement. The protection of the public and the environment depends on evaluation of radiation and radioactive materials in the environment. Because of diversity in exposures in both routine and accident conditions, internationally accepted measurement conventions are required for assessment of irradiation of individuals and for monitoring of the environment. Specialized quantities and a substantial collection of reference data are needed for correlation of individual exposures and the associated risk. Work is under way on reports treating determination of body burdens for radionuclides, measurement of operational quantities for

neutrons, requirements for radioecological sampling, and retrospective assessment of exposure to ionizing radiation.

In diagnostic radiology and nuclear medicine, the ICRU has enlarged its programme on medical imaging, ranging from fundamental concepts to practical applications involving all types of techniques, and also encompassing specific dosimetric procedures related to medical exposure. In radiation therapy, the current programme on specification of volumes and doses for reporting is being extended to newer types of therapy for which the spatial distributions of absorbed dose need to be known more precisely.

International Nuclear Safety Group (INSAG)

In November 2003, the newly reconstituted International Nuclear Safety Group (INSAG) had its initial meeting. This group was chartered by the Director General to be an independent, authoritative body who could provide insights and recommendations to the Member State governments, industry, the media, the public and the Secretariat. Its efforts focus on nuclear installation safety, but include any other issues that could relate to the safety of nuclear facilities. The group is made up of 16 internationally recognized experts from around the world, who serve for a four year term. The group represents national regulatory bodies, the nuclear industry, academia and research institutions.

The outgoing International Nuclear Safety Advisory Group had ended its term of office in 2002, and the following reports appeared in 2003: INSAG Series No. 15, Key Practical Issues in Strengthening Safety Culture. This report discusses key issues in safety culture and practical matters such as the assessment of personal contributions to the enhancement of safety culture. It complements Safety Series No. 75-INSAG-4, Safety Culture (1991) and INSAG Series No. 13, Management of Operational Safety in Nuclear Power Plants (1999).

- INSAG Series No. 16 (a 're-release' of an INSAG Statement issued in 2001), Maintaining Knowledge, Training, and Infrastructure for R&D in Nuclear Safety was published to emphasize the importance of maintaining nuclear research and education capabilities, especially with regard to safety aspects, and to alert States to the potential for significant negative impacts on safety if the research, development and education infrastructure is not maintained.
- INSAG Series No. 17, Independence in Regulatory Decision Making, was published to provide details regarding the independence needed in the regulatory decision making process and how to meet the potential challenges to that independence. The report is intended to promote a common understanding among legislators and other political decision makers, nuclear safety regulators and licensees of the concept of independence in regulatory decision making and how to achieve it.
- INSAG Series No. 18, Managing Change in the Nuclear Industry: Recognizing and Managing the Effects of Change on Safety, discusses how and why change can challenge the maintenance of a high level of safety, and what can be done to control that challenge and hence reap all the benefits of change. It draws an analogy between the well established principles for managing engineering changes safely, and the need to put in place similar approaches to manage organizational changes. The report also identifies issues that regulators should review when licensees propose changes to the organization and management of their enterprise.

- INSAG Series No. 19, *Maintaining the Design Integrity of Nuclear Installations Throughout Their Operating Life*, discusses the problem of maintaining the integrity of the design of a nuclear power plant over its entire lifetime in order to achieve a continuous high level of safety. The purpose of this report is to identify the issues and some of the principles that should be addressed, discuss some of the solutions to the problem and determine the specific responsibilities of designers, operators and regulators.

ACTIVITIES OF OTHER INTERNATIONAL ORGANIZATIONS

International Labour Organization (ILO)

Protection of the worker against sickness, disease or injury arising out of employment is a key task assigned to the ILO in the preamble of its constitution and of course includes protection against radiation injury. In 1960, the International Labour Conference adopted Convention No. 115 concerned with the Protection of Workers against Ionizing Radiation. Through State ratification, Convention No. 115 is currently binding on 47 countries. The ILO is a co-sponsor of the Interagency Basic Safety Standards and has also co-sponsored other Agency Safety Series publications. The Conference in 2002 on Occupational Radiation Protection was convened jointly by the Agency and ILO and held in the ILO headquarters in Geneva. Much joint effort has taken place during 2003 to draw up a proposed Action Plan based on the findings and conclusions of this conference.

World Health Organization (WHO)

In the area of ionizing radiation, as in other areas, the WHO is striving to achieve safe, sustainable and healthy human environments, protected from biological, chemical and physical hazards. Recently, ionizing radiation has been receiving an increased priority within WHO with the establishment of a new Radiation and Environmental Health Unit. The WHO is a co-sponsor of the Interagency Basic Safety Standards and issues its own guidance on allowable concentrations of radioactive materials in air, water and food. Much basic research on radiation induced cancer is carried out by the WHO specialized institute, the International Agency for Research on Cancer (IARC). The WHO is a signatory to both the Assistance and Early Notification Conventions under which it maintains a network of centres for Radiation Emergency Preparedness and Assistance (REMPAN).

World Association of Nuclear Operators (WANO)

The WANO unites all nuclear electricity operators in the world. It facilitates the exchange of operating experience, so that its members can work together to achieve the highest possible standards of safety and reliability in operating their nuclear power plants. Through WANO, nuclear power plant operators can communicate and exchange information with one another within a culture of cooperation and openness.

WANO's eighth Biennial General Meeting was held in October 2003 to discuss safety in the nuclear industry, including improvement in the conduct of peer reviews. WANO conducted peer reviews at 27 nuclear power stations during 2003, altogether 211 since the programme began in 1992. WANO's long term goal is for every nuclear power station to host a peer review by 2005, and at least every six years thereafter.

WANO continues to emphasize technical support missions, which focus on providing assistance in selected areas. Forty-eight technical support missions were undertaken during

the year. A central operating experience team with representatives from all four WANO regional centres continues to develop operating experience products and information for the members. This team produced seven Significant Event Reports and two Significant Operating Experience Reports during 2003. In addition, 73 topics were added to the “Just in Time Training” database. Plant staff can use the database for relevant operating experience immediately prior to undertaking specific operations and maintenance activities. WANO’s workshop/seminar/training course programme has developed both in scope and in numbers. Approximately 21 workshops and seminars were held in 2003. WANO performance indicators continue to show a trend of constant improvement.

Nuclear Energy Agency of the Organisation for Economic Cooperation and Development (OECD/NEA)

The Nuclear Energy Agency (NEA) is a semi-autonomous body within the OECD maintaining and developing, through international cooperation, the scientific, technological and legal bases required for a safe, environmentally friendly and economical use of nuclear energy. The NEA operates mainly through a number of committees covering specific areas.

NEA’s Committee on the Safety of Nuclear Installations (CSNI) continued to carry out a large number of tasks regarding operating experience review, integrity of structures and components, analysis and management of accidents, assessment of analytical tools and research data, risk assessment, fuel safety margins, human and organizational factors, knowledge transfer and management, and maintaining research infrastructure and competence. The Committee has issued over 20 technical reports covering topics from Redefining the Large Break LOCA to more general matters such as Reactivity Initiated Accidents. In addition, the Committee has endorsed a Collective Opinion Statement on Good Practices for Safety Research and Closure Criteria. Together with the Committee on Nuclear Regulatory Activities (CNRA), the CSNI prepared a report on research in support of efficient and effective regulation.

In 2003, the CSNI started two new internationally funded research and development projects, and a major new programme devoted to integrated assessment of plant changes on safety margins. Work has also started on a report on approaches to the resolution of safety issues.

The CNRA is an international committee made up of senior representatives from regulatory bodies to guide NEA’s programme concerning the regulation, licensing and inspection of nuclear installations. This Committee carried out a number of activities relating to inspection practices such as regulatory effectiveness, regulatory challenges relating to human performance and the inspection of contracted work, public communication by nuclear regulatory organizations, regulatory requirements for next decade reactors and maintaining future competencies. In 2003, the CNRA published the Proceedings of a workshop on regulatory inspection activities relating to inspection of events and incidents, inspection of internal and external hazards, and inspection activities related to challenges arising from competition in the electricity market and published two other reports of the working group on inspection practices. The Committee also released a report on nuclear regulatory effectiveness indicators and held a Forum on Measuring, Assessing and Communicating Regulatory Effectiveness.

In the area of radioactive waste, work has focused on management of long lived waste with emphasis on institutional, regulatory and technical aspects and on documentation to further clarify the concept of stepwise decision making and the role of and needs for a safety case in implementing geologic disposal. The Radioactive Waste Management Committee

(RWMC) also organized international peer reviews, both on a French and a Swiss study representing a milestone in the respective country's waste management programmes. The RWMC's Forum on Stakeholders' Confidence (FSC) published an international survey compiling national experience in public consultation and held a workshop which analysed the Belgian experience in this field. It also reflected on the new role for regulators in an environment of public involvement in geologic disposal.

Through its Integration Group for the Safety Case (IGSC) the RWMC further supported the development of geologic disposal with two new projects, the Engineered Barrier Systems (EBS) project (co-sponsored with the EC), which addresses the role of engineered barriers, and the Approaches and Methods for Integrating Geologic Information in the Safety Case (AMIGO) project aimed to better integrate geologic information into the safety case. Other ongoing work addressed the handling of timescales, the stability of the geosphere and the management of uncertainties in the context of long term safety assessment. To secure the scientific basis of this work, NEA continued to support the sharing of quality assured databases and models.

In the area of decommissioning, the RWMC collected experience available in its decommissioning groups in a booklet on the status and challenges in decommissioning, and analysed decommissioning strategies at a workshop in Spain. Specific regulatory challenges to decommissioning and decommissioning costs have been analysed by the CNRA and the Nuclear Development Committee (NDC). Specific contribution comes from the Cooperative Programme on Decommissioning (CPD), which shares experience from 42 decommissioning projects based on a special agreement between its 24 participating organizations.

The Committee on Radiation Protection and Public Health (CRPPH) has been further developing its views on how the current international system of radiological protection could evolve to better serve the needs of policy makers, regulators and practitioners. An in-depth report on a CRPPH umbrella concept of regulatory authorization is in preparation. The CRPPH also analysed the concepts presented in the ICRP, to highlight their possible implications. This work was presented during the joint NEA/ICRP Forum held in Lanzarote. Many of the NEA's suggestions have been taken up by the ICRP.

In its 3rd Villigen workshop, the CRPPH has been studying processes of stakeholder involvement to gain broader acceptance on radiological decisions. Generic lessons have been identified, and illustrated through concrete case studies. In the area of emergency management, the CRPPH is designing and preparing for the third NEA International Nuclear Emergency Exercise (INEX 3) that will use a contamination footprint scenario to study short- to mid term 'soft' countermeasures.

On the occasion of the renewal of its Terms and Conditions, the Information System on Occupational Exposure (ISOE), that is jointly supported by the NEA and the Agency, performed a full review of its structures and functions in order to identify ways to better address the needs of its participants.

Institutions of the European Union (EU)

In January 2003 the Commission issued a proposal for a Council Directive on the Control of High Activity Sealed Sources (the HASS Directive), which supplements Council Directive 96/29/Euratom, laying down the EU Basic Safety Standards. The latter sets out a number of provisions that, properly applied, would prevent the risks connected with the manufacture, use and disposal of high activity sealed sources. However, it was felt that additional Community provisions with respect to potentially highly dangerous sources should

be in place to further reduce the likelihood of accidents involving such sources. The European Parliament issued its opinion approving the proposal with minor amendments on 18 November 2003. Council Directive 2003/122/Euratom, on the Control of High Activity Sealed Sources and Orphan Sources, was formally adopted on 22 December 2003 (Official Journal L 346, p. 57).

Basically, the Directive applies to sealed sources giving a dose rate in the order of more than 1 mSv/h at a distance of 1 metre. The resulting activity of the source depends on the radionuclides and on the quality of the radiation emitted. Such definition would include all the radioactive sources that in past years caused accidents with serious health effects reported in published surveys, all the sources that caused major contamination at plants handling metal scrap, all sources in the IAEA Category 1 and a large fraction of those in Category 2. The Directive requires prior authorization for any practice involving a high activity source. Before issuing an authorization, the competent authorities shall ensure that arrangements have been made not only for the safe use of the source, but also for the proper management of the source when it becomes disused. The Directive also has requirements relating to record keeping, holding and transfer of sources and responsibilities for “orphan” sources.

Guidance was issued under Commission Recommendation 2003/274/Euratom of 14 April 2003, on the protection and information of the public with regard to exposure resulting from the continued radioactive caesium contamination of certain wild food products as a consequence of the accident at the Chernobyl nuclear power station (Official Journal L 99, p. 55), and Commission Recommendation 2004/2/Euratom of 18 December 2003, on standardized information on radioactive airborne and liquid discharges into the environment from nuclear power reactors and reprocessing plants in normal operation (Official Journal L 2, p. 36).

On 29th January 2003, Euratom signed an Agreement, negotiated between the European Atomic Energy Community and non-member States of the European Union, on the participation of the latter in the Community arrangements for the early exchange of information in the event of radiological emergency (Ecurie). The agreement extends the Ecurie system (set up by Council Decision 87/600/Euratom of 14 December 1987) to the ten new Member States of the enlarged EU, already before their formal accession to the EU. It also replaces the existing bilateral agreement concluded in June 1995 between Euratom and the Swiss Confederation.

An important new initiative has been proposed in a Communication from the Commission to the Council and the European Parliament on Nuclear Safety in the European Union issued early in 2003. The initiative contains two proposals for Directives that can be summarized as follows:

There is a current Proposal for a Directive setting out basic obligations and general principles on the safety of nuclear installations from design to decommissioning. The draft Directive proposes common safety standards and verification mechanisms to guarantee the application of common methods and criteria with regard to nuclear safety throughout the enlarged EU. These standards will be based on those of the IAEA, but the establishment of supplementary standards is not ruled out, where appropriate. Each Member State will have a safety authority which must operate independently. The common reference framework for the safety standards will be based on principles internationally established by the IAEA and will give them the force of law. This approach will have the advantage of ensuring a binding Community framework, and a single criterion for monitoring and interpretation. Community monitoring will be aimed at verifying the way in which the safety authorities carry out their regulatory control. The proposed approach is based on the principle of peer review. The

purpose of the inspections is not to verify in situ the conditions regarding the safety of nuclear facilities but rather to verify the effective implementation of national control. The coordination of the national systems in a Community framework is a guarantee of the maintenance of a high level of safety in nuclear facilities. Nuclear safety cannot be guaranteed without making available adequate financial resources. In particular regard to the decommissioning of nuclear facilities, the draft Directive defines the Community rules for the establishment, management and use of decommissioning funds allocated to a body with a legal entity separate from that of the nuclear operator. This fund must be able to guarantee the availability and sufficiency of resources so that the decommissioning operations can be carried out in conditions which protect the general public and the environment from ionizing radiation.

The proposal for a Directive on radioactive waste was proposed to contribute to a clear, transparent and timely answer to issues associated with the management of radioactive waste. This proposal for a Directive is aimed at supporting and developing the research effort and better coordinating the national research programmes in this area. For half a century radioactive waste has been stored in intermediate storage facilities. This proposal advocates the geological disposal of high activity waste. This proposal for a Directive requires its Member States to adopt national programmes for the disposal of radioactive waste in accordance with a pre-established timetable. In particular, these programmes are to address the deep disposal of high activity waste. Choice of the disposal site (national or regional) would be made by 2008, and the repository should be operational by 2018. For low-activity and short lived waste, disposal would be achieved by 2013. Cooperative solutions between its Member States would be envisaged, however, none of its Member States would be required to accept imports of radioactive waste from another Member State. The Commission notes that the funds allocated to research into waste management are inadequate despite the efforts of the research framework programme. The Commission intends to propose, in agreement with the industries concerned and its Member States, the creation of a Joint Undertaking, in accordance with Chapter 5 of the Euratom Treaty, responsible for managing and directing research funds from the Joint Research Centre, its Member States and enterprises for the management of radioactive waste.

As of the end of 2003 these proposals were still being discussed in the Atomic Questions Group and in the Council of Permanent Representatives (COREPER) of the European Union. The European Parliament has discussed the proposal in one of the committees and has supported a number of amendments which should be taken up in a plenary vote in early 2004.

In addition to its activities in the regulatory domain, the EU has for many years carried out a considerable amount of research into all aspects of radiological protection and associated subjects. These research activities are structured in “framework programmes” and the Sixth Framework Programme (FP6) covering the period from 2002–2006 is now getting under way. The Sixth Programme differs in some respects from the earlier programmes as it has an underlying objective to promote the development of the European Research Area in which there is increased and closer collaboration among European research institutes at the programmatic level rather than at the level of specific research contracts. Thus, the focus of the programme is on large, multi-institute projects of a general nature, rather than on smaller and specific research contracts. The Euratom part of FP6 is structured into three thematic priorities (fusion energy research, management of radioactive waste and radiation protection) although there are some other activities in the field of nuclear technology and safety.

On 15 December 2003, the Council adopted a Decision amending the Council Decision of 7 December 1998 approving the accession of the European Atomic Energy Community to the Nuclear Safety Convention with regard to the Declaration attached thereto. This amended Decision now modifies the wording of the Declaration made by Euratom pursuant to Article 30(4)(iii) of the Nuclear Safety Convention, and executes a judgement of the European Court of Justice of 10 December 2002, according to which the Euratom Declaration of competences should have also referred to Articles 7, 14, 16(1) and (3) and Articles 17 to 19 of this Convention.

International Radiation Protection Association (IRPA)

The IRPA is the main association of professionals involved in radiation protection worldwide. It has members in over 50 countries. Recently, IRPA has taken a more dynamic role as a stakeholder in developing and implementing radiation protection standards, in providing a mechanism for dissemination of ICRP proposals and in collecting comments from the profession. It has also participated in several major conferences and taken part in the preparation and implementation of resulting Action Plans.

SAFETY LEGISLATION AND REGULATION

In January 2003, a new “Federal Law on the Technical Regulatory Process” was published in the Russian Federation. Effective in July 2003, this Law established a new process for the preparation of technical requirements, including technical requirements in the field of nuclear and radiation safety. During the seven year transition period, the existing legislation, standards and rules and regulations in the nuclear area will be kept in force, and new technical regulations on nuclear and radiation safety will be developed to bring present regulations into compliance with the provisions of the new law. Furthermore, it appears that this new law may redefine the regulatory body’s authorities and responsibilities.

Over the past several years the USNRC has devoted significant resources in efforts to implement the risk informed regulation concept. Its regulatory review and assessment activities, as well as its Reactor Oversight Programme received significant benefit from these efforts. In 2003, the USNRC continued its activities to develop alternative “risk informed” versions of selected regulations.

SAFETY OF NUCLEAR INSTALLATIONS

The collection of feedback regarding the international operating experience of nuclear power plants and the promulgation of lessons learned from these operating experiences are important activities for improving and maintaining the safe operation of plants.

Agency activities and discussions in the framework of the Incident Reporting System (IRS) have highlighted the following important aspects of nuclear power plant events that occurred in 2003:

- Minor modifications to equipment or procedures, if not properly reviewed before implementation, may cause serious safety consequences;
- Despite abundant operating experience information, similar plant events continue to reoccur. This recurrence requires further close examination;
- Incorrect performance testing, maintenance or modifications procedures continues to be a significant contributor to plant events;

- Human factors, organizational and communication deficiencies, unexpected structural defects and loss of corporate knowledge are additional contributing causes of plant events; and
- Delegation of excessive responsibility to contractors, failure to ensure sufficient assessment of contractor competence and inadequate licensee oversight of contractor activities are additional factors in plant events.

Four specific events were discussed in detail during the 2003 meeting of the IRS and in other Agency meetings in 2003.

On 10 April 2003, a fuel-cleaning incident occurred at Unit 2 of the Paks nuclear power plant in Hungary. Unit 2 was shut down for scheduled maintenance, and 30 fuel assemblies had been removed from the reactor and placed approximately 10 metres under water in a fuel cleaning tank, adjacent to the fuel pool. The fuel assemblies were being cleaned due to magnetite deposits on their cladding. Initial indications of increased radiation levels, led operators to suspect that a fuel assembly was leaking due to the cleaning operation. However, during an inspection that was performed several days later, a video camera revealed that most of the fuel had suffered heavy damage due to insufficient cooling during the fuel cleaning process.

At the request of the Hungarian Government, the Agency conducted an independent expert mission and determined that a poor cleaning tank design, combined with a weak safety analysis and inadequate operational oversight, contributed to the incident. It is significant that neither the regulator nor the organization that operates the plant used conservative decision making in the nuclear safety assessment for the unproven fuel cleaning system. They left the responsibility for operation of the system with the contractor. Furthermore, the tight schedule for design, fabrication, installation, testing and operation of the new fuel cleaning system contributed to a sense of urgency that influenced decisions regarding the rigor of nuclear safety assessment and design review. Unit 2 at the Paks plant remains shut down beyond the end of 2003 with ongoing safety analysis, regulatory oversight and specialized work to remove the damaged fuel. The Paks plant has dedicated significant personnel resources to the recovery operations and to the prevention of a similar event.

During a regular inspection of the reactor vessel bottom penetrations at the South Texas 1 nuclear power plant in the USA, boric acid deposits were discovered on two bottom-mounted instrumentation (BMI) nozzles. Although this event is of less significance than the reactor upper head corrosion event at the Davis Besse nuclear power plant in the USA, the events are related. The root cause of the event was determined to be weld defects that occurred during fabrication. The event resulted in no damage to safety related equipment other than the affected BMI penetrations.

There were two separate cases of destructive failures of gas coolant circulators at the Torness nuclear power plant in the UK. The first case involved complete disintegration of the impeller on a 1.6 m diameter circulator. At present, fatigue is considered the event initiator. This event was followed a few months later by another failure involving the same type of impeller. In both cases, an associated vibration alarm was ignored because the operational staff mistrusted the alarm system and considered it of low safety significance. This event illustrates the need for plant management to better anticipate the needs of the operating organization.

A spurious case of safety injection occurred at the Dampierre-3 reactor in France. The plant was in an intermediate startup state with a bubble in the pressurizer, and decay heat was

being removed by the steam generators. A key is intended to prevent safety injection during plant start up. However, an operator inappropriately removed this interlock, and high-pressure injection initiated. Consequently, the pilot-operated relief valve performed 21 cycles at high reactor pressure. This sequence would have resulted in more severe consequences if it had occurred at lower temperatures. Although analysis of this event is not completed, preliminary lessons learned indicate a need for more training and better procedures regarding the associated interlocks.

Potential recirculation line blockage has been addressed as an issue the USA, France, and Germany. In 2003, several unusual external events took place that challenged the ability of the associated plants to continue to operate in a safe manner, and may have led to plant shutdowns.

Large-scale blackouts occurred in various regions of the world. These blackout events are significant safety events, because a loss of power from the electric grid usually results in reliance upon the backup diesel generators as the only immediately available source of power to safely shut the plant down. In August, the blackout in North America (in the north-eastern and mid-eastern parts of the USA and parts of Canada) caused nine nuclear power plants in the USA and five in Canada to shut down. In September, a blackout in Southern Sweden and Denmark resulted in two out of eleven nuclear power plants having to shut down due to grid instability in Sweden.

Natural events, such as heavy winds, earthquakes, and water temperatures and level extremes also challenge a plant's safe operation. In this regards, the water level of the Danube River fell to an extremely low level during the hot and dry summer of 2003. This resulted in the shutdown of the Cernavoda nuclear power plant in Romania. In general, the high temperature of the river water used for cooling in Europe necessitated the lifting of environmental limits on plant cooling water discharge temperatures (e.g., an extra 1°C increase in river temperatures was allowed at six plant sites in France.).

Also, early in September 2003, typhoon Maemi hit the Korean peninsula, and five nuclear power plants were shut down in that region. Associated safety evaluations are being conducted.

In March 2003, an advisory group meeting was held at the Agency in Vienna to discuss the most significant issues and challenges for the nuclear industry over the next five years. The results of this meeting indicated that the most significant challenges are driven by the need to balance safety and competitiveness during times of financial stress, deregulation and increased market competition, early plant closures owing to political and other pressures, equipment obsolescence, a diminishing nuclear work force and knowledge pool, and the potential financial burden of eventual decommissioning. It was also clear that the majority of future challenges were related to organizational effectiveness, maintaining the quality of programmes and processes and maintaining competent staff. Management of change and ensuring public confidence were identified as additional areas of significance. The most important challenges to safety involved the need to: (1) ensure that nuclear competence is maintained in all sectors and at all levels of the industry, (2) develop and maintain a good safety culture, (3) develop ways to safely manage an ageing plant in an economic and competitive environment, and (4) continue with plant safety improvements and modernization, as well as improve operational safety monitoring and analytical techniques. Other important challenges included the attention needed to ensure that the public is properly informed about the risks associated with the operation of plants and that both the industry and the regulatory authority promote a strong culture of transparency.

EMERGENCY RESPONSE

During 2003, three emergency assistance missions were undertaken upon request to: Ecuador, Nigeria and Qatar, under the provision of Assistance Convention.

The first event, in February 2003, was to assist the Government of Nigeria in response to their request for assistance in responding to the theft of two Am-Be log-welling radioactive sources. The theft is presumed to have happened when the sources were being transported by truck between two cities. The transporting truck experienced mechanical problems and had to be fixed. However, instead of completing their journey after the truck had been repaired, the driver and his assistant decided, against the company's transport rules, to break their journey in order to get some sleep. On the next day, at their final destination, when the equipment was offloaded from the truck, it was realized that the container, in which the two Am/Be sources had been packed, was missing. The padlock used to secure the transport package as well as the two padlocks securing the boron shielding plug were found broken inside of the transport package. With good cooperation from the Nigerian authorities and from those persons that had been involved in the event, the IAEA Mission gathered the facts and obtained clarification of the details of the theft. In addition, possibilities for the disposition of the sources were discussed and advice and recommendations were given to the Nigerian Authorities. Later, around August 2003, these sources were detected and confiscated from a scrap metal dealer in Germany.

In March 2003, the Supreme Council for the Environment and Natural Reserves (SCENR) of Qatar requested prompt assistance through the Agency's ERC, to assist their staff in recovering unidentified buried orphan sources, which were detected casually after a routine inspection at a petroleum company. The inspectors from SCENR detected a significant increase in background radiation levels at one of the company's entrances, which is situated in an industrial area of the city. They suspected this increase to be from orphan sources. In response to this request a Field Response Team (FRT) was dispatched to Qatar. The FRT went to the location where the radiation levels were elevated and surveyed the area. They identified the source of elevated radiation levels as being from ^{192}Ir (iridium). Five sources were embedded in loose concrete and the total activity was estimated to be in the order of 400 MBq (150 mCi). All five sources were successfully recovered, placed in their appropriate containers, and stored in the company's source storage facility.

The third event was in relation to the theft of five ^{192}Ir radioactive sources from a private company and to the loss of another ^{192}Ir source in a river accident during a boat crossing; both occurrences happened in Ecuador. In May 2003, the Agency's ERC received a request for assistance from the Atomic Energy Commission of Ecuador (CEEA). With the main objective of assessing the threat to public safety from the missing sources and to determine their most likely location and condition, an FRT was dispatched to Ecuador. During discussions and other activities with local counterparts, the FRT was informed that the owner recovered two of the five stolen sources and that recovery of the source in the river was delayed due to weather conditions. Later, in August 2003, that source was safely recovered and stored. To date, the FRT is unable to locate the other three sources. If these radioactive sources are still in the possession of thieves, the potential radiological threat to safety and health of the public remains.

MANAGEMENT OF SPENT FUEL AND RADIOACTIVE WASTE

Management of spent fuel and solid radioactive waste

Progress on spent fuel and high level waste disposal

The first Review Meeting of the Joint Convention provided many insights into the current status and trends in spent fuel and radioactive waste management. Spent nuclear fuel is presently being stored at power stations, research reactors, in facilities at other locations, or being reprocessed. Storage is under water in ponds or in dry casks or vaults; storage times varying depending on national policies, which range from storage pending disposal to storage pending a decision on longer term management. In the case of Netherlands, a dedicated spent fuel storage facility with a design lifetime of one hundred years was officially opened this year. Two countries, the United States and Finland, are both actively developing geological disposal facilities for spent fuel and high level waste. In the former case, a licence application is under preparation and in Finland an underground laboratory is under construction. Sweden is at an advanced stage of site selection and a number of other European countries as well as Japan, China and India have active investigation programmes under way. Also this year, Krasnokamensk was suggested as a site for a major spent fuel repository in the Russian Federation.

Disposal of low level waste

Many countries operate near surface radioactive waste disposal facilities for low and intermediate level waste, some of which have been operational for several decades. A number of new facilities are planned in various countries; in particular, a decision was made in May 2003 on the site to develop a facility in Australia. Advanced siting programmes are also under way in Belgium and Slovenia. The approach to demonstrating the safety of near surface facilities has undergone considerable harmonization at the international level in recent years. The approach has been applied at several disposal facilities in central and eastern Europe which were not originally subjected to rigorous safety assessment and licensing processes at the design and construction stage and considerable efforts are now being expended to improve the situation. In particular, within the Russian Federation, safety assessments are being undertaken as a requirement of the national regulatory authority. In some countries safety assessment has indicated the need for upgrading the safety of facilities.

Other developments are taking place in the management and disposal of low level waste with lower levels of specific activity. As part of its integrated approach to waste management, France recently opened facilities at Morvilliers (Aube) for disposing of very low level waste. Such waste does not require the same degree of containment robustness as provided in normal, modern near surface facilities, that are engineered accordingly.

Disposal of disused sealed sources

This is an issue that has received more attention of late due to the heightened security concerns about the often poor and unsafe conditions of storage of many such sources. The disposal of longer lived or higher activity radiation sources in near surface facilities is questionable from both a safety point of view and from the perspective of optimal facility management. Alternative disposal options are geological disposal, which is not readily available to most countries, or disposal in borehole facilities. Borehole facilities offer the prospect of access to suitable geological horizons at reasonable cost, but the safety standards for such facilities and approaches to demonstrate their safety are still under discussion and development internationally. In this regard, a development project is under way in South

Africa under the auspices of the African Regional Cooperative Agreement for Research, Development and Training related to Nuclear Science and Technology, an association of Agency Member States which aims to demonstrate the economic and technical feasibility of this disposal option and at developing cost effective approaches to proving its safety. Interest is being shown in this concept by an increasing number of countries.

National arrangements for radioactive waste management

The issue of public acceptance of radioactive waste management and disposal facilities has become a dominant issue in some countries. In some countries, such as the UK and Canada, national arrangements have been recently put in place to involve all interested and affected parties in finding long term management solutions. Other countries such as Romania, Bulgaria and Slovakia have recognized the need to establish national organizations dedicated to the management of waste and with responsibility to investigate, develop and operate waste management facilities in an integrated and holistic manner.

Management of radioactive discharges to the environment

Governmental policies on controlling the discharge of radionuclides to the environment are coming under increasing scrutiny, especially in the parts of Europe affected by the OSPAR Convention (Convention for the Protection of the Marine Environment of the North-East Atlantic; Radioactive Substances). At an OSPAR Commission and Ministerial meeting in Bremen, progress towards implementing the OSPAR Strategy for reductions in radioactive discharges, agreed at the previous Ministerial meeting in Sintra in 1998, was reviewed. The OSPAR Strategy aims to progressively reduce the discharges of artificial radionuclides so that, by the year 2020, the resulting additional concentrations in the marine environment, above historic levels, are close to zero. After several years of difficult negotiations, a baseline level of discharges against which the required reductions can be measured, was finally agreed at Bremen.

Policies on the control of discharges to the environment are also expected to be influenced by new considerations for ensuring that the environment is protected from the effects of ionizing radiation. This has been recognized as a “gap” in the international radiation protection system and work is currently under way by the relevant international organizations to remedy the situation. At present a major role is being played by the International ICRP in developing specific recommendations for the protection of non-human species; at a later stage it is expected that established international mechanisms such as the Agency’s Safety Standards Committees will provide the framework for formalizing an international approach to environmental protection and its implications for discharge control, radioactive waste disposal and environmental remediation.

Management of residual radioactive waste

Uranium mining and milling residues

In mid 2003, a project was started to address the mitigation of potential disasters involving the mill tailings in Kyrgyzstan. The World Bank and the Agency are supporting this project. There have been two organizational and initial evaluation meetings in 2003 and an overall remediation plan is being developed. The project will improve the stability of the landslide areas, thereby reducing the risk from the tailings impoundments and strengthening the river banks. A monitoring and warning system will also be established to identify potential hazards and mitigate them before they endanger the local population and infrastructure.

Depleted uranium in the environment

At the request of the Kuwaiti Government, an Agency mission visited Kuwait in September 2001, with the participation of UNEP and WHO. The mission team visited sites potentially affected by depleted uranium and took measurements and samples. A further mission in February 2002 conducted a sampling campaign at eleven sites in Kuwait, based on a plan devised by the Agency on the basis of the earlier results. A report describing the results of the sampling campaign and a discussion of radiological conditions was published in August 2003¹¹.

Contact Expert Group

The Contact Expert Group (CEG) for International Radioactive Waste Management Projects in the Russian Federation established in 1996 under the auspices of the Agency, continues its activities to promote the international cooperation with Russia to solve the most critical and urgent problems. The signature of the Framework Agreement on Multilateral Nuclear Environmental Programme in Russia (MNEPR), which took place in May 2003 in Stockholm, provides a legal framework for cooperation under the Northern Dimensions Environmental Partnership (NDEP). Following the signature, the fund administered by the European Bank of Reconstruction and Development (EBRD) has become available and will contribute to enhancing this cooperation. New projects have also been initiated under the Global Partnership Programme of G8 countries and the implementation of further cooperative activities is planned for the near future.

In March 2003, a workshop devoted to the dismantling of multi-purpose nuclear submarines in the north-western region of Russia was held in Severodvinsk, Russia. Shortly after the workshop, two contracts were signed between Norway and the Russian shipyards to dismantle two submarines. Furthermore, in December 2003, a contract was signed with the UK for the dismantling of two nuclear submarines at the Sevmash plant in Severodvinsk.

Another workshop took place in October 2003 in the Nuclear Research Centre of the Atomic Energy Commission in Cadarache, France. This workshop was devoted to the remediation of the former naval base in Gremikha. The results and recommendations of the workshop were presented at the 17th CEG plenary meeting held in Murmansk, Russia in November 2003, and the CEG endorsed the recommended projects for further implementation. It is intended that cooperative activities at this site will be initiated in the near future.

TRANSPORT OF RADIOACTIVE MATERIAL

The International Conference on the Safety of Transport of Radioactive Material took place in Vienna, Austria, from 7 to 11 July 2003. The objective of the Conference was to foster exchange of information on issues related to the safety of transport of radioactive material by providing an opportunity for representatives of IAEA Member States and international organizations to discuss critical issues relating to the safety of transport of radioactive material by all transport modes and to formulate findings, as appropriate, based on the papers contributed and the discussions held. Topics discussed included: liability, communication, radiation protection programmes, compliance assurance and quality assurance programmes, emergency preparedness and response, broadly effective packaging

¹¹ International Atomic Energy Agency, Radiological Conditions in Areas of Kuwait with Residues of Depleted Uranium, Radiological Assessment Reports Series, IAEA, Vienna (2003).

regulations, the recognized increasing nature of the modern global marketplace for radioactive material, development of tools to consistently treat non-routine transport (discovered sources), and addressing problems stemming from refusal of shipments.

In summary, there was broad agreement among Conference participants that the IAEA Transport Regulations, and the regulations of the modal organizations based on the IAEA Regulations, provide a sound technical basis for the safe transport of radioactive material. There is room for improvement of the regulations in a number of areas, and the detailed issues involved — and discussed during this Conference — should further be pursued by the relevant organizations, with due account of the need to balance the benefits of flexibility and continuing improvement against those of regulatory stability. In particular, the regulations should be readily applicable to all the types of radioactive material that might need to be transported, while leaving some flexibility in the handling of some materials, such as urgent medical supplies. This means making sure not only that the regulations are applicable to all these types of material and are as simple to apply as possible, but also that those who have to apply the regulations have sufficient guidance so as to be able to apply them correctly. As directed by the 47th IAEA General Conference in September 2003, the Secretariat is submitting an International Action Plan to the March 2004 Meeting of the Board of Governors.

UNITED NATIONS CHERNOBYL FORUM

The Agency initiated the establishment of the United Nations Chernobyl Forum, as a contribution to the implementation of the UN's new strategy launched in 2002 on the "Human Consequences of the Chernobyl Nuclear Accident — A Strategy for Recovery". The Chernobyl Forum involves the participation of relevant international organizations and representatives of Belarus, the Russian Federation and Ukraine. The Chernobyl Forum's first organizational meeting was held from 3 to 5 February 2003 at the Agency's Headquarters in Vienna, in cooperation with the Food and Agriculture Organization, United Nations Office for the Coordination of Humanitarian Affairs, United Nations Development Program, United Nations Environmental Program, UNSCEAR, WHO and the World Bank, as well as Belarus, the Russian Federation and Ukraine. The Terms of Reference and Work Plan of the Forum were accepted at the meeting.

In order to carry out its mandate, the Chernobyl Forum has established two international expert groups on environment and health, under the aegis of the Agency and the WHO, respectively. The first meeting of the Expert Group "Environment" was held between 30 June and 4 July 2003; the second meeting was held in December 2003 at the Agency's Headquarters in Vienna. The draft technical report on environmental consequences of the Chernobyl accident and remediation activities has been prepared. The Expert Group "Health" met in December 2003 at the Headquarters of WHO in Geneva. The activity of the two groups will continue for approximately two years. A concluding international public conference is slated for 2005 or 2006.