

Nuclear Safety Review for the Year 2007

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**Nuclear Safety Review
for the Year 2007**

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Foreword

The *Nuclear Safety Review for the Year 2007* reports on worldwide efforts to strengthen nuclear, radiation, transport and radioactive waste safety and emergency preparedness.

An analytical overview is supported by more detailed Appendices: *Safety Related Events and Activities Worldwide during 2007* (Appendix 1) and *The Agency's Safety Standards: Activities during 2007* (Appendix 2).

A draft version of the *Nuclear Safety Review for the Year 2007* was submitted to the March 2008 session of the Board of Governors in document GOV/2008/2. The final version of the *Nuclear Safety Review for the Year 2007* was prepared in the light of the discussions in the Board of Governors.

Executive Summary

In 2007, the 50th anniversary year of the Agency, the safety performance of the nuclear industry, on the whole, remained high, although incidents and accidents with no significant impact on public health and safety continue to make news headlines and challenge operators and regulators. It is therefore essential to maintain vigilance, continuously improve safety culture and enhance the international sharing and utilization of operating and other safety experience, including that resulting from natural events.

The establishment and sustainability of infrastructures for all aspects of nuclear, radiation, transport and waste safety will remain a high priority. Member States embarking on nuclear power programmes will need to be active participants in the global nuclear safety regime. Harmonized safety standards, the peer review mechanism among contracting parties of the safety conventions, and sharing safety knowledge and best practices through networking are key elements for the continuous strengthening of the global nuclear safety regime.

Technical and scientific support organizations (TSOs), whether part of the regulatory body or a separate organization, are gaining increased importance by providing the technical and scientific basis for safety related decisions and activities. There is a need for enhanced interaction and cooperation between TSOs. Academic and industrial expert communities also play a vital role in improving safety cooperation and capacity building.

Countries embarking on nuclear power programmes, as well as countries expanding existing programmes, have to meet the challenge of building a technically qualified workforce. A vigorous knowledge transfer programme is key to capacity building — particularly in view of the ageing of experienced professionals in the nuclear field. National and regional safety networks, and ultimately a global safety network will greatly help these efforts.

Changes in world markets and technology are having an impact on both the nuclear industry and regulators as never before. A key challenge now is to properly assess and address the safety implications of these changes. With the globalization of the nuclear business and the consequent implications for supply, ownership and operational management of nuclear power plants, there is greater need for international consistency of standards and their application and for strong leadership and clear responsibility for safety.

International experience on plant life management and long term operation has reinforced the need for a comprehensive life cycle approach and the Agency has been urged to establish safety standards for safe long term operation, periodic safety reviews and ageing management.

Much progress has been made regarding emergency preparedness in recent years. Even so, most Member States still need to attain and sustain a satisfactory level of nuclear and radiological emergency preparedness, including adequate preparations for first responders.

Seismic safety is not a new issue, but the recent earthquake in the vicinity of the Kashiwazaki nuclear power plant in Japan highlighted the need to consider the potential consequences of earthquakes in siting, new designs and ageing management of operating nuclear power plants. The Agency sent an expert mission to Japan and is establishing a knowledge centre for seismic safety, tsunami hazard assessment and disaster mitigation management to develop and share state-of-the-art knowledge and to facilitate its application to enhance nuclear safety.

New multi-purpose research reactors have been commissioned or are being designed for utilization as regional and international centres. Safety assessments will need to cover the broad range of experiments and irradiations to be conducted in these facilities.

In anticipation of the expansion of nuclear power and the use of new technologies, many Member States will need to enlarge their occupational radiological dose assessment capacity to take account of all types of potential exposure. The development of electronic dosimetry as a legally acceptable measurement of dose received will also require new approaches and standardization.

There is increasing awareness among governments and interested parties regarding the need for early planning, adequate funding and long term strategies for decommissioning, waste and spent fuel management. There is a need for national and international mechanisms to preserve and maintain operational knowledge and experience for assuring the safety of decommissioning.

There is international interest in the establishment of comprehensive national radioactive waste management policies and implementing disposal strategies for all types of radioactive waste. A comprehensive system of radioactive waste classification is required and the Agency's safety standards in this area are currently being revised.

Spent fuel storage is becoming more and more important as the construction of geological disposal facilities is being delayed. In consequence, storage periods are extended and storage times of 100 years or longer are being taken into consideration.

The safety record for the transport of radioactive material remains excellent. The International Steering Committee on Denials of Shipment of Radioactive Material is coordinating efforts to find solutions related to denials of shipment.

There may be situations relating to new uranium mining activities where the regulatory infrastructure for waste and environmental safety issues is not present or is inadequate. It is essential that lessons learned from past and present remediation efforts are taken into account with new activities.

Increasing attention is being given to waste containing radionuclides of natural origin, often arising from activities not associated with the nuclear fuel cycle or traditional industrial and medical uses of radioactive material.

Continuous efforts are necessary for clear and timely communication of nuclear and radiation issues to the public using plain language.

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Analytical Overview

A. Introduction

The *Nuclear Safety Review for the Year 2007* presents an overview of worldwide trends and issues in nuclear, radiation, transport and radioactive waste safety and emergency preparedness, highlighting developments in 2007. This overview is supported by more detailed Appendices¹. This report also discusses nuclear security, but only in as far as it relates to nuclear safety. A separate report will cover nuclear security as a whole.

B. Global safety trends and issues

As interest in nuclear power grows and many Member States are considering their first nuclear power plant or expanding their existing nuclear power programmes, often after a long interval, the quest for safety is at the top of the agenda. The prime responsibility for safety rests with the person or organization responsible for facilities and activities that give rise to radiation risks. National governments have the responsibility of establishing and sustaining an effective legal and governmental framework for safety. Technology can be transferred, but safety culture cannot; it must be learned and embedded. To achieve this, strong leadership and global networking of safety knowledge and experience are essential. As a cornerstone of the global nuclear safety regime, international safety conventions and codes of conduct provide an important guiding framework and incentives for achieving a high level of safety. Adherence to the global safety principles contained in the Agency's *Fundamental Safety Principles* demonstrates commitment to safety and transparency, facilitates open communication, and is vital for a successful nuclear programme. Complacency, excessive cost savings, inadequate reporting, and even falsification are hazards against which both operators and regulators must constantly guard. The recurrence of such events shows that the promotion of strong safety culture and experience sharing should always be viewed as a 'work in progress'.

Changes in world markets and technology are having an impact on the nuclear industry and regulators as never before. Both the nuclear industry and regulators have traditionally been rather conservative when it comes to embracing changes and a key challenge for the future is to properly assess and address the safety implications of these changes. There is a need to maintain the appropriate balance between quickly taking advantage of new technologies and the requirement to thoroughly validate and verify their safety. Both the Generation IV initiative and the International Project on Innovative Nuclear Reactors and Fuel Cycles (INPRO) continue to include safety issues as integral aspects of new technology development. With the globalization of the nuclear business and the consequent implications for supply, ownership and operational management of nuclear power plants, there is greater need for international consistency and harmonization of standards and their application by Member States.

¹ *Safety Related Events and Activities Worldwide during 2007* (Appendix 1) and *The Agency's Safety Standards: Activities during 2007* (Appendix 2).

The need to enhance the international sharing and utilization of operating and other safety experience, including the impact of natural events such as earthquakes, remains high on the list of challenges. Although the safety performance of the nuclear industry, on the whole, remains high, incidents and emergencies at nuclear installations or involving radioactive materials continue to make news headlines and challenge operators and regulators. Even if in most cases the nuclear or radiation safety implications or health effects are technically minimal, public perception is influenced and the challenge remains to ensure transparency, timely and objective communication and that the lessons are learned and shared worldwide. More than any other sector, weak links in the nuclear industry and regulators can have a worldwide impact.

In spite of extensive precautions, incidents and emergencies continue to occur — often involving lost, stolen, damaged or discovered sources. Even relatively minor incidents at nuclear installations may raise undue anxieties among the public, and there remains the unlikely possibility of a severe emergency that could result in transnational impacts. In recent years there has been increased concern about the possibility of incidents or emergencies resulting from the malicious use of radioactive material or attacks on nuclear installations. In the early stages of such events it would usually not be known whether the cause is accidental, deliberate or due to negligence. The principal aim is to mitigate the radiological consequences of such events. However, it is also important to address non-radiological issues through timely, consistent and authoritative provision of information to the public. Many Member States are currently not adequately prepared to respond to these emergency situations. Standardized and harmonized approaches are important to ensure that effective protective actions are taken in all countries to maintain public trust.

An increasing number of Member States are announcing their intention to build nuclear power plants and to expand medical applications of advanced nuclear technology. The importance of a sound nuclear safety infrastructure as a prerequisite to adopting or expanding nuclear technology cannot be overemphasized. Included in this challenge is the fact that, with the exception of Asia, nuclear opportunities have been limited in recent years. This has resulted in a smaller cadre of qualified nuclear experts and fewer graduates in nuclear disciplines. Even those countries where there is a resurgence of interest in nuclear construction are confronting staffing problems. While these new opportunities have created incentives that draw workers to the nuclear field, there is however a delay between the demand for experts and the build-up of supply. This infrastructure extends beyond competent owners, operators and regulators to research and development activities, education and training facilities and sound knowledge management. The trend to reduced financing for safety research in the nuclear and radiation safety areas needs to be reversed.

With heightening expectations of the use of nuclear technology, exploration, mining and milling and transport activities are also on the increase. It is a prerequisite that all new and increased activities have proper regulatory oversight and that due attention is paid to the public's concerns over safety and the environment.

Resolving the issue of denials of shipment of nuclear and radioactive materials remains essential for the sustainable use of nuclear power and other nuclear applications.

The management of spent fuel and disposal of high level radioactive waste remain a key challenge for the nuclear power industry. Experts agree that the geological disposal of high level radioactive waste is safe and technologically feasible. For the most advanced projects, disposal sites have been chosen and pre-construction work is under way. Even so, it will still be more than a decade before the first such facility is operational. In the meantime, the trend has been to construct and use above-ground interim storage facilities, and many Member States are exploring the feasibility of interim storage for 100 years or more. Some progress has been made in areas related to the disposal of particular types of

low and intermediate level waste. There is also interest in finding better methods for safely recycling or disposing of spent high activity radioactive sources.

Most Member States have taken steps to prevent those who would cause harm from using nuclear material and facilities to achieve their malevolent aims. However, much remains to be done and efforts continue to enhance nuclear security. Safety and security intersect with each other and changes to ensure security can also have impacts on safety — positive in some cases, and negative in others. It is essential that the impacts of safety modifications on security and vice versa are properly assessed so that the appropriate balance and optimum level of protection against all potential threats are achieved. An International Nuclear Safety Group (INSAG) report on safety/security synergy is being prepared.

C. Safety infrastructures

C.1. Trends and issues

The establishment and sustainability of infrastructures for all aspects of nuclear, radiation, transport and waste safety will remain a high priority. Even if a foreign vendor is responsible for the design, construction, commissioning and operation of a nuclear or radiation installation or activity, the recipient country has the obligation to ensure the existence of a strong infrastructure that will assure continuing attention to safety. Regional and international networking to share information on best practices will play a key role in the continuous improvement of safety infrastructure. Nuclear and radiological safety training and education will also be in great demand.

Countries embarking on or expanding nuclear power programmes and expanding the uses of radiation (e.g. new radiotherapy or nuclear medicine programmes) will be faced with increasing demands for regulatory staff to fulfil necessary regulatory functions (review of licence applications, regulatory inspections, environmental impact assessments, etc.) for nuclear and radiation facilities. Countries embarking on nuclear power need to have and maintain an adequate national radiation, waste and transport safety infrastructure and ensure that regulatory staff and resources are not diverted to new activities at the expense of existing safety programmes.

Safety infrastructure includes many components, including the legal framework and regulatory capability, emergency preparedness and response, educated and trained manpower, a stable electrical grid, adequate financial and industrial resources, and the nurturing of an appropriate safety culture in the generating entity. In short, there are many responsibilities that arise from a commitment to nuclear power and the new entrants and expanding programmes must take appropriate and timely actions to fulfil those responsibilities. Some countries are expressing interest in a regional approach for building a new nuclear power plant. These countries must remain mindful of the fact that the prime responsibility for safety always rests with the operator and that the host country will require an appropriate safety infrastructure, independent of any contractual arrangements.

Continuous efforts are necessary to maintain the safety infrastructure and prevent it from deteriorating over time. The safety performance of these programmes deserves careful attention. There is increasing concern as worldwide dependence on ageing nuclear installations grows. There remains a need for strengthened monitoring and surveillance in order to preserve safety margins, to continue to capture, analyse and implement lessons learned from previous events, and to develop and reinforce the importance of a strong management system and leadership for safety.

Public communication, transparency and openness are important aspects of safety. Not only do they allow the public to be more informed and involved in safety programmes, but they also serve to improve the credibility of regulators, licensees and the nuclear industry at large.

C.2. International activities

The global nuclear safety regime is the framework for worldwide implementation of high levels of safety. At its core are the activities undertaken by regulatory bodies, licensees and governments to ensure continuous safety improvement and to enhance international cooperation based on legally binding safety conventions and non-binding codes of conduct. Consistency between national safety standards and the Agency's safety standards is particularly important in this regard.

In view of the large number of requests for assistance from new entrants, the Director General has established a Nuclear Power Support Group to coordinate the Agency's infrastructure activities and ensure that the services provided are consistent with the Agency's safety standards and other relevant documents.

While regulation remains a national responsibility, international, regional and technology specific regulatory forums strengthen cooperation and coordination, information exchange and best practices, and address common problems. The need to maintain or improve safety while still improving security is one area currently being addressed.

Ultimately, safety is based on the quality of the workforce and the professional expert community. Education, training and research and development need to be an integral part of international cooperation efforts to enhance safety.

The Agency's safety review services based on the Agency's safety standards and self-assessment, such as the Integrated Regulatory Review Service (IRRS), provide Member States with a valuable tool for mutual learning and improving safety infrastructure. The IRRS contributes toward a better harmonization of regulatory approaches worldwide. It has been demonstrated that countries with mature and experienced nuclear industries, as well as countries with less experienced nuclear industries, have opportunities to further improve their regulatory system and activities. Developing a comprehensive and effective legislative and regulatory framework for new countries embarking on nuclear power remains a significant challenge. In addition, the IRRS is also becoming an important mechanism for promoting the application of legally binding and non-binding international instruments, as well as the Agency's safety standards. The safety standards are continuously being improved with the incorporation of experience gained from review service missions and they remain the international reference for the high levels of safety required in the nuclear field.

C.3. Future challenges

To facilitate the effective and efficient use of limited resources, the Agency will need to continue to collect and analyse data from its missions and national self-assessments to identify national, regional and global trends and needs.

The expected nuclear renaissance and general increase in uses of radiation will place greater demands on regulators and technical support organizations, such as increased needs for training experts, capacity building and monitoring for staff members as well as for itinerant workers.

Although nuclear equipment and material can be bought, sold and transferred, safety culture and the safety knowledge associated with utilizing nuclear technology must be learned and embedded in all activities at the national level. Adherence to the fundamental safety principles promulgated by the

Agency should be a common objective for ensuring the sustainable use of nuclear energy and radiation technology.

Technical and scientific support organizations (TSOs), whether part of the regulatory body or a separate organization, are gaining increased importance by providing the technical and scientific basis for safety related decisions and activities. International programmes such as those of the Agency depend on the active participation of TSOs. In this respect, there is a need for enhanced interaction and cooperation between TSOs. Academic and industrial expert communities also play a vital role in improving safety cooperation and capacity building.

Licensing processes and regulatory inspection programmes related to component manufacturing, construction and commissioning will need to meet the challenge of new designs and technologies, and the increasingly multinational character of the nuclear industry will require greater and new regulatory competencies. This may be a particular issue for Member States that have not licensed a nuclear installation for many years as well as for those considering the nuclear option for the first time.

Nuclear development plans may face serious challenges in terms of manufacturing capacity, engineering, construction and commissioning expertise. Human resources within the nuclear and radiation safety community are ageing. Efforts are needed to establish an effective process for the development and transfer of knowledge in all of these areas and to ensure the preservation and availability of resources within universities and research facilities.

D. Incident and emergency preparedness, reporting and response

D.1. Trends and issues

With an anticipated increase in the use of nuclear energy and a heightened awareness of the need to strengthen arrangements to respond to emergencies that could arise from criminal or terrorist activities involving nuclear and other radioactive materials, Member States are increasing their focus on emergency preparedness, in particular on infrastructural and functional components and internationally consistent operational criteria.

Nevertheless, many Member States are not yet adequately prepared to respond to such emergency situations. Moreover, without common approaches or internationally consistent operational criteria, protective actions can differ between countries resulting in confusion and mistrust among the public, and interference with recovery operations, which could lead to severe socioeconomic and political consequences.

Incidents and emergencies continue to occur throughout the world. During 2007, the Agency's Incident and Emergency Centre (IEC) was informed or became aware of 140 events involving or suspected to involve ionizing radiation. In 25 cases the Agency took action, such as authenticating and verifying information with external counterparts, sharing and providing official information or offering the Agency's services. For example, in November, the Agency, at the request of the authorities of Honduras, arranged for regional assistance from the USA in recovering a radioactive source found in a scrap metal shipment container. In general, industrial radiography applications, in particular failure to follow established procedures, continued to be the major cause of radiation exposure related events in 2007.

Consolidating a trend among Member States towards greater cooperation and working more closely together in the area of emergency preparedness and response, 2007 saw numerous multilateral meetings taking place. For example, France reported many bilateral and multilateral meetings with neighbouring countries (Belgium, Germany, Luxembourg, Spain and Switzerland) to prepare emergency preparedness and response arrangements and the nuclear authorities of Finland and Sweden launched a bilateral cooperation programme.

To assist Member States in developing an adequate response capability, it is essential to provide detailed practical procedures (and associated training) that can be readily adapted for local use. The Agency, with the International Technical Committee for the Prevention and Extinguishing of Fires (CTIF), the Pan American Health Organization (PAHO) and the WHO as co-sponsors, has published a *Manual for First Responders to a Radiological Emergency*². The Manual provides practical guidance for those who will respond to a radiological emergency during the first few hours and for national officials who would support this early response.

D.2. International activities

In 2007, the XV Pan American Games took place in Rio de Janeiro. Brazil took advantage of substantial international cooperation in its emergency preparedness activities before and during the Games. In particular, Brazilian authorities used the Agency's emergency preparedness and response guidance³ to prepare for the Games and provide training to its National Force for Public Security, bomb squad and radiation protection officers.

In 2007, Latin America, with Agency support, initiated a Latin American biological dosimetry network that will work in close cooperation with national emergency response systems.

A full-scale international emergency response exercise (ConvEx-3) is conducted once every three to five years to test and evaluate the international exchange of information and coordination of assistance during the early phase of a major nuclear emergency. Representatives from Canada, Cuba, Mexico and the USA met in preparation for the ConvEx-3 (2008), which will be based on an exercise at the Laguna Verde nuclear power plant in Mexico.

In July 2007, the Competent Authorities identified under the Convention on Early Notification of a Nuclear Accident and the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency (Early Notification and Assistance Conventions) met in Vienna for their fourth meeting, with 96 participants from 56 Member States and three international organizations in attendance. At the meeting, Competent Authorities recognized the quality and thoroughness of the findings of two work groups⁴ and agreed that their recommendations represented a sound basis for enhancing international communications and assistance.

In 2007 in Budapest, the Competent Authorities of the eastern European region held their first regional meeting, with the participation of 11 countries and the Agency, and discussed regional exercises, an emergency response database and information exchange in general.

² <http://www-ns.iaea.org/tech-areas/emergency/emergency-response-actions.asp>

³ In particular the *Manual for First Responders to a Radiological Emergency* and *Preparation, Conduct and Evaluation of Exercises to Test Preparedness for a Nuclear or Radiological Emergency*

⁴ Work Group on International Communications and the Work Group on International Assistance of the International Action Plan for Strengthening International Preparedness and Response Systems for Nuclear and Radiological Emergencies

Safety Requirements No. GS-R-2, *Preparedness and Response for a Nuclear or Radiological Emergency*, is the international standard on nuclear and radiological emergency preparedness and response and many Member States have used it as a basis for their relevant legislation. For example, about 60% of European countries receiving Agency assistance comply with most of the requirements in Safety Requirements No. GS-R-2.

In 2007, Egypt, Russian Federation and Tajikistan hosted Emergency Preparedness Review (EPREV) missions. The Agency offers EPREV on request to provide an independent assessment of a Member State's emergency preparedness and response programme and capabilities against international standards.

The Agency performs regular exercises with the contact points identified under the Early Notification and Assistance Conventions. The Agency has established a follow-up programme to address issues of performance highlighted during the 2007 exercises. During 2007, many Member States also conducted exercises, training and seminars on various levels, including a national nuclear emergency exercise with participation of the local population at the Atucha nuclear power plant in Argentina.

D.3. Future challenges

Although much progress has been made regarding emergency preparedness in recent years, most Member States still need to attain a satisfactory preparedness level. Successful completion of the International Action Plan for Strengthening the International Preparedness and Response System for Nuclear and Radiological Emergencies is one of the keys to achieving this. In addition, substantial effort is also required to ensure that first responders are adequately prepared to deal with nuclear and radiological incidents and emergencies.

One of the challenges for the international community will be the full implementation of the Response Assistance Network (RANET), which will be a global network with a valuable repository of information about national assistance capabilities that can be called upon on request under the Assistance Convention. In order to make the RANET process effective, Member States must register their response capabilities in the RANET. To start this process, the Director General wrote to the 95 Parties to the Assistance Convention encouraging registration in RANET. While many technical organizations appear anxious to register, a policy decision must be made by Member States to move forward on RANET.

In 2005, the Competent Authorities' meeting asked the Secretariat to seek to close gaps in the legal framework of the Early Notification and Assistance Conventions by negotiating a code of conduct on emergency issues. At the 2007 Competent Authorities' meeting, representatives noted that a code of conduct was not universally accepted. Consequently, the Competent Authorities requested that the Agency consider alternatives to enhance the global legal infrastructure. The identification of an alternative will be a significant challenge for the Agency and the international community.

E. Civil liability for nuclear damage

E.1. Trends and issues

The importance of having effective civil liability mechanisms in place to insure against harm to human health and the environment, as well as actual economic loss caused by nuclear damage, has become

the subject of increased attention among States, especially in light of the renewed interest in nuclear power around the world. At the same time, uncertainty remains with regard to the implementation of the existing international nuclear liability instruments. In addition, although a number of States are parties to these instruments, many others are not and the compatibility of the provisions of the various instruments and the relationships between them are considered complex.

The International Expert Group on Nuclear Liability (INLEX), established by the Director General in 2003, continues to consider and address the concerns of Member States regarding the international nuclear liability instruments established under the auspices of the Agency, with a view to contributing towards a better understanding of, and adherence to, the international nuclear liability regime as a whole.

E.2. International activities

INLEX held its seventh meeting in June 2007. During the course of this meeting the Group continued its work on, inter alia, addressing possible gaps and ambiguities in the existing nuclear liability regime, by identifying further steps to resolve them. The Group also considered gaps in insurance coverage and considered possible ways of increasing the amounts of nuclear liability coverage through voluntary international pooling of operators' funds. In discussing the issue of the liability limit in the 1963 Vienna Convention on Civil Liability for Nuclear Damage (1963 Vienna Convention), the Group concluded that the unit of account was “\$35 per one troy ounce of fine gold” as provided for in Article V paragraph 3. Accordingly, the Group concluded that the correct minimum amount of liability under the 1963 Vienna Convention was dependent on the day-to-day price of gold, and that it was currently equivalent to approximately \$93 million.

E.3. Future challenges

The international nuclear liability instruments on the whole suffer from a lack of adherence by States. In this regard and with the aim of promoting adherence, INLEX will continue to play an active role. A third Regional Workshop on Liability for Nuclear Damage, is scheduled to be held in South Africa in February 2008, and the eighth meeting of the Group is scheduled to be held in May 2008.

On a separate platform, the European Commission will study how to harmonize nuclear liability coverage across European Union (EU) member states. The European Commission has asked an ad hoc group composed of interested parties, including the Agency, to assess, during the early part of 2008, the diverse nuclear liability regimes in the EU and to recommend ways to achieve harmonization. Currently, different EU member states belong to the Paris or Vienna liability conventions, or to neither of them. Independently from the above study, some support has also been expressed for harmonization with the 1997 Convention on Supplementary Compensation for Nuclear Damage.

F. Nuclear power plant safety

F.1. Trends and issues

One noticeable trend is that an increasing number of Member States are considering the introduction of nuclear power, while at the same time, countries already using nuclear power are considering construction of nuclear power plants (NPPs) of improved or new design. New organizational arrangements and relationships are being considered by the organizations responsible for the design,

construction, commissioning and operation of NPPs. These arrangements need to include the existence of a strong safety infrastructure harmonized with the Agency's safety standards that can assure the necessary attention to safety.

Many NPP operators are actively conducting or considering activities to extend the life of their plants. The vast majority of hardware issues associated with life extension have been thoroughly studied and common methodologies exist for assessing the physical state of structures, systems and components and for performing periodic safety reviews. The methodologies associated with knowledge preservation and management, and transmission of safety culture tend to be less well known and a shared methodology does not yet exist.

The continued strong safety performance of operating NPPs is encouraging. However, the potential for a complacent attitude among operators and regulators remains a concern. Significant events continue to occur in NPPs and Agency missions continue to reveal a shortfall between management expectations and the situation existing in the workplace.

Operators and regulators are not always effective in identifying and proactively responding to early symptoms of emerging problems. Information available from events occurring in the world is not being fully considered in the operating experience feedback process and is not being fully utilized to identify weaknesses or to give early warning of declining performance. At many NPPs and regulatory bodies, there is no clear integrated oversight process or consistent understanding of the overall ownership of the operating experience feedback process. This is hindering the effective feedback of available operating experience.

Many operating NPPs are re-evaluating safety and implementing upgrades as a result of developments in technology, the need to resolve identified safety issues, new regulatory requirements, or new data or evidence on hazards greater than those at the design time. While progress has generally been good, further development of the safety evaluation approach is needed.

New types of NPPs with new safety features are requiring the development and utilization of advanced techniques in the areas of deterministic and probabilistic safety analyses. In turn, this is requiring the development of the analytical capabilities of many organizations. This is necessitating the expansion of existing, as well as the development of new, skills in nuclear safety, including safety assessment capabilities. The establishment of training programmes and dedicated centres for training is becoming increasingly important in order to meet this challenge.

During all phases of nuclear power utilization, including the construction phase of NPPs, more attention is needed to the management of safety and quality. Nuclear power includes unique features related to safety, security and public concern and any leadership must recognize these aspects.

Fire safety, including the suitable storage of combustible materials, inspection and testing of fire protection measures and the adequacy of response of fire services, has been identified as an issue by a number of safety review missions. The use of probabilistic safety assessment for internal fires in NPPs is helping to identify vulnerabilities associated with design features and operational practices.

F.2. International activities

The Agency's safety review services and the World Association of Nuclear Operators' (WANO) peer evaluations continue to provide useful and important tools for operating organizations in all Member States as part of the enhancement and maintenance of their operational safety. Operational Safety Review Team (OSART) follow-up visits indicate that about 95% of the issues identified during

OSART missions have either been resolved or progress towards resolution has been satisfactory by the time of the visit.

The Agency has also carried out OSART missions to NPPs that have experienced unexpected problems with safety performance. These missions provide a benchmark against the Agency's safety standards and international good practice, which NPP managers can then take into account for their improvement plans. Specific assessment of safety culture is now being requested by plant operators. The results of these missions are made available to the regulatory body and the public to promote openness and transparency.

Analysis by WANO of plant events in 2005 and 2006 pointed to several key issues that needed to be addressed. These include reactivity management, service water degradation, flow-accelerated corrosion, material handling, and intake water events. As a result, WANO issued several reports addressing these issues.

The Agency has developed a generic process, based on the Agency's safety standards, for the review of safety documentation of new reactor designs, which is currently being applied to a number of new reactor designs. Also, there is strong demand for the Agency's site evaluation, design and long term operation services. Significant recent developments are the joint project with the European Commission and Ukraine to review the safety of all WWER-type Ukrainian NPPs and the peer review services for plant life management for safe long term operation.

A pilot project on the Multinational Design Evaluation Programme (MDEP) is being carried out within the Organisation for Economic Co-operation and Development's Nuclear Energy Agency (OECD/NEA). The main objective of this effort is to enable and encourage standardized designs for safe reactors, facilitate the design reviews of new reactors in many countries, and to further understanding and acceptance of safety goals on an international basis. The Agency takes part in the MDEP. It is expected that the results of the MDEP will be available in 2008.

In the field of seismic safety reviews, the Agency sent an expert mission to Japan following the Niigataken-Chuetsu-Oki earthquake at the Kashiwazaki-Kariwa NPP in Japan. Recovery of NPPs from such events depends on a proactive resolution of technical issues by the operator as well as the effectiveness and efficiency of the regulator to take decisions based on rules and procedures that are transparent and internationally accepted. The Agency is developing a knowledge centre for seismic safety, tsunami hazard assessment and disaster mitigation management to develop and share new knowledge and to facilitate its application to enhance nuclear safety.

The risk informed decision making process is gaining greater acceptance in many Member States. The Agency is developing new safety guidance and a number of Member States are currently testing the approach and guidelines. The Centre for Advanced Safety Analysis Tools (CASAT) is also being more extensively used by Member States to collaborate and share information on safety assessments, nuclear safety knowledge management, and training.

The Incident Reporting System (IRS), operated jointly with the OECD/NEA, continues to prove its usefulness as a source of information for worldwide operating experience and lessons learned from that experience. The IRS has played an important role in the prevention of both the occurrence and the recurrence of incidents. In 2007 all reports submitted to the IRS were reviewed by the Secretariat. A common software platform for registration, representation and analysis is being created for all events occurring at NPPs, research reactors and fuel cycle facilities.

F.3. Future challenges

Greater emphasis needs to be placed on operating experience feedback with respect to events at NPPs. Not only does the feedback process need to include rigorous root cause analysis and the determination of corrective actions, the information also needs to be widely shared with the nuclear community as recurrence of such events will decrease credibility and public confidence. There are still Member States that are not reporting any events through the IRS, even for events receiving broad national and international exposure.

The maintenance and continuous enhancement of safety will require effort on the part of the nuclear community. In particular, the management of ageing and long term operation continue to require significant attention. Management of safety in order to develop and maintain a strong safety culture also needs continuous attention in addition to the development of tools and processes to assist decision making.

In order to build up sustainable safety infrastructures, Member States introducing nuclear power will need to address nuclear safety in a comprehensive manner including site selection, design and safety evaluation, as well as component manufacturing, construction and commissioning.

In addition, severe natural events have triggered more attention to natural hazards, including the need to review the international safety standards in this area.

G. Research reactor safety

G.1. Trends and Issues

Research reactors continue to provide a cornerstone of national nuclear science and technology programmes worldwide and are an important part of the nuclear infrastructure of Member States. As in previous years, there were no serious accidents involving research reactors in 2007.

Around two thirds of existing operating research reactors have been in operation for more than 30 years and ageing of equipment and systems continues to be one of the primary causes of incidents reported to the Agency. Obsolescence of instrumentation and control systems is an important safety issue for many facilities. Many facilities are underutilized while others are in ‘extended shutdown’ pending a decision about their future. These issues tend to be exacerbated by the lack of financial resources.

Continued long term operation of research reactors with no or minimal operating schedules is raising concern regarding the continued ability of operating staff to properly deal with day to day events and anticipated operational occurrences. With the loss of experienced staff due to retirement and insufficient recruitment of new personnel, the knowledge base available to the operating organization for the safe operation of the research reactor is continuing to decrease.

While many operating organizations have measures in place to analyse events occurring at their own facility, there is limited sharing of operating experience between operating organizations and Member States. As a result, events with the same root causes that challenge defence in depth are continuing to occur.

G.2. International activities

The International Conference on Research Reactors: Safe Management and Effective Utilization, held in Australia in November 2007, highlighted the central role of the Code of Conduct on the Safety of Research Reactors in enhancing the safety of such facilities and the importance of networking to further improve exchange of operating experience.

The Agency continues to promote the application by Member States of the Code of Conduct, and has held a number of regional workshops to provide additional guidance on the requirements of the Code of Conduct in preparation for an international meeting on this subject in 2008. These workshops have allowed attendees from both regulatory bodies and operating organizations to carry out self appraisals as part of determining the degree to which they meet the Code of Conduct and the areas where they need further assistance.

In addition to the Code of Conduct, the Agency is also strongly promoting regional cooperation by Member States as a means of enhancing safety and increasing utilization through training, exchange of information and promotion of good safety practices.

The Integrated Safety Assessment of Research Reactors (INSARR) missions carried out in 2007 have contributed to the determination of overall trends in the area of research reactor safety. The missions themselves are changing in part to provide a better vehicle for procurement of Agency safety equipment and services.

The Incident Reporting System for Research Reactors (IRSRR) continues to develop as an important tool for improving operational safety via the exchange of safety-related information on events with safety implications. From 28 April to 1 May 2007, a workshop was held in Vienna, bringing together the Member States that have signed up to the system, to exchange experience on safety significant events. However, more work needs to be done to maximize the degree and amount of information exchanged in this area.

G.3. Future challenges

Many research reactors around the world are operating with obsolescent equipment, many are losing experienced operating staff through retirement, and many have small or non-existent operating schedules. Inadequate funding has the potential to isolate research reactor operators from developments in safety.

Although some Member States have self-assessment capabilities for the safety review of their research reactors, additional effort is required to increase this capability and make it consistent with the Agency's safety standards.

Greater cooperation with international organizations — such as the International Organization for Standardization (ISO) and the European Commission — in research reactor areas is needed, as is close cooperation and integration of activities with the topical groups operating under the framework of the Asian Nuclear Safety Network.

H. Fuel cycle facility safety

H.1. Trends and issues

Fuel cycle facilities cover a wide range of activities, including milling and refining, conversion and enrichment, fuel fabrication, interim spent fuel storage, reprocessing and waste conditioning. Many of these facilities are operated by the private sector, with operators often in competition with each other, making much of the process and technology information commercially sensitive. Although in the past this sensitivity often extended into the safety area, there is now more sharing of information on specific technical safety practices.

With the renewed interest in nuclear power, new commercial fuel cycle facilities, some with innovative designs, are under consideration. The production of new nuclear fuel adapted to the design of future NPPs also needs to be addressed. In all cases, the safety of new facilities remains essential.

Fuel cycle facilities face many safety challenges such as criticality control, confinement of hazardous materials, chemical hazards and susceptibility to fires and explosions. In some Member States, many facilities and regulatory bodies lack human and financial resources. The international safety guidance currently available for such facilities is still incomplete and needs to be further developed. Efforts are being made to improve the situation by developing a complete set of safety standards and providing training for their graded application based on potential hazards.

H.2. International activities

In June 2007, the Board of Governors endorsed the Safety Requirements entitled *Safety of Fuel Cycle Facilities*. Three new Safety Guides related to uranium fuel fabrication facilities, MOX fuel fabrication facilities and conversion and enrichment facilities are under final review.

The Agency's first Safety Evaluation During Operation of Fuel Cycle Facilities (SEDO) mission was successfully implemented to a uranium fuel fabrication facility in Brazil in April–May 2007. The update of the SEDO Guidelines will take into account the lessons learned during the pilot mission.

In December 2007, the Agency conducted its first national training course related to operational safety of fuel cycle facilities in China.

The Agency is cooperating closely with the OECD/NEA on fuel cycle safety and a common web platform covering the incident reporting systems for NPPs (IRS), research reactors (IRSRR) and the Fuel Incident Notification and Analysis System (FINAS) for fuel cycle facilities is being developed.

H.3. Future challenges

The broadening of the scope of the SEDO service for application to all fuel cycle facilities will require substantial effort. In addition, self-assessments of the safety of fuel cycle facilities need to become common practice.

I. Radiation protection

I.1. Trends and issues

Trends and issues are discussed in detail in chapters J through Q.

I.2. International activities

In 2007, following a long period of consultation in which the Agency actively participated, the ICRP adopted new recommendations for radiological protection. There are no fundamental changes to standards of safety for radiation protection, and dose limits for occupational and public exposure remain the same.

In 2007, the Committee on Radiation Protection and Public Health (CRRPH) of the OECD/NEA celebrated its 50th anniversary. At a meeting to commemorate the occasion, participants discussed the decision-making and scientific challenges facing radiation protection.

The Agency, in cooperation with co-sponsoring and potential co-sponsoring international organizations, embarked on a revision of the BSS in 2007, in order to incorporate new findings and needs and the new ICRP recommendations. An updated BSS draft was reviewed by the Agency's safety standards committees in late 2007, and drafting and refinement will continue through 2008, with an expectation that a draft suitable for Member State consultation will be available in 2009.

I.3. Future challenges

In general, all Member States will need to assess their national standards for radiation protection for consistency with the new ICRP recommendations. Specific future challenges for radiation protection are discussed in chapters J through Q.

Some specific issues are also expected to pose challenges in the immediate future. One is the need to develop strategies for radiation protection measures in areas that may not be subject to regulatory control, such as in the case of exposure to radon in dwellings. Another is to develop decision-aiding recommendations for ensuring due process in the justification of practices that deliberately expose people to radiation, such as in the case of security screening using ionizing radiation.

J. Occupational radiation safety

J.1. Trends and issues

Technical support organizations (TSOs) and appropriate quality management systems will be in greater demand. Additional guidance will have to be provided on issues covering the monitoring of workers exposed to naturally occurring radioactive material (NORM) and of itinerant workers.

The expansion of nuclear power generation as well as the increasing worldwide use of radioactive sources will lead to more persons being occupationally exposed and will also require expanded monitoring programmes (e.g. neutron radiation monitoring and evaluation of internal exposure from unsealed radioactive material/contamination). Ageing of old nuclear installations will foster the

development of adequate radiation programmes to be implemented in workplaces which were not initially designed for future decommissioning.

J.2. International activities

Close cooperation with international bodies such as the International Labour Organization and World Health Organization contributes to promoting the harmonized implementation worldwide of occupational radiation protection standards.

The Information System on Occupational Exposure (ISOE) is managed through a joint OECD/NEA–IAEA Secretariat and the Agency operates the ISOE Technical Centre for non-OECD countries to contribute to the improvement of radiation safety in NPPs located in 11 countries.

J.3. Future challenges

As a consequence of the expansion of nuclear power and new technologies, Member States would need to enlarge their occupational assessment capacity to take account of other types of potential exposure, such as neutron and internal. The development of electronic dosimetry as a legally acceptable measurement of dose received will require new approaches and standardization requirements. In addition, clearer guidance is needed to assist Member States in creating a pragmatic and graded approach to occupational radiation protection regulation, especially concerning exposure to NORM.

The establishment of regional centres of excellence could improve Member States' ability for addressing occupational radiation protection issues through a global approach to workplace safety, taking into consideration indigenous and synergistic aspects.

K. Radiological protection of patients

K.1. Trends and issues

Radiological accidents involving patients continue to be reported and modern equipment and new technologies require greater attention to radiation safety as the risk of unintended exposure can be large. The degree of alertness, awareness and attention to detail required with complex radiotherapy techniques is much larger than with conventional techniques. The current growth in the number of positron emission tomography (PET) and computed tomography (CT) facilities in operation has been faster than anticipated. Similarly, the rate of growth of new CT scanners and the technology associated with them has also been higher than anticipated. Many imaging techniques are available now that were not a decade ago. This leads to an increase of radiation exposure to the population. There are indications that, in some countries, the collective dose to the population from medical exposure exceeds that from background radiation. Data from the United Nations Scientific Commission on the Effects of Atomic Radiation (UNSCEAR) show increasing per capita radiation doses to patients.

K.2. International activities

Appropriate training of medical staff in radiation protection of patients underpins global initiatives in this area. The Agency supports such training actions, which can then lead to international developments in achieving sustainability and capability. One example of this in 2007 was the

establishment of the Asian Network of Cardiologists in Radiation Protection, which has launched a newsletter on radiation protection — a first for cardiologists. Worldwide training initiatives now include medical doctors that do not normally have training in radiation protection but that perform fluoroscopy (e.g. urologists, orthopaedic surgeons, gynaecologists). Agency support in this area started in 2006 and was further strengthened through a successful course in Asia in 2007.

K.3. Future challenges

The Agency's website⁵ on radiological protection of patients has provided information for health professionals worldwide to help them achieve patient radiation protection. Complementary information for patients should also be made available on the website.

Lack of reporting of incidents of unintended exposure has been a big problem in the medical area, limiting the opportunities for lessons learned. Development of a system for educational reporting of cases of high patient exposure remains a challenge.

Many Member States need to implement modified national legislation and regulations or enforce existing requirements to ensure that all elements of an adequate and sustainable national radiation safety infrastructure are in place to provide for the radiation protection of patients.

L. Protecting the public and the environment

L.1. Trends and issues

The Agency assisted in the ongoing development of an internationally harmonized system for protection of the public and the environment by participating in the preparation of the 2007 ICRP recommendations and consulting with Member States in the framework of the revision of the BSS, as well as through its ongoing long term collaboration with the ICRP and UN organizations.

As Figure 1 shows, the inventory of total activity of beta and gamma emitting radionuclides in liquid discharges from nuclear installations has fallen substantially since the 1980s.

L.2. International activities

In 2007, the Agency organized an International Conference on Environmental Radioactivity in Vienna in cooperation with UNSCEAR. The second part of the conference title “From Measurements and Assessments to Regulation” reflects the broad scope of the subject area and the interests of some widely different disciplines, including regulation, assessment, monitoring, sampling and measurement. In the context of controlling the exposure of humans due to radioactivity in the environment, each of these disciplines is involved and interlinked. The conference sought to address all of these aspects and the inter-linkages between them.

The European Commission's ERICA⁶ project, which targets organism and ecosystem protection through the generation of relevant databases to support assessments and through the development of

⁵ <http://rpop.iaea.org>

⁶ Environmental Risk from Ionizing Contaminants: Assessment and Management

assessment and risk characterization methodologies, was successfully completed in February 2007. A new European Commission project, PROTECT⁷, follows up using the ERICA results to explore definitions of the protection framework at the regulatory level and to test their application.

The Agency web-based version of the Database on Discharges of Radionuclides to the Atmosphere and Aquatic Environment (DIRATA) is now open for public use. Worldwide or regional trends in radioactive discharges can be drawn for research or information purposes.

At the request of the Contracting Parties of the 1972 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (London Convention), the Agency initiated a process to update databases on the inventory of radionuclides from dumping activities and accidents and losses at sea.

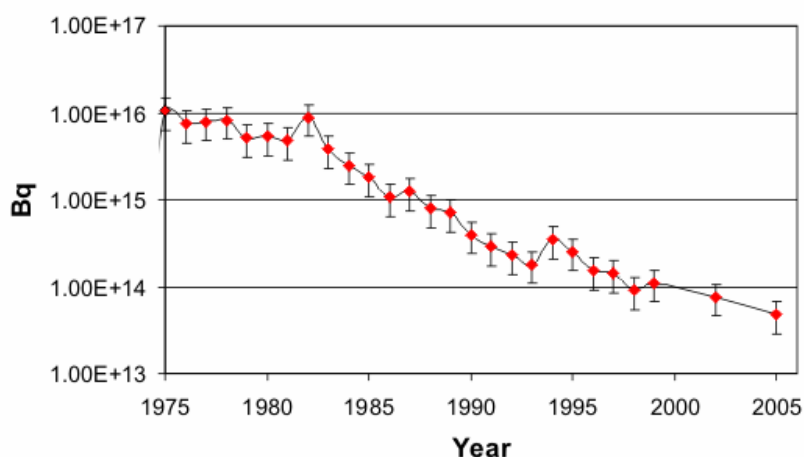


Figure 1: Evolution of worldwide inventory of total activity of beta and gamma emitting radionuclides in liquid discharges from nuclear installations (from DIRATA)

L.3. Future challenges

The safety standards related to controlling radioactive discharges need to be updated to reflect current best practices and to include essential elements coming from the new ICRP Recommendations.

M. Radioactive source safety and security

M.1. Trends and issues

The replacement of radioactive sources with non-radioactive sources of ionizing radiation, in the medical area in particular, has begun. However, in many applications and in many countries in general, radioactive sources continue to play an important and useful role and the regulatory control and related safety infrastructure worldwide still requires strengthening.

M.2. International activities

Communication between national authorities prior to the import and export of Category 1 and 2 radioactive sources has begun as recommended in the supplementary Guidance on the Import and Export of Radioactive Sources.

The Agency organized an open-ended meeting of technical and legal experts on sharing of information on States' implementation of the Code of Conduct on the Safety and Security of Radioactive Sources

⁷ Protection of the environment from ionizing radiation in a regulatory context

and its supplementary Guidance in June 2007. In line with the non-legally binding nature of the Code and the Guidance, participation and presentation of papers was on a voluntary basis. The meeting was attended by 122 experts from 70 Member States, two non-Member States, and observers from the European Commission, the Organization for Security and Co-operation in Europe (OSCE) and the Food and Agriculture Organization of the United Nations (FAO). Canada and the USA provided extrabudgetary funding to specifically support the participation of experts from States that otherwise could not have attended the meeting. Experts from 53 States took the opportunity to present papers on their experiences in implementing the Code and the Guidance. Participants appreciated the open nature of the discussions, and encouraged the Agency to hold similar meetings in future, perhaps on a triennial basis, subject to availability of funds. A number of conclusions were reached which are summarized in the Chairman's report⁸.

Increasing international assistance is being provided to developing countries to make vulnerable disused radioactive sources safe and secure. The assistance includes support for establishing verified source inventories, repatriation of certain types of sources, funding of national projects to arrange for safe and secure long term storage and establishing national capabilities to search and recover orphan sources.

A new radiation warning symbol, to supplement the existing trefoil sign for ionizing radiation has been published by the International Organization for Standardization as ISO Standard 21482, "Ionizing-radiation warning — supplementary symbol". The new symbol is the completion of a multi-year effort by the Agency to develop a universal radiation warning symbol that anyone anywhere will understand as meaning "Danger — Stay Away." It is intended to supplement, rather than replace, the trefoil sign for ionizing radiation on Category 1, 2 and 3 sources. The Agency will assist Member States in the appropriate implementation of the new symbol.



Figure 2: Ionizing radiation warning — supplementary symbol

M.3. Future challenges

Assistance to Member States in their efforts to implement the provisions of the Code and the Guidance, in particular by strengthening their regulatory infrastructure, is still needed. An increasing number of Member States are requesting the Agency to appraise their legal and regulatory system related to the control of radiation sources. The Agency will continue conducting such appraisals (formerly called RaSSIA) within the IRRS programme.

The increasing number of orphan sources detected at national borders due to rapidly developing detection capabilities highlights the urgent need for appropriate regulatory and technical infrastructure to properly manage, recover, store and dispose of disused sources, in particular in developing countries.

It still remains a challenge to strengthen control over radioactive sources while not decreasing the benefits that various applications of radioactive sources provide to society.

⁸ http://www.iaea.org/About/Policy/GC/GC51/GC51Documents/English/gc51-3-att1_en.pdf

N. Safety of transport of radioactive material

N.1. Trends and issues

The set of regulations and guidance material for the safe transport of radioactive material is almost complete. The publication of Safety Guides No. TS-G-1.1 (ST-2), *Advisory Material for the IAEA Regulations for the Safe Transport of Radioactive Material*, and TS-G-1.3, *Radiation Protection Programmes for the Transport of Radioactive Material*, fulfils the needs for a continued record of safety in transport activities. The guidance on management systems (quality assurance) and compliance assurance and schedules related to Safety Requirements No. TS-R-1, *Regulations for the Safe Transport of Radioactive Material*, (Transport Regulations) are under review.

Harmonization with other relevant UN bodies is an essential part of the Agency's standards activities. Lack of harmonized requirements can lead to misunderstanding and non-compliance with the international standards as they are applied around the world. Lack of harmonization is a significant impediment to facilitating transport of radioactive material.

The International Steering Committee on Denials of Shipment of Radioactive Material coordinates international efforts at finding solutions to issues related to denials of shipment. In 2007, the Committee developed a comprehensive international action plan of activities, which includes activities that would significantly reduce cases of denials of shipment and alleviate hardships by reaching out to concerned organizations and increasing awareness about the uses of radioactive material in the fields of public health, industry and power production.

N.2. International activities

In July 2007, the Agency held a regional workshop on denials and delays of shipment of radioactive material in Uruguay. There was consensus from the 16 countries attending on the need for dissemination of accurate information on the transport of radioactive material. Communication among authorities, both at the national and regional level, needs to be improved. A number of reported instances of denials and delays could have been avoided if an efficient communication system in the region existed. Future actions include a tailored education and training programme for front line personnel (cargo handlers, customs, shipping agents, carriers) and the engagement of national regulatory bodies, other authorities and transport organizations.

International organizations are addressing harmonization of the Transport Regulations with the UN Recommendations on the Transport of Dangerous Goods. Meetings were held in February 2006 and September 2007. The 15th revised edition of the UN Regulations includes the related changes, as will the 2009 Edition of the Transport Regulations.

In September 2007, a group of shipping and coastal states held, with Agency participation, a third round of informal discussions in Vienna with a view to maintaining dialogue and consultation aimed at improving mutual understanding, confidence building and communication in relation to safe maritime transport of radioactive material.

N.3. Future challenges

The greater use of radioactive material will increase concerns on safety and security, which may in turn increase instances of denials and delays of shipment. The lack of common guidance on safety and security of transport of radioactive material will need to be resolved and a harmonized safety and

security approach to the existing package designs or shipments of radioactive material will be required.

The process by which the transport regulations of the Agency and UN could progressively move to a full harmonized structure should be discussed. Such a move will further facilitate worldwide understanding and compliance with the transport regulations of both the Agency and UN.

O. Safety of radioactive waste management and disposal

O.1. Trends and issues

There is international interest in the establishment of comprehensive national radioactive waste management policies and implementing strategies that will ensure that all radioactive waste is appropriately managed and that a safe solution can be found for the disposal of all types of radioactive waste. The concept of a common framework linking radioactive waste types to disposal options in a manner that respects international safety standards and takes cognisance of local circumstances, has been evolving for a number of years. Important to the concept is a comprehensive system of radioactive waste classification — an area where the Agency’s safety standards are presently being revised.

Some radioactive waste is not suitable for near surface disposal, but does not warrant the degree of isolation and containment provided by geological disposal. Disposal at intermediate depths, between a few tens of metres and several hundred metres, is considered to offer good prospects for safety.

The increase in decommissioning activities suggests that significant amounts of radioactive waste with low levels of radioactive content will need to be disposed of in the near future. This waste does not require the robust containment provisions typical of modern near surface radioactive waste disposal facilities.

Increasing attention is also being given to waste containing radionuclides of natural origin, often arising from activities not associated with the nuclear fuel cycle or traditional industrial and medical uses of radioactive material.

Table 1: Worldwide radioactive waste inventory (1000s of cubic metres) at the end of 2005

| | Storage | | Disposal | |
|---|-------------|-----------|-------------|-----------|
| | Unprocessed | Processed | Unprocessed | Processed |
| Short-lived Low & Intermediate Level Waste | 1 923 | 1 696 | 15 460 | 4 280 |
| Long-lived Low & Intermediate Level Waste | 13 434 | 105 | 42 | 63 |
| High-Level Waste | 363 | 27 | 0 | 0.01 |

Spent fuel storage is becoming more and more important as the construction of geological disposal facilities is being delayed. In consequence, storage periods are extended and storage times of 100 years or longer are being taken into consideration.

O.2. International activities

Increasingly, Member States are requesting the Agency to arrange for international peer review of radioactive waste management programmes and facilities against international standards. In 2007 programmes were reviewed in Chile, Colombia, Guatemala, Pakistan, and the Bolivarian Republic of Venezuela. In the Republic of Korea, the safety case of a future near surface disposal facility was reviewed. In Romania, the review included site characterization and conceptual repository design for a planned near surface disposal facility.

Three international projects on the harmonization of safety assessment processes were completed in 2007: Application of Safety Assessment Methodologies for Near-Surface Radioactive Waste Disposal Facilities (ASAM), International Project on Evaluation and Demonstration of Safety during Decommissioning of Nuclear Facilities (DESA), and Environmental Modelling for Radiation Safety (EMRAS). All results obtained and tools developed by the projects are available for public use on the Agency's website⁹.

In 2007, the OECD/NEA and the Agency organized a symposium entitled "Safety Cases for the Deep Disposal of Radioactive Waste: Where Do We Stand?" There is increasing interest in international harmonization of approaches to structuring and presenting safety cases and their review by regulatory authorities. The meeting clearly agreed that a harmonized approach internationally would be beneficial and that achieving broader societal acceptance was considerably handicapped by the variation of national requirements.

An international conference entitled "Geological Repositories: A Common Objective, a Variety of Paths", organized by the International Association for Environmentally Safe Disposal of Radioactive Material (EDRAM), was held in Berne, Switzerland in October 2007. There is consensus at an international level that disposing of high level radioactive waste in a deep geological repository offers the required long term safety and security. A sound technical basis for implementing such repositories has already been established. Effort needs to be invested now in discussing the way forward, as well as how the technical flexibility of the geological disposal concept can be used to help meet social and political requirements and expectations.

The Agency's Net Enabled Waste Management Database (NEWMDB) was redesigned to better meet user needs, in particular to prepare national reports for the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management. NEWMDB contains information, such as the consolidated radioactive waste inventory shown in the figure below, on national radioactive waste management programmes, plans and activities, policies and radioactive waste inventories. Major nuclear programmes are represented and there are currently four years of inventory data in the system for 61 Member States — representing 70% of worldwide nuclear energy production — that contribute data via the online system.

⁹ <http://www-ns.iaea.org/projects/asam.htm>; <http://www-ns.iaea.org/tech-areas/waste-safety/desa/start.asp>; <http://www-ns.iaea.org/projects/emras/>

O.3. Future challenges

The emergence of the concept of intermediate depth disposal in some countries will trigger the need for appropriate safety standards for this domain.

In the case of geological disposal, good progress was made in a few countries. However, delays can be seen in many countries. These delays are normally not connected to technical aspects, but mostly to delays or restarts in the political/societal process. Also, the renewed interest in recycling and a belief in a multinational solution are pushing into the future the time when a repository is needed. The later need for geological disposal capacities, particularly for smaller nuclear programmes, has been noted as another reason for postponing plans for commissioning disposal facilities.

P. Decommissioning

P.1. Trends and issues

The awareness of governments and interested parties of the need for early planning, adequate funding and long term strategies for decommissioning, waste and spent fuel management is rising and there is now a need for national and international mechanisms to preserve and maintain the operational knowledge and decommissioning experience that are important to the safety of decommissioning. In addition, with the recent increase in plans for the development of nuclear installations worldwide, it is important that the lessons already learned from decommissioning be used as an input in the design, operation and maintenance of all new nuclear installations. Straightforward, proven and available decommissioning technologies are generally preferable to new and innovative technologies and flexible and graded approaches to the regulation of decommissioning now need further development and support.

Definition of a clear endpoint of decommissioning by all interested parties is necessary, in particular in relation to the release of material from control and the reuse of sites. Such a mechanism would contribute to building public confidence, staff motivation and the consideration of the social aspects relating to decommissioning. It is very important for a decommissioning project to have a defined clearance route, adequate infrastructure and measures for processing/reuse of scrap metal in order to reduce the material that needs to be stored, processed or disposed of as radioactive waste.

P.2. International activities

The Agency's Research Reactor Decommissioning Demonstration Project (R²D²P) was launched to provide training to experts from countries with small nuclear programmes. The decommissioning of the Philippine Research Reactor (PRR-1) is the model project for this activity. The demonstration work is progressing with the characterization of PRR-1 for decommissioning and the preparation of a decommissioning plan. In addition, under R²D²P, the transition from operation to decommissioning at the Australian High Flux Reactor will be demonstrated. Other research reactors that could provide complementary demonstrations may be included in future R²D²P activities, e.g. heavy water reactors.

Lessons learned from decommissioning are an important topic worldwide and two international events were organized in 2007 in this regard: the American Nuclear Society's Topical Meeting on Decommissioning, Decontamination and Reutilization, and the Electric Power Research Institute's 6th EPRI International Decommissioning and Radioactive Waste Workshop.

The Contact Expert Group for International Radioactive Waste Projects in the Russian Federation organized two workshops, one to review preliminary results for nuclear clean-up projects in the north-west of Russia and one on nuclear legacy problems in the far east of Russia, including dismantlement of nuclear submarines and nuclear service ships and remediation of contaminated sites.

The Agency established an International Decommissioning Network to provide, to countries starting decommissioning projects, hands-on training and to facilitate experience sharing on decommissioning technologies at facilities and sites undergoing decommissioning.

P.3. Future challenges

Awareness of governments and interested parties of the need for early planning, adequate funding, governmental support and long term strategies for decommissioning still needs to be increased. One way to achieve this could be a more effective use of the Joint Convention peer review mechanism.

Harmonization in the application of the clearance values — the values at which materials coming from decommissioning activities are removed from any further regulatory control by the regulatory body — still needs to be achieved, as well as the establishment of agreed surface contamination values.

The most important challenge in the future of decommissioning is to maintain adequate and qualified resources for decommissioning projects while the nuclear industry is expanding.

Q. Remediating contaminated sites

Q.1. Trends and issues

The continuing demand for nuclear power generation has resulted in an increase in exploration and development of uranium resources. Consequently, the need for the safe management of residues from all phases of the mining and processing of uranium has grown whilst the need for remediation of former legacy sites remains high.

There is a growing awareness of residue safety issues involving naturally occurring radioactive material (NORM). Many of these issues are related to legacy sites and the challenges of residue management and waste. The need for specialized guidance in NORM residue management has been recognized.

With the current expansion of the nuclear industry, the lack of personnel with the required background, training and experience has become very apparent. In all parts of the world there is now a shortage of personnel to support the expanding uranium mining industry. Training materials and courses to assist in the development of suitably qualified staff are another current priority.

Q.2. International activities

The Agency has continued to provide assistance to countries of Central Asia, at both the regional and national level, in planning the remediation and management of the uranium mining legacy sites in Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan. The development and strengthening of institutional capabilities in these countries remains a priority activity.

An Agency review was carried out in Gabon at the remediated site of the former Oklo uranium mine.

The growing interest in uranium mining has resulted in an Agency fact-finding mission to Malawi to look at the regulatory and field situations for a proposed new uranium mine and in a technical meeting in Namibia to discuss uranium mining development.

Several international fact-finding visits to NORM contaminated sites in Azerbaijan and Kyrgyzstan were made by UN organizations (including the World Bank, United Nations Development Programme and the Agency) to prepare remediation projects, to relocate uranium mill tailings and to improve public and environmental safety. A project was also prepared for the management of NORM residues in the oil and gas industry in Kuwait.

To help meet new challenges in uranium mining development and NORM residue management, international groups involving producers of the uranium and phosphate mining industries and regulatory bodies of producing countries were set up under the auspices of the Agency, with the intention of developing guidance and training materials that set out good practices to ensure long term public and environmental protection.

Q.3. Future challenges

The demand for assistance and support for waste and environmental safety issues relating to new uranium mining development is likely to increase significantly over the next few years until the market stabilizes. There may be situations where no regulatory infrastructure is present but mine development is under way; or places where efforts are under way to restart previously abandoned uranium production facilities or commence mining where the regulatory infrastructure is inadequate.

Appendix 1

Safety related events and activities worldwide during 2007

A. Introduction

This report identifies those safety related events or issues during 2007 that were of particular importance, provided lessons that may be more generally applicable, had potential long-term consequences, or indicated emerging or changing trends. It is not intended to provide a comprehensive account of all safety related events or issues during 2007.

B. International instruments

B.1. Conventions

B.1.1. Convention on Nuclear Safety (CNS)

In 2007, Malta acceded to and Nigeria ratified the CNS, which had 60 Contracting Parties at the end of 2007¹⁰, including all Member States operating nuclear power plants.

The Organizational Meeting for the 4th Review Meeting of the Contracting Parties was held in Vienna from 24 to 25 September 2007, with 44 Contracting Parties participating.

The Meeting elected Mr. Maurice T. Magugumela of South Africa as President of the 4th Review Meeting and Ms. Ann McGarry of Ireland and Mr. Juan Eibenschutz of Mexico as Vice- Presidents. The Meeting also established six Country Groups for the 4th Review Meeting and allocated Contracting Parties to Country Groups. The Country Groups then met separately and elected Country Group Coordinators and Officers.

The 4th Review Meeting of the Contracting Parties will be held in Vienna from 14 to 25 April 2008.

B.1.2. Convention on Early Notification of a Nuclear Accident and Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency (Early Notification and Assistance Conventions)

In 2007, Mali ratified and Montenegro succeeded to the Early Notification and Assistance Conventions. The Early Notification Convention had 101 parties and the Assistance Convention had 99 parties at the end of 2007.

¹⁰ For Malta, the CNS entered into force on 13 February 2008

In 2007, no notification messages were submitted under the provisions of the Early Notification Convention. However, in relation to five events, advisory messages were exchanged under the *Emergency Notification and Assistance Technical Operations Manual* (ENATOM) arrangements or came as requests for information from the official designated counterparts under the conventions.

In two cases, the Agency was requested to provide assistance pursuant to the Assistance Convention. In one of these cases, the Agency deployed a source recovery assistance mission in cooperation with the requesting State Party and with the State Party which delivered assistance.

In eight cases, the Agency has also offered its good offices in accordance with Article 5(d) of the Assistance Convention.

B.1.3. Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (Joint Convention)

The Joint Convention applies to spent fuel and radioactive waste resulting from civilian nuclear activities and to planned and controlled releases into the environment of liquid or gaseous radioactive materials from regulated nuclear facilities. In 2007, Nigeria and Tajikistan¹¹ acceded to the Joint Convention, which had 45 parties at the end of 2007. Considering that the vast majority of Member States have some requirements for radioactive waste management, it is hoped that more States adhere to the Joint Convention. The Agency conducted a workshop for members of the Asian Nuclear Safety Network in Sydney in September 2007 regarding the benefits of adherence to the Joint Convention. The Agency promotes the Joint Convention at all Agency meetings related to spent fuel and radioactive waste management.

The Third Review Meeting will be held from 11 to 22 May 2009.

B.2. Codes of Conduct

B.2.1. Code of Conduct on the Safety of Research Reactors

The provisions and guidance in the Code of Conduct have been integrated into appropriate Agency safety review services, technical cooperation projects and extrabudgetary programmes. Application of the Code of Conduct is being accomplished through implementation of national safety regulations. Member States are being encouraged to make full use of the Agency's safety standards relevant to research reactors and the legal and governmental infrastructure for nuclear, radiation, radioactive waste, and transport safety.

As recommended by the December 2005 open-ended meeting that, inter alia, periodic meetings be held to exchange information and discuss experience in application of the Code of Conduct, two regional meetings¹² were held in 2007 for Asia and the Pacific and Latin America and Caribbean regions. These meetings allowed participating countries to exchange information and views on the recommendations contained in the Code of Conduct, to discuss the results of self assessments made on the status of research reactor safety and to identify needs for assistance in applying the Code of Conduct.

Preparations were started for an international meeting on the application of the Code of Conduct in 2008, close to the Fourth Review Meeting of the Contracting Parties to the CNS.

¹¹ For Tajikistan, the Joint Convention entered into force on 11 March 2008.

¹² Regional meetings for Africa and Eastern Europe were held in 2006.

B.2.2. Code of Conduct on the Safety and Security of Radioactive Sources

By the end of 2007, 90 States had expressed their political support and intent to work toward following the Code of Conduct on the Safety and Security of Radioactive Sources and 45 States had expressed support for the supplementary Guidance on the Import and Export of Radioactive Sources.

From 25 to 29 June 2007, the Agency held an open-ended meeting of technical and legal experts for sharing of information as to States' implementation of the Code of Conduct on the Safety and Security of Radioactive Sources and its supplementary Guidance on the Import and Export of Radioactive Sources. This meeting is described in greater detail in Section G.8.

C. 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, some deal with particular reactor types and others are based on the size of the nuclear power programme. All of these forums meet regularly to exchange information of common interest and some are developing exchange mechanisms involving the Internet for more rapid means of communication. Selected safety issues of wide interest to regulators are discussed at a meeting of senior regulators held in association with the Agency's General Conference each year.

C.1. International Nuclear Regulators Association (INRA)

INRA comprises the most senior officials of a number of well-established national nuclear regulatory organizations in Europe, America and Asia who wish to exchange perspectives on important issues with the purpose of influencing and enhancing nuclear safety and radiological protection from a regulatory perspective. INRA met twice in 2007 in Spain and discussed, inter alia, waste management, the CNS, safety culture, International Commission on Radiological Protection Recommendations, emergency planning and management, new build approaches and the Agency's Integrated Regulatory Review Service programme.

C.2. G8-Nuclear Safety and Security Group (G8-NSSG)

Under the presidency of Germany, the G8-NSSG met three times in 2007. The Agency, European Commission, Nuclear Energy Agency of the Organisation for Economic Co-operation and Development and the European Bank for Reconstruction and Development (ERBD) also attend these meetings. The G8-NSSG discussions focussed on: Chernobyl NPP projects for the shelter and interim spent fuel storage administered by the EBRD; implementation of the Code of Conduct on the Safety and Security of Radioactive Sources and its supplementary Guidance on import/export control; the global initiative to combat nuclear terrorism; safety improvement programmes for Armenian and Ukrainian water cooled, water moderated power reactors; Russian technical regulations for nuclear safety and radiation protection; EU programmes and perspectives for the period 2007–2013; global nuclear safety network; and safety aspects of multinational approaches to the nuclear fuel cycle. The group provided input on safety and security issues to the G8 summit held in July 2007 in Heiligendamm, Germany.

At the last meeting in November 2007, the main themes to be addressed during the 2008 Japanese G8 presidency were introduced. In addition to continuing present activities, the proposed priorities include

support to nuclear power infrastructure and earthquake and nuclear safety. Japan also announced that it will support Agency efforts to assist countries embarking in nuclear power programmes focussing on 3Ss (Safety, Security and Safeguards) approach.

C.3. Western European Nuclear Regulators Association (WENRA)

WENRA was established in 1999 and currently includes the heads of nuclear regulatory authorities of 17 European countries having at least one nuclear power plant. One of its main objectives is to develop a harmonized approach to selected nuclear safety and radiation protection issues and their regulation, particularly within the European Union. To this end, two working groups have been established: the Reactor Harmonization Working Group (RHWG) and the Working Group on Waste and Decommissioning (WGWD).

In January 2007, WENRA published the *WENRA Reactor Safety Reference Levels* covering 15 safety issues relevant for the harmonization of reactor safety. In March 2007, modifications to the January 2007 documents were issued based on comments received from WENRA members. Also in March 2007, the WENRA Working Group on Waste and Decommissioning published the *Decommissioning Safety Reference Levels Report*.

WENRA continues to closely follow the progress regarding revisions to IAEA safety standards in order to revise their reference levels if necessary.

C.4. The Ibero-American Forum of Nuclear and Radiological Regulators

The Forum met in July 2007 in Mexico, with the chief regulators from Argentina, Brazil, Cuba, Mexico, Spain and Uruguay attending. At that meeting, the Forum reviewed ongoing projects, including the implementation of the Ibero-American Radiation Safety Network. At the meeting, the presidency was transferred from Mexico to Uruguay.

The Agency continued to support the activities of the Forum in the frame of an extrabudgetary programme dedicated to nuclear and radiation safety. In 2007, the project on probabilistic safety assessment applied to radiotherapy treatment with linear accelerators was finalized. The project was successful in identifying potential accident sequences and grading them in terms of risks and provided recommendations to prioritize the use of resources to avoid accidental exposure. Considerable progress was also achieved with the development of a methodology for self-assessment of the regulatory system for protection of patients against radiation exposure and harmonization of procedures for import/export of radioactive sources, which is scheduled to be available at the end of 2008. The Forum held a workshop to exchange regulatory experience in nuclear safety, and is considering a project related to life extension of NPPs. Synergies between the Forum and the Agency were further explored, including the dissemination of results of the Forum's projects to other Member States and making them available for application through the Agency's technical cooperation programme.

C.5. Cooperation Forum of State Nuclear Safety Authorities of Countries which operate WWER¹³ Reactors

The Forum conducts annual meetings where senior staff of regulatory bodies in countries that operate WWER reactors discuss regulatory and safety issues related to operation of WWERs. The 14th Annual Meeting of the Forum was conducted in July 2007 in Dubna, Russian Federation. The Forum members

¹³ Water cooled, water moderated power reactor

reported on their countries' recent changes in nuclear legislation; and exchanged information related to nuclear safety regulation, atomic energy utilization and operational events. Other topics discussed included the status of the Agency's safety standards revisions, the Agency's IRRS programme, and new developments in PSAs. The Forum working groups reported on activities completed since the previous annual meeting in the areas of digital instrumentation and control systems, evaluation of operating experience, and the regulatory use of PSA. The 15th Annual Meeting will be hosted by Ukraine in 2008.

C.6. Network of Regulators of Countries with Small Nuclear Programmes (NERS)¹⁴

The current membership of NERS includes Argentina, Belgium, Czech Republic, Finland, Hungary, Netherlands, Pakistan, Slovakia, Slovenia, South Africa and Switzerland. The Tenth Annual Meeting of NERS was held in Egmond aan Zee, the Netherlands from 7 to 8 June 2007 and the meeting agenda included the following items:

- Regulatory Body preparation for new build: maintenance and development of nuclear safety competences (including manpower management).
- Management of safety culture with a special view to the changing ownership structure of nuclear facilities.
- A round table of actual capacity of the regulatory body and how it is financed.

The Czech Republic will be the next chair of NERS, with the annual meeting to be held in Prague in June 2008.

C.7. The senior regulators from countries which operate CANDU-type nuclear power plants

The annual meeting of senior regulators of countries operating CANDU-type reactors (Argentina, Canada, China, India, Republic of Korea, Pakistan and Romania) was hosted by the Canadian Nuclear Safety Commission in Ottawa, Canada in November 2007. The issues discussed covered a large variety of topics, including: regulatory issues related to new pressurized heavy water reactor designs, plant and life extension; comparison of PSA practices, large Loss of Coolant Accident response and positive void coefficient; regulatory tools for independent verification of licensees' submissions; categorization of the CANDU safety issues using risk-informed decision-making process; recent developments and operational feedback from significant events; and reporting for the next review meeting of the Contracting Parties for the CNS.

C.8. The International Nuclear Event Scale (INES)

More than 60 Member States are currently members of the INES and use it to communicate the safety significance of events at the national level. Member States also used the INES to communicate on events that are rated at Level 2 or higher or that are of international media interest — through the Nuclear Event Web-based System (NEWS) — to the media, the public and to the international scientific community.

Currently, the INES covers a wide range of practices, including industrial uses such as radiography, uses of radiation sources in hospitals, operations at nuclear facilities, and transport of radioactive material. Since the publication of the INES Manual 2001 edition, there have been additional guidance

¹⁴ www.ners.info

and clarifications to the methodology. Therefore, the 51st regular session of the General Conference encouraged the Secretariat to continue its efforts in consolidating the INES procedures for rating nuclear and radiological events into a revised manual.

The Agency, jointly with the OECD/NEA and INES members, is undertaking a major revision of the INES manual. In 2007, the draft revised document was sent to INES National Officers for final comment. In the new manual, the underlying INES methodology has not changed. However, the criteria used for rating radioactive sources and transport events have been reviewed and consolidated according to additional guidance which was in pilot use for almost two years and then approved by IAEA Member States in 2006. The new Manual also incorporates other clarifications approved since the publication of the 2001 edition of the INES manual, such as the clarification on the rating of fuel damage events and includes more examples and uses terminology consistent with the various areas of application of INES.

D. 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.

D.1. United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR)

The United Nations General Assembly established UNSCEAR in 1955 to assess and report levels and effects of exposure to ionizing radiation. UNSCEAR's Programme of Work is approved by the General Assembly, and has extended typically over a 4–5 year period. The UNSCEAR Secretariat, which is provided through the United Nations Environment Programme (UNEP), engages specialists to analyse information, study relevant scientific literature and produce scientific reviews for scrutiny at UNSCEAR's annual sessions. At the end of the cycle, the United Nations publishes the substantive reports, which are recognized as authoritative scientific reviews and provide the scientific foundation for the International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources (BSS). UNSCEAR also reports annually to the General Assembly. The last publications of UNSCEAR were issued in the years 2000 and 2001.

UNSCEAR held its 55th session in Vienna from 21 to 25 May 2007. It considered documents related to: public and worker exposure; medical radiation exposures; exposures from radiation accidents; health effects due to radiation from the Chernobyl accident; and non-human biota. UNSCEAR expects that these documents will all receive final review and approval in 2008. The Committee also approved its annual report¹⁵ for consideration by the General Assembly.

¹⁵ *Official records of the General Assembly, Sixty-second Session, Supplement No. 46 (A/62/46)*, which can be downloaded from http://www.unscear.org/unscear/en/general_assembly_all.html.

UNSCEAR is developing a longer term strategic plan and proposal for its future programme of work for submission to the General Assembly in 2008. The strategic plan will act as a planning tool for future programme budgets, and will need to consider the context of UNSCEAR in the face of global challenges, such as increasing interest in the nuclear power option as a possible response to concerns regarding carbon emissions, and the fast pace of developments in biological science. It also needs to consider streamlining the future development of documents and to ensure their relevance, quality and rapid dissemination; modernizing the processes and mechanisms to conduct the work of UNSCEAR; optimizing the use of expertise between formal sessions; and improving coordination of data collection and dissemination with countries and other relevant organizations.

The next session of UNSCEAR is planned for 10 to 18 July 2008.

D.2. International Commission on Radiological Protection (ICRP)

The ICRP is an independent group of experts that issues recommendations on the principles of radiation protection. ICRP Recommendations have provided the basis for national and international standards including the BSS. Appointments to the ICRP and its Committees are made for periods of four years, and the current cycle began in July 2005. Five committees deal with radiation effects, doses from radiation exposure, protection in medicine, application of ICRP Recommendations, and protection of the environment.

At its meeting in Essen, Germany from 19 to 21 March 2007, the ICRP approved a new set of fundamental Recommendations on the protection of man and the environment against ionizing radiation. The new Recommendations take account of new biological and physical information and trends in the setting of radiation standards. While much more information is available now than in 1990, the overall estimate of the risk of various kinds of harmful effects after exposure to radiation remains fundamentally the same. The three basic principles of radiological protection are still justification of activities that could cause or affect radiation exposures, optimisation of protection in order to keep doses as low as reasonably achievable, and the use of dose limits. The new Recommendations feature an improved and streamlined presentation, give more emphasis to protection of the environment, and provide a platform for developing an updated strategy for handling emergency situations and situations of pre-existing radiation exposures. These Recommendations replace the ICRP's previous Recommendations from 1990.

In October 2007, the Secretariat participated in meetings of the ICRP Main Commission and committees dealing with: radiation effects; doses from radiation exposures; protection in medicine; applications of ICRP recommendations for protection of the population during nuclear or radiological emergencies, protection of population living in contaminated areas; and naturally occurring radioactive material (NORM).

D.3. International Commission on Radiation Units and Measurements (ICRU)

The ICRU, a sister organization of the ICRP, provides internationally acceptable recommendations concerning concepts, quantities, units, and measurement procedures for users of ionizing radiation in medicine, basic science, industry, and radiation protection. The current ICRU programme is focused on four areas:

- Diagnostic radiology and nuclear medicine;
- Radiation therapy;
- Radiation protection;
- Radiation in science.

D.4. International Nuclear Safety Group (INSAG)

The INSAG is a group of experts in the field of safety working in regulatory organizations, research and academic institutions and the nuclear industry. It was chartered by the Director General to be an independent body to provide authoritative advice and guidance on nuclear safety approaches, policies and principles. In particular, INSAG will provide recommendations and opinions on current and emerging nuclear safety issues to the Agency, the nuclear community and the public.

INSAG was reconstituted in 2007 as INSAG VII. In that connection, ten members continue from INSAG VI while seven members were newly appointed. A complete listing of INSAG members including a short biography is available on <http://www-ns.iaea.org/committees/insag.asp>.

INSAG met twice in 2007, including one meeting in Mumbai, India, and continued its discussions and preparation of reports on the topics of operational experience feedback, safety/security interface and infrastructure for nuclear safety.

For the second year in a row, an INSAG forum was conducted in conjunction with the regular session of the General Conference in September. It is anticipated that the INSAG forum will be a yearly feature of the General Conference. This year the subjects of the Forum — operational experience feedback and safety/security interface — were examined by a knowledgeable panel of experts who solicited audience participation in order to assist INSAG in preparing papers on the subjects.

INSAG Chairman Richard Meserve also issued his fourth ‘State of Nuclear Safety’ letter to the Director General. The letter was distributed along with other high level correspondence as part of the General Conference. The letter is available on the INSAG website.

E. Activities of other international organizations

E.1. Institutions of the European Union

The High Level Group on Nuclear Safety and Waste Management was established by the European Commission Decision of 17 July 2007 (2007/530/Euratom) to assist the EU institutions in progressively developing common understanding and eventually additional European rules in the fields of the safety of nuclear installations and the safety of the management of spent fuel and radioactive waste. The Group may set up working groups or subgroups to study specific subjects and submit a report of its activities to the European Commission, the European Parliament and the Council of the European Union every two years. The Group comprises senior officials from national regulatory or nuclear safety authorities from the 27 Member States. The first meeting of the Group, held on 12 October 2007, was opened by the EU Energy Commissioner, followed by discussions on the working method and the purpose of the Group. The members will develop more detailed proposals at the next meeting. In principle, the Group will convene several times a year to discuss and follow up the agreed work programme.

The European Community supports nuclear safety-related research through the Framework Programme of the European Atomic Energy Community (Euratom). Euratom’s Seventh Research Framework Programme (2007–2011) was launched in 2007, with a budget of around 2750 million euros. Just under one-third of this is earmarked for research in the field of nuclear fission, to be carried out either by means of a programme of indirect actions or by the Joint Research Center, focusing on

the safe exploitation and development of fission reactor systems, the management of radioactive waste, radiation protection and safety and security related to non-proliferation.

On 21 September 2007, the European Commission launched the Sustainable Nuclear Energy Technology Platform (SNE-TP). Its scope includes nuclear installation safety and nuclear systems including partitioning and transmutation and the fuel cycle, related research infrastructures and human resources. It is built around three pillars: the safety of current generations of light-water reactors; the development of the next generation fast reactors with closed fuel cycles and full actinide recycling; very-high temperature reactors for the co-generation of both electricity and process heat for industrial applications.

Since 1 January 2007, external cooperation on nuclear safety, as well as on physical protection and safeguards, is mainly financed through the new Instrument for Nuclear Safety Cooperation. The Council Regulation no. 300/2007 establishes a framework for the financial assistance provided by the Community to support the promotion of a high level of nuclear safety, radiation protection and the application of efficient and effective safeguards of nuclear material in third countries, covering the period 2007-2013. The Community assistance granted through this instrument is complementary to any other assistance provided under other EU instruments.

The measures that will be supported are related to the following main fields:

- The promotion of an effective nuclear safety culture at all levels;
- The promotion of effective regulatory frameworks, procedures and systems to ensure adequate protection against ionising radiations from radioactive materials;
- The establishment of the necessary regulatory framework and methodologies for the implementation of nuclear safeguards;
- The establishment of effective arrangements for the prevention of accidents with radiological consequences as well as the mitigation of such consequences should they occur, and for emergency-planning, preparedness and response, civil protection and rehabilitation measures;
- The promotion of international cooperation in the above fields, including in the framework of the IAEA.

E.2. Nuclear Energy Agency of the Organisation for Economic Co-operation and Development (OECD/NEA)

The Nuclear Energy Agency 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. It operates mainly through a number of committees covering specific areas.

The Steering Committee for Nuclear Energy adopted a statement on the need for qualified human resources in the nuclear field. This statement, available on the OECD/NEA website¹⁶, reflects the concerns about the difficulties nuclear institutions in many OECD/NEA member countries are experiencing in recruiting qualified specialists.

In 2007, the Committee on Nuclear Regulatory Activities (CNRA) group of senior regulators started preparing a report which will present the main elements that a regulator should address to ensure nuclear safety. The primary focus of this report is to underline the responsibilities and activities of the

¹⁶ <http://www.nea.fr/html/general/press/2007/2007-05.html>

regulator to promote and ensure safety based on an integrated evaluation, to balance it against stakeholder expectations, to address regulatory interaction with licensees, and finally how to communicate the results. The discussion at the OECD/NEA Regulatory Forum (Forum on Assuring Nuclear Safety 2007, Paris, France, 12 to 13 June 2007), bringing together many top regulators, industry managers and safety research leaders to address the needs and challenges of a changing environment for nuclear energy, will also be reflected in the CNRA report.

Stage 2 of the Multinational Design Evaluation Programme (MDEP) continued to progress and will meet the deadline of completing the feasibility phase early in 2008. The MDEP Policy Group invited the OECD/NEA to act as the technical secretariat for this initiative and agreed to launch two pilot projects on the 'Licensing Basis and Scope of Design Safety Review' and 'Component Manufacturing Oversight'.

The OECD/NEA is currently running 16 joint projects on nuclear safety research, including two new multilateral projects, THAI¹⁷ and BIP¹⁸, for 2007.

Regarding fuel cycle facilities, the Committee on the Safety of Nuclear Installations (CSNI) organised an international workshop in October 2007 in Wilmington, North Carolina, USA. The workshop addressed how to ensure the safety of current and new fuel cycle facilities, discussing potential future issues based on the preliminary results of the CSNI survey on fuel cycle safety, such as fire, human factors and ageing.

On the occasion of the 50th anniversary of the Committee on Radiation Protection and Public Health (CRPPH), a special session 'Radiation Protection in Today's World: Moving Forward Together' was held on 31 May 2007. There was broad agreement on the radiation protection challenges, including: increasing relevance of balancing local, national and international needs when making decisions; the need to take new approaches to applying the precautionary principle to worker and public protection; the need to specifically consider application of the radiation protection system to particular applications (decommissioning, discharges, expansion of medical use of radiation, emergencies and malevolent acts); and knowledge management. Presentations by regulatory authorities and international organisations identified the issues of: the central role of stakeholder involvement in decision making; the importance of preparing to address radiation protection issues that could arise from the possibly extensive new build of nuclear reactors; and the need for strong and consistent international support for coherent application of radiation protection standards (in particular the new ICRP recommendations and their consistent application in the revised BSS through a collaborative partnership of all co-sponsoring organizations). Participants agreed on the importance of addressing the radiological protection of the environment in an internationally coherent fashion, on the need to address radiation protection issues in waste and transportation, and the need for increased attention and funding for R&D activities.

The current CRPPH programme of work, approved by the Committee at its May 2007 meeting, includes several new or extended expert groups. One extended group (Expert Group on Best Available Techniques) will continue its work on issues surrounding new build, notably investigating best available techniques for abatement of discharges, and is expected to continue its activities over the next three years with input from regulatory authorities and industry. This work, together with input from the new Expert Group on Occupational Exposures, will nurture discussions on radiological protection objectives that could be used by designers and operators of nuclear power plants in terms of

¹⁷ The Thermal-hydraulics of Hydrogen, Aerosols and Iodine Project

¹⁸ Behaviour of Iodine Project

new build, and that could also be used as expectation values by regulatory authorities assessing new license applications.

In addition, a new expert group, the Expert Group on Stakeholder Involvement and Organisational Structures, has been established to examine organisational challenges arising from increased engagement of stakeholders, building on last year's scoping study which concluded that engagement of stakeholders has become common practice.

The CRPPH continues its programmes in the areas of emergency management and occupational exposure. Its Working Party on Nuclear Emergency Matters, based on experience from the 2006 INEX 3 exercise, has created two new expert groups to study the areas of recovery efforts, mostly in the intermediate and later phases of an emergency situation, and decision making, again mostly in the later phases and involving input from affected stakeholders. Also, the Working Party is collaborating with the Nuclear Law Committee to identify areas for information exchange and common work to address the interfaces between emergency management and nuclear liability.

In 2001, the Radioactive Waste Management Committee (RWMC) issued the document entitled, *Reversibility and Retrievability in Geologic Disposal of Radioactive Waste*. In light of current interest in the topic, RWMC has decided to revise the document and a working group has been formed. The RWMC Forum on Stakeholder Confidence released three major reports in 2007. The first: *Fostering a Durable Relationship between a Waste Management Facility and Its Host Community*, notes that the societal durability of an agreed solution is essential for the success of any long-term radioactive waste management project. A second report: *Stakeholder Involvement in Decommissioning Nuclear Facilities* reviews stakeholder concerns and best practice in addressing them. The lessons learnt can contribute to better foresight in siting and building new facilities. Finally, the report *Cultural and Organisational Changes in RWM Organisations* provides insight on the different environments in which waste management organizations work.

E.3. World Association of Nuclear Operators (WANO)

Every organization in the world that operates an NPP is a member of WANO. This association has been set up to help its members achieve the highest practicable levels of operational safety by giving them access to the wealth of operating experience from the world-wide nuclear community. WANO is non profit making and has no commercial ties. It is not a regulatory body and has no direct association with governments.

In 2007, WANO conducted peer reviews at 43 NPPs, bringing the total number of peer reviews to 357 since the programme began in 1992. WANO's long-term goal is to conduct a WANO peer review of member nuclear stations such that each nuclear unit is reviewed at least once per six years, either as an individual unit or as part of a peer review that includes other units at a station. In addition, each station is encouraged to host an outside review at least every three years (allowing a WANO peer review to count as an outside review.) An outside review includes OSARTs, WANO follow-up peer reviews, national organizational reviews such as Institute of Nuclear Power Operations (INPO) and Japan Nuclear Technology Institute (JANTI) reviews.

WANO continues to emphasize technical support missions, which focus on providing assistance in selected areas, with more than 150 technical support missions undertaken during 2007.

A central operating experience team with representatives from all four WANO regional centres continues to develop operating experience products and information for members. This team produces Significant Event Reports, Significant Operating Experience Reports, and Hot Topics to keep members informed of important events and trends occurring in the industry. In addition, WANO

maintains a "Just-in-time" operating experience database that gives plant staff access to relevant operating experience immediately prior to undertaking specific operations and maintenance activities.

WANO held its Biennial General Meeting (BGM) in Chicago, USA from 24 to 25 September 2007. Every two years, senior nuclear utility executives and representatives from WANO members meet at the BGM to review progress and provide guidance for the future aims and objectives of WANO. The theme of the 2007 BGM was "Closing the gap – turning today's promise into tomorrow's reality".

F. Safety legislation and regulations

In 2007, many Member States either passed or updated their nuclear safety legislation and/or regulations. Examples of this, which were reported during meetings of the Commission on Safety Standards in 2007, include:

- In July 2007, the National Institute of Radiation Protection of Denmark issued Order No. 985 on sealed sources. The Order implements EU Directive 2003/122/EURATOM of 22 December 2003 on the control of high-activity sealed radioactive sources and orphan sources and the Agency's Code of Conduct on the Safety and Security of Radioactive Sources and its supplementary Guidance on the Import and Export of Radioactive Sources. In addition to requirements for safety, the order also specifies security requirements based on Agency guidance.
- In Switzerland, the nuclear safety inspectorate (HSK) is part of the Swiss Federal Office of Energy (SFOE), although at a technical level it acts independently from the rest of the Office. To achieve formal independence of the HSK from the SFOE, a new Federal Nuclear Safety Inspectorate Act (ENSIG) was developed. Under ENSIG, the Swiss supervisory authorities (the Inspectorate and the Section for Protection Against Sabotage of Nuclear Installations, which was attached to the SFOE) will be separated from the SFOE and converted to a single institution with formal, institutional and financial independence. The new law was discussed in parliament and approved by both chambers on 22 June 2007. After a three month period for a referendum had passed without objection, the law was approved by the Swiss Federal Council on 17 October 2007. At the same time, six members of the board of the Swiss Federal Nuclear Safety Inspectorate (ENSI) were elected by the Council. The board will take up its duties on 1 January 2008, whereas the Inspectorate will become formally independent of SFOE on 1 January 2009, when the name will change from HSK to ENSI.

G. Safety significant conferences in 2007

G.1. International Symposium on the Safety Cases for Deep Disposal of Radioactive Waste – Where Do We Stand?

The OECD/NEA and the Agency organized this international symposium, which was held from 23 to 25 January 2007 in Paris, France. There is increasing interest in international harmonization of approaches to structuring and presenting safety cases and their review by regulatory authorities. The meeting clearly agreed that an internationally harmonized approach would be beneficial and that achieving broader societal acceptance was considerably handicapped by the variation of national requirements.

G.2. Fifth International Symposium on Naturally Occurring Radioactive Material (NORM V)

This international symposium was organized by the University of Seville and held from 19 to 22 March 2007 in Seville, Spain. It followed, as a natural continuation, four previous symposia dealing with exposure to natural sources of radiation, held in Amsterdam, the Netherlands (1997), Krefeld, Germany (1998), Brussels, Belgium (2001) and Szczyrk, Poland (2004) respectively. Special attention was devoted to the following NORM topics:

- Thorium and its industrial applications;
- Processing and use of zircon and zirconia;
- Production of titanium dioxide;
- Monazite and the extraction of rare earths;
- Extraction, processing and use of phosphate minerals;
- Scrap recycling and waste management.

G.3. Workshop on the Agency’s Integrated Regulatory Review Service

The French Nuclear Safety Authority (ASN), in cooperation with the Agency, hosted a workshop on the IRRS from 22 to 23 March 2007 in Paris, France, with the participation of governmental and regulatory authorities from Member States. In addition to informing governmental and regulatory authorities about the IRRS, participants reviewed lessons learned to date and identified ways in which the IRRS can be improved, including the establishment of a network of experts from nuclear regulatory authorities.

G.4. Special Symposium for Agency’s 50th Anniversary: “Global Challenges for the Future of Nuclear Energy and the IAEA”

Hosted by the Japan Atomic Industrial Forum on the occasion of its 40th annual conference, this one-day Symposium held on 11 April 2007 was exclusively dedicated to the review of the Agency’s 50 year history and activities and to assess the current status of the nuclear sector in the world. Topics addressed during the event included nuclear power generation and fuel cycle, nuclear safety and security, non-proliferation and future challenges for the Agency.

In addition to noting how the Agency has responded to challenges in the past, the symposium participants also looked at the challenges the Agency will face in the future and noted that safety must

remain the highest priority. It was also noted that new entrants must establish an infrastructure that provides the capability to build, operate and decommission NPPs safely and that the challenge of disposing of radioactive waste remains. Participants also noted that knowledge management will be ever more important in the years to come and that all of these challenges must be addressed in a transparent and open manner, with international cooperation at the forefront.

G.5. International Conference on Environmental Radioactivity: From Measurements and Assessment to Regulation

The Agency, in cooperation with UNSCEAR, organized this Conference, which was held in Vienna, Austria, from 23 to 27 April 2007. The Conference title ‘From Measurements and Assessments to Regulation’ reflects the broad scope of the subject area and the interests of some widely different disciplines, including regulation, assessment, monitoring, sampling and measurement. In the context of controlling the exposure of humans due to radioactivity in the environment, each of these disciplines is involved and interlinked. The conference sought to address all of these aspects and the inter-linkages between them.

G.6. International Conference on the Challenges Faced by Technical and Scientific Support Organizations in Enhancing Nuclear Safety

This Conference was hosted by the Government of France in Aix-en-Provence from 23 to 27 April 2007. Technical and Scientific Support Organizations (TSOs), whether part of a regulatory body or a separate organization, are gaining increased importance in providing the technical and scientific basis for decisions and activities regarding nuclear and radiation safety. International organizations such as the Agency and OECD/NEA also rely on the active contribution of TSOs. The Conference provided TSOs from different countries and other organizations and experts the opportunity to discuss and develop a common understanding of the TSO’s responsibilities, needs, and opportunities.

The Conference concluded that TSOs are playing an important role in the safe and secure use of nuclear energy and associated technologies both at present and in the future and made a number of recommendations. These include, inter alia, that the Agency should facilitate the establishment of new or enhancement of existing networks on regional, international or topical bases between TSOs and other relevant bodies and that the Agency should consider developing peer review and self assessment approaches for the benefit of TSOs in enhancing nuclear safety.

G.7. International Conference on Knowledge Management in Nuclear Facilities

This Conference was held in Vienna, Austria from 18 to 21 June 2007, with a total of 212 participants and 20 observers from 42 Member States and ten international organizations attending. The objectives of the Conference were to take stock of the recent developments in nuclear knowledge management, to demonstrate and discuss the benefits of nuclear knowledge management in promoting excellence in operation and safety of nuclear facilities, to promote the use of nuclear knowledge management in the nuclear industry, and to provide insights and recommendations to the nuclear community. The Conference built upon the International Conference on Nuclear Knowledge Management — Strategies, Information Management and Human Resources Development held in 2004 in France.

Conference participants noted that nuclear knowledge management can, inter alia, contribute to maintaining the core knowledge that must be in place to operate existing facilities safely and help assure the smooth and effective transfer of knowledge from the current generation to the next. It was also noted that many key nuclear organizations, including regulatory authorities, utilities, research and

development organizations and vendors, have introduced and apply knowledge management as a corporate management approach with top-level commitment. At the strategic level, knowledge has emerged as a key resource and many organizations now have formal policies on knowledge management. These policies often include human resource management, information management and process management aspects.

The main recommendation of the conference is that nuclear knowledge management should become an integral part of all nuclear activities at the project, corporate and national level. The Conference also recommended that the Agency remain the global forum for advancing the use of nuclear knowledge management, continue to develop and provide guidance and assist in self assessments and programme development, and extend nuclear knowledge management activities to regulatory bodies and TSOs.

G.8. Open-ended Meeting of Technical and Legal Experts for Sharing of Information as to States' Implementation of the Code of Conduct on the Safety and Security of Radioactive Sources and its supplementary Guidance on the Import and Export of Radioactive Sources

The Agency organized this meeting, which was held from 25 to 29 June 2007 in Vienna, Austria. The objective of the meeting was to promote a wide exchange of information on national implementation of the Code and the Guidance. In line with the non-legally binding nature of the Code and the Guidance, participation and presentation of papers was on a voluntary basis. The meeting was open to all Member and non-Member States, whether or not they had made a political commitment to the Code and/or to the Guidance. The meeting was attended by 122 experts from 70 Member States, two non-Member States, and observers from the European Commission, the Organization for Security and Co-operation in Europe (OSCE) and the Food and Agriculture Organization (FAO). Canada and the USA provided extrabudgetary funding to specifically support the participation of experts from States that otherwise could not have attended the meeting. Experts from 53 States presented papers on their experiences in implementing the Code and the Guidance. A number of conclusions were reached which are summarized in the Chair report¹⁹. The second such international meeting will be held from 26 to 28 May 2008.

G.9. Fourth Meeting of Competent Authorities Identified Under the Early Notification and Assistance Conventions

From 10 to 13 July 2007, the Competent Authorities met in Vienna for their 4th meeting, with 96 participants from 56 Member States and three international organizations in attendance. At the meeting, Competent Authorities recognized the quality and thoroughness of two work groups²⁰ findings and agreed that their recommendations represent a sound basis for enhancing international communications and assistance.

¹⁹ http://www.iaea.org/About/Policy/GC/GC51Documents/English/gc51-3att1_en.pdf

²⁰ Work Group on International Communications and the Work Group on International Assistance of the International Action Plan for Strengthening International Preparedness and Response Systems for Nuclear and Radiological Emergencies

G.10. Regional Workshop on Denials and Delays of Shipment of Radioactive Material

From 12 to 13 July 2007, the Agency held a regional workshop on denials and delays of shipment of radioactive material in Montevideo, Uruguay. There was consensus from the 16 countries attending on the need for dissemination of accurate information on the transport of radioactive material. Communication among authorities, both at the national and regional level, needs to be improved. A number of reported instances of denials and delays could have been avoided if an efficient communication system in the region existed. Future actions include a tailored education and training programme for front line personnel (cargo handlers, customs, shipping agents, carriers) and the engagement of national regulatory bodies, other authorities and transport organizations.

G.11. International Workshop on Defence in Depth Aspects in Electrical Systems of Importance for Safety

This Workshop was hosted by the Swedish Nuclear Power Inspectorate (SKI) and was held from 5 to 7 September 2007 in Stockholm. The Workshop provided an opportunity for experts from industry and regulatory organisations to discuss events having occurred to electrical power supply systems, to exchange experience and to identify approaches to prevent or mitigate the consequences.

G.12. Geological Repositories: A Common Objective, a Variety of Paths

This Conference was organized by the International Association for Environmentally Safe Disposal of Radioactive Materials (EDRAM) and held from 15 to 17 October 2007 in Berne, Switzerland. There was consensus at an international level that disposal of high level radioactive waste in a deep geological repository offers the required long-term safety and security. A sound technical basis for implementing such repositories has already been established and effort needs to be invested now in discussing the way forward, as well as how the technical flexibility of the geological disposal concept can be used to help in meeting social and political requirements and expectations.

G.13. International Workshop on Harmonization of Approaches to Assuring Safety within National Radioactive Waste Management Policies and Strategies - A Common Framework for the Safety of Radioactive Waste Management and Disposal

The Agency organized this workshop, which was hosted by the Government of South Africa and held from 2 to 6 July 2007 in Cape Town, to assist in the establishment of comprehensive national radioactive waste management policies and implementing strategies that will ensure that all radioactive waste is appropriately managed and that a safe solution can be found for the disposal of all types of radioactive waste.

G.14. Technical Meeting on Remediation and Long Term Management of Radioactive Waste after Accidental Radioactive Releases to the Environment - the 20th Anniversary of the Goiânia Accident

The Agency, in cooperation with the Brazilian National Nuclear Energy Commission and the Spanish Nuclear Safety Council, held this technical meeting in Santos, Brazil from 3 to 5 October 2007. The long term consequences of different accidents were addressed, such as environmental impacts and management of radioactive waste arising from remediation actions. In the intervening two decades

since a series of accidents released radioactivity to the environment, much has been learned about management of the long term consequences of such accidents.

G.15. Technical Meeting on the Effective Management of Safety of Reactivity Control during Power Change and Shutdown in NPPs

This meeting, hosted the Nuclear and Industrial Safety Agency of Japan (NISA) and the Japan Nuclear Safety Organization (JNES), was held from 3 to 5 October in Tokyo. More than 80 participants, representing NPP operators, regulators and TSOs from 12 Member States and three international organizations, discussed reporting of events and incidents, technical issues, regulatory aspects and management of safety and leadership.

G.16. International Symposium on Extending the Operational Lifespan of Nuclear Plants

The Agency, in cooperation with the China Atomic Energy Authority and the China National Nuclear Corporation, organized this international symposium, held in Shanghai from 15 to 18 October 2007. With proper management, vigilance and safety enhancements, nuclear power plants can operate beyond their typical design lifespan of 30 to 40 years. Extending the operational life span of nuclear power plants is commonly referred to in the industry as plant life management or PLiM. This issue has gained increased attention over the past decade from regulators and operators alike.

The symposium focused on topical issues affecting PLiM and provided a forum for information exchange on national and international policies, regulatory practices and safety culture; demonstrated effective strategies, including applications in an ageing management and PLiM programme; provided key elements and good practices related to the safety aspects of ageing, ageing management and long term operation; identified the progress made in ageing management and PLiM processes since the first international symposium; and assisted Member States further develop their PLiM programmes based on the latest technology available.

G.17. International Conference on Research Reactors: Safe Management and Effective Utilization

This conference was hosted by the Government of Australia and held from 5 to 9 November 2007 in Sydney. The conference focused on sharing of the latest scientific and technical information, including projects on design, construction and commissioning of new research reactor facilities. The conference fostered the exchange of information on current research reactors and provided a forum for reactor operators, designers, managers, users and regulators to share experience, exchange opinions and discuss options and priorities. A number of significant issues, primarily related to safety and security, operation and utilization, the fuel cycle, decommissioning and waste management, were also addressed.

G.18. Technical Meeting on the Risk Informed Decision Making Process

The Agency hosted this technical meeting in Vienna from 26 to 30 November 2007, with 21 delegates from 13 Member States plus the European Union attending. The meeting provided an opportunity for experts from industry and regulatory bodies to discuss the risk informed decision making process focusing on the key elements: defence-in-depth; safety margins; risk information; performance monitoring; and regulation.

H. Safety significant events in 2007

Through the various reporting mechanisms, the Agency was informed of 140 situations involving or suspected of involving ionizing radiation. In all cases, the Agency took actions, such as authenticating and verifying information, providing official information or assistance to the requesting party, or offering the Agency's good offices. Most of the situations were found to have no safety significance and/or no radiological impact to people or the environment.

The Nuclear Events Web Based System (NEWS) is a joint project of the Agency, OECD/NEA and WANO that provides fast, flexible and authoritative information on the occurrence of nuclear events that are of interest to the international community. NEWS covers all significant events at NPPs, research reactors, nuclear fuel cycle facilities, as well as occurrences involving radiation sources and the transport of radioactive material. The general public can access information submitted during the previous six months through the Agency's website²¹.

The Incident Reporting System (IRS), operated jointly with the OECD/NEA, was set up in 1983 to exchange information on unusual events at NPPs and increase awareness of actual and potential safety problems. Since 2006, Web-based IRS has facilitated data input and report availability. As a consequence, the number of reports has increased and the dissemination delays have reduced. Activities within the IRS extend beyond the exchange of IRS reports. The Agency and the OECD/NEA have meetings and working groups of experts who meet regularly and discuss the safety relevance of events.

The 2007 joint Agency – OECD/NEA meeting of the IRS national coordinators discussed corrective actions and lessons learned from 22 recent events which occurred in NPPs. Two events were discussed in detail:

- *Dampierre 3, France (Pressurized Water Reactor): (2007-04-09)* A relay failure led to the loss of the two 6.6kV emergency switchboards on train A. Protective and safeguard auxiliaries could only be power supplied from the 6.6kV switchboard on train B. During this incident, the initial situation was made worse by another fault, this time on a turbine trip breaker, causing the line breaker to open, disconnecting unit 3 from the 400 kV main offsite power line. In addition, the instrumentation and control device used to switch over to the auxiliary power supply had been cut, in accordance with the required operating procedures in the event of this type of incident. The loss of offsite power led to a reactor scram, reactor coolant pump shutdown and the automatic start up of the emergency diesel generator on train B.

It has been established that the loss of the 6.6 kV emergency switchboard on train A was caused by a malfunction on an overcurrent relay. Although the conditions triggering the on-site emergency plan had not been reached, the plan was implemented as a preventive measure, thereby ensuring effective technical dialogue between the operator, the TSO and the nuclear safety authority. Offsite power was restored in the morning on 10 April, providing better conditions for bringing the reactor unit to a safe state. Investigations and studies are still underway to determine the exact cause of the failures observed during the incident. Incidents involving electrical switchboard failures have highlighted the complexity of the situations that may arise in connection with such incidents and the difficulties of managing these situations using current

²¹ <http://www-ns.iaea.org/news/default.asp>

applicable procedures.

An INES rating has not been assigned to this event.

- *Kashiwazaki-Kariwa, Japan, (Boiling Water and Advanced Boiling Water Reactors):* (2007-07-16) At 10:13 a.m. local time, a strong earthquake measuring 6.8 on the Richter scale struck Chuetsu area in Japan, with the epicentre approximately 9 kilometres from the NPP. Units 2, 3, 4 and 7 shut down automatically as designed. Unit 2 was under start up operation when the reactor was shut down. Unit 1, 5 and 6 were already shutdown for maintenance when the earthquake occurred. The maximum acceleration observed at the station was 680 gals. The designed acceleration at the observation point is 273 gals. At Unit 2, the maximum acceleration recorded was 3.6 times the value anticipated in the design stage (observation: 606 gal; design value: 167 gal). At 10:15, plant operators identified smoke coming from the station transformer at Unit 3. The Fire Department extinguished the fire at 12:10. Water in the Unit 6 spent fuel pool sloshed around and some leaked into non radiation controlled areas on the third floor and mezzanine. An estimated 1.2 cubic metres of water containing ~90 000 Bq radioactivity in total was discharged to the sea. Ducts connected to the main exhaust stacks in Units 1 to 5 were displaced, but this has not resulted in changes to releases from the plant. The entire 5th basement floor of the Reactor Combination Building at Unit 1 (controlled area) was flooded with water measuring 48 centimetres deep, with minute traces (~6 Bq/ml) of radioactive materials, caused by earthquake damage to the outdoor piping of the fire protection system. The basement floors of the Reactor Combination Building do not contain structures, systems or components important for reactor safety. From the perspective of ensuring public safety and security, the following measures are being implemented in all Japanese NPPs:
 - Enhance the in-house fire-fighting system;
 - Build a swift and strict accident reporting mechanism;
 - Confirm facilities' seismic safety with priority on public safety.An INES rating of 0 has been assigned to this event.

Other events of interest that were reported to the Agency include:

- *SGS Tecnos SA, Spain (radiography):* (2007-10-22) an event resulting in the overexposure of one radiographer. The event occurred in an enclosure industrial radiography installation during the preparation of the radiography exposures. The event involved a gammagraphy device with a 2 TBq (55 Ci) Co-60 source. The interlock access control system to the room was broken so there were two fixed radiological survey instruments with visual alarm inside the room to check the radiation levels during operation. The worker carried a thermoluminescent personal dosimeter as well as a direct reading dosimeter with an acoustic alarm and a radiometer, but these monitoring systems had been failing occasionally. The operator did not realise the visual warning signals from the fixed instruments and remained inside the room for 10 -15 minutes while the source was exposed. The dose recorded by the thermoluminescent personal dosimeter was 718 mSv. On October 29 the worker was submitted to a medical review following the national standard guidance for accidentally exposed individuals as well as dosimetry by chromosome aberration analysis. An INES rating of level 3 has been assigned to this event.
- *OPAL Research Reactor, Australia:* (2007-07-24) During a routine core video inspection at the end of the operating programme, the team discovered three plates of three different fuel assemblies being displaced from their nominal positions by some 25mm, 250mm and 400mm respectively. No release of

- fission products was detected. An INES rating of level 2 has been assigned to this event.
- *Georges François Leclerc Radiation Therapy Centre, France: (2007-06-15)* This event occurred during the treatment of a patient in radiation therapy. The irradiation of the patient was started while a radiation therapist was still in the treatment room. The irradiation was stopped after around ten seconds, resulting in an effective dose to the therapist of about 30 mSv, exceeding the annual regulatory dose limit of 20 mSv for a worker. No health effects are expected for the worker. The French regulatory authority conducted a reactive inspection and determined that the event was caused by human errors and a lack of procedures. The centre has taken immediate corrective organisational measures and committed itself to perform an in-depth risk identification analysis. This event has been assigned an INES rating of level 2.
 - *University Hospital Ghent, Belgium: (2005-12-29 to 2006-09-22)* In March 2007, the Belgian Federal Agency for Nuclear Control (FANC) was informed of a problem in applied radiotherapy. Upon investigation, a misalignment of 13 mm between the reference point of the CT localization box and the reference point of the linear accelerator caused the dose to be administered incorrectly for 17 patients undergoing stereotactic radiosurgery. To date, none of the patients has shown clinical symptoms that are, or that even can probably be, attributed to the misalignment. Every identified patient has been followed up medically. An INES rating has not been assigned to this event.

I. Safety Networks

I.1. Asian Nuclear Safety Network (ANSN)

During 2007, the ANSN continued to develop with hubs in China, Japan and Republic of Korea and national centres in Indonesia, Malaysia, Philippines, Thailand and Vietnam. Australia, France, Germany, Japan, Republic of Korea and the USA provide in-kind and/or financial support in the frame of the Extrabudgetary Programme on the Safety of Nuclear Installations in South East Asia, Pacific and Far East Countries (EBP).

The ANSN Steering Committee, chaired by Australia, met twice in 2007 to coordinate ANSN development and work of the topical groups.

At the review meeting of the EBP, held in December 2007, results of 2007 activities were discussed and the work programme for 2008 was finalized. It was also decided to combine the review meeting and the meeting of the Steering Committee of the ANSN into one single annual meeting starting in 2008.

The ANSN has now reached maturity as a technical network for pooling and sharing nuclear safety knowledge. Considering the rapid expansion of nuclear power programmes, notably in China, and the interest of other countries in the region to embark on nuclear power programmes, the ANSN is expected to play an increasingly important role as a regional forum for senior decision makers to share strategies and experience to enhance nuclear safety. This role will be further explored in 2008.

The role of the topical groups is increasing, in particular for the management of regional activities, the creation of new knowledge to be shared in the ANSN, and the consolidation of existing knowledge. The new topical group on safety management of research reactors was activated in 2007.

The Agency's ANSN website developed considerably in 2007 with the upload of the material of past EBP activities.

During a Consultancy Meeting in March 2007 in Vienna, a new Integrated Safety Evaluation (ISE) process was approved. The scope of this self-evaluation process has been expanded to include new topics such as emergency preparedness and radioactive waste management. The first two steps of the process are available electronically on the Agency's ANSN website and was successfully used by the participating countries at the end of 2007.

To increase the ANSN outreach, the bi-weekly ANSN Newsletter is being widely distributed worldwide. In 2007, a promotional meeting (Caravan) was conducted in Vietnam to introduce the ANSN to those its scientific communities.

Increasing cooperation with the Forum of Nuclear Cooperation in Asia (FNCA) and Regional Cooperation Agreement (RCA) took place in 2007. It was also decided to inform the Association of Southeast Asian Nations (ASEAN) of ANSN activities and to look into the possibility of seeking participation in the nuclear safety related activities of that organisation.

I.2. Ibero-American Nuclear and Radiation Safety Network

In 2007, the Ibero-American Forum of Nuclear and Radiological Regulators agreed that the Ibero-American Nuclear and Radiation Safety Network would be hosted in Brazil. Installation of the server in Brazil has started and will be fully implemented in 2008.

The Network contains technical knowledge of regulatory interest in areas such as radiological protection of patients, safety of radioactive sources, national and Agency safety standards, national legislation and education and training. The Network is populated with resources provided by participating countries. Resources are classified and uploaded according to an agreed taxonomy that allows efficient interrogation and retrieval by registered users.

The Network also provides a working environment for implementing specific projects (see section C.4 of this Appendix). Project working group spaces provide participants with common access to drafts and results and meeting reports, as well as teleconferencing facilities.

J. The evolution of the uranium market and its consequences on Agency Programme L²²

J.1. Current situation

The world energy demand is increasing and as a consequence the place of nuclear powered electricity generation has been reconsidered as a significant part of the solution to mitigate the effects of climate change while maintaining a sustainable economic development.

²² More information on Agency activities concerning the front-end of the fuel cycle is available in relevant sections of the latest IAEA Annual Report (<http://www.iaea.org/Publications/Reports/Anrep2006/>) and at <http://www.iaea.org/OurWork/ST/NE/NEFW/index.html>.

The anticipated expansion of the nuclear power industry has sparked off a very rapid expansion of the market in uranium, the fuel source for the nuclear industry. One result is that interest in uranium mining world-wide is increasing at an astounding rate. The 2007 demand for uranium was 69 110 tonnes compared to 66 500 tonnes in 2006, but mine production in 2006 was only approximately 60% of this at 39 600 tonnes²³. The immediate consequence has been a rapid increase in the price of uranium in the spot market. Figure 1 shows how spot prices of U₃O₈ have risen rapidly in the past two years after more than 20 years of depression. Outside short term variations related to market speculation, the trend of the contract price is still upwards steadily from \$20-25 per pound of U₃O₈ for sales in 2007 to current contract prices of \$60+ for future sales.

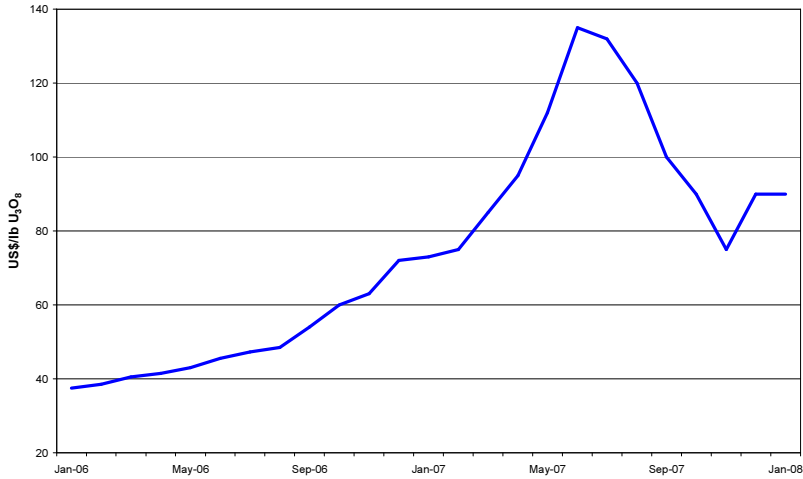


Figure 1: evolution of US\$/lb U₃O₈ in 2006-2007²⁴

The economic situation will remain buoyant as the demand for fuel for nuclear power plants seems likely to rise steadily as shown in the Figure 2 below. Even at the low end of the projections the demand for uranium will far exceed current production and will require new mining and processing facilities.

²³ These figures are based on the forthcoming OECD/NEA-IAEA ‘Red Book’ (OECD NUCLEAR ENERGY AGENCY-INTERNATIONAL ATOMIC ENERGY AGENCY, Uranium – 2007: Resources, Production and Demand, OECD, Paris (2007))

²⁴ http://www.uxc.com/review/uxc_Prices.aspx

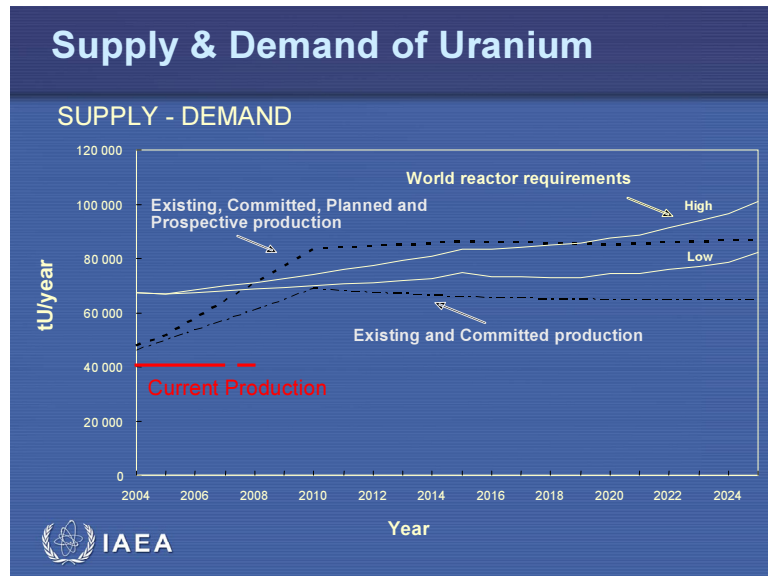


Figure 2: Projection of forward supply and demand for uranium

The time taken to find and develop new uranium resources has also been lengthening and is typically around 20 years. The rate of expenditure on uranium exploration has been low for many years. The first wholly new uranium mine since 1986 was opened only late in 2006 in Namibia. With the increasing uranium price, uranium exploration is increasing exponentially. New countries predominantly receive the attention of junior mining companies, whilst the major mining houses tend to look more closely at the assets and licence areas they already control. With such long lead times for major deposits, the development of many smaller deposits is likely to be where the industry will concentrate its efforts. Such deposits are often in Member States with little or no previous mining history, let alone uranium mining experience.

In this market atmosphere the number of smaller mining companies interested in uranium has grown rapidly. In both Australia and Canada, the two leading producer countries, the number of companies expressing an interest in uranium mining has gone from 20 or less in 2004 to over 240 in each country in 2007.

For the past 20 years, the expenditure of the uranium mining industry was low and there were many legacy sites from earlier days requiring remediation that were not given proper attention. For example, in the early 1990's, there was a sudden cessation of much of the uranium mining in the newly independent states of Central Asia. The Agency has been working for many years to help the affected Member States to restore their regulatory infrastructures and upgrade their skills and abilities to prepare for the remediation of these legacies once funding could be made available from multilateral donors. There have both been regional and national projects under the technical cooperation programme since 2004 addressing these issues in Central Asia. Other projects have been assessing remediation in Africa and looking at the potential for remediation activity in Asia, Europe, and South America.

J.2. Increasing demand for Agency assistance

Since 2005 there has been a rapid expansion in Member State requests for Agency assistance related to the growth of activity in the uranium mining industry. This has manifested itself in a sharp increase in requests for Agency assistance related to uranium mining and production and to regulatory issues and legal aspects. Also some existing projects, related initially to the remediation of legacy sites, may now have changed emphasis with the sites being actively investigated for possible re-opening and

redevelopment of remaining resources or re-working of old residues. All this activity needs to be undertaken with proper regulation and supervision to ensure that safety standards are enforced and maintained to protect people and the environment. This boom in uranium related activity is worldwide and covers two types of situation:

- Where a country already has one or more NPP but does not mine uranium or not enough for present demand: In order to assure themselves of future energy supplies, such Member States are seeking to expand uranium mining or even to begin exploration for uranium and develop the mining sector very quickly. These Member States also may not have regulatory systems sufficiently well developed to assure the safe development and exploitation of uranium resources.
- Where a previously known uranium deposit has become economic with the price increase: Most of these countries have no history of uranium mining, little history of any mineral exploitation activity, no appropriate regulatory framework for radiological protection and few qualified staff who could be expected to regulate such a new activity. Mining companies are increasingly interested in exploiting uranium assets. A regulatory authority to set the necessary standards and to regulate the mining activities is required.

As examples for 2007: Malawi has been seeking urgent assistance to develop the legal and regulatory infrastructure and system to be able to manage its responsibilities in relation to a new uranium mine. Mongolia has begun to look at remediation of former uranium mines that were legacy sites; in the meantime these same sites are being evaluated for re-opening as mines. Member States in South America are looking at how to regulate proposed new uranium exploration programmes submitted by mining companies and asking for Agency assistance. In Africa, there is a much increased level of interest in exploration for new deposits, development of unexploited resources previously identified, and possible re-opening of former production sites. A similar, but less pronounced, situation exists in Europe.

Member States need a secure supply of energy. This requires a legal and regulatory regime that will ensure that the public and the environment remain protected and safe from any possible impacts from the development and exploitation of uranium deposits.

The Agency has already undertaken a proactive development in which operators (through the World Nuclear Association) and regulators from the major uranium mining countries have been brought together to produce a Code of Practice in Radiation, Environmental and Occupational Safety. This is intended to provide new junior partners in the uranium resource development industry with a set of principles by which they can abide to ensure that appropriate standards are met.

A serious developing issue is the provision of properly trained staff in Member States to ensure the safe and secure development for all these operations. The uranium mining industry has been very quiet for about 20 years and so there has been little to attract new and young professionals into either the operation or regulation of the mines. Many of the current staff are close to retirement and there are barely enough experienced personnel available to manage the present production situation, much less any expansion. With the rapid expansion of activity, finding a sufficient number of suitable people for the industry will become more and more difficult. As the industry seeks to recruit, it will be more difficult for the regulatory systems in existing and new producer countries to attract personnel. This is inevitable since industry frequently offers higher rewards to staff than government entities. As such, one activity which will require support is the training of sufficient numbers of staff in Member States to ensure the safe and secure development of the expanding uranium mining industry. This is an area in which the Agency has an opportunity to assist — if it can supply sufficient trainers.

An additional issue will be the requirement for the Agency to undertake expert missions and fact-finding missions to ascertain exactly what Member State requirements are in the various activities that will need to be undertaken to support the safe expansion of uranium resource development.

In order to be able to support the anticipated expansion of activity in the whole of the uranium mining cycle, a major effort will be required on the part of the Agency. The availability of external experts of suitable knowledge and experience is decreasing rapidly due to a combination of the ageing of the working population in this specific area and the demand from industry, which is prepared to offer significantly higher incentives.

Links exist with multilateral agencies that are either already funding activities or have been asked for support by Member States. Examples include: a request for assistance from Kyrgyzstan directed to UNDP in dealing with legacy sites; the World Bank funding of some safety related work in relocation of uranium mill tailings at one legacy site in Kyrgyzstan; and Tajikistan's request for aid to develop an appropriate safety regime to support a programme of re-processing uranium mill tailings and the eventual remediation of the associated legacy site. The OSCE and NATO are partners in a programme in Central Asia to assist in the remediation planning for uranium mining legacy sites. The Agency has been working to maintain liaison with all these other organisations to try and ensure that the technical assistance effort going into the region is optimized.

Appendix 2

The Agency's Safety Standards: Activities during 2007

A. Introduction

Article III.A.6 of the IAEA Statute authorizes the Agency “to establish or adopt, in consultation and, where appropriate, in collaboration with the competent organs of the United Nations and with the specialized agencies concerned, standards of safety for protection of health and minimization of danger to life and property (including such standards for labour conditions), and to provide for the application of these standards to its own operation as well as to the operations making use of materials, services, equipment, facilities, and information made available by the Agency or at its request or under its control or supervision; and to provide for the application of these standards, at the request of the parties, to operations under any bilateral or multilateral arrangements, or, at the request of a State, to any of that State’s activities in the field of atomic energy.” The categories in the Safety Standards Series are Safety Fundamentals, Safety Requirements and Safety Guides.

The end of the four year term (2004–2007) of the Commission on Safety Standards (CSS) and of the three year term (2005–2007) of the four Safety Standards Committees was reached in 2007. Member States noted with appreciation the high quality and great relevance of the safety standards achieved with the help of the Committees and the CSS at the Board of Governors and at the 51st regular session of the General Conference in September 2007. Term reports are being prepared by the CSS and the Safety Standards Committees and will be available on the Agency’s website when complete.

The main achievement during these CSS and Safety Standards Committees’ terms was the completion and publication of the Safety Fundamentals publication on Fundamental Safety Principles, as a central element for the strengthening of the global safety regime and use of the Agency’s Safety Standards worldwide. The successful completion of the action plan approved by the Board of Governors in March 2004 was another major achievement that has resulted in further enhancement of the global safety regime.

The Agency’s new Integrated Regulatory Review Service (IRRS) has enjoyed considerable success owing to its firm foundations on the Fundamental Safety Principles and the Safety Requirements publication No. GS-R-1 on Legal and Governmental Infrastructure for Nuclear, Radiation, Radioactive Waste and Transport Safety. The revision of publication No. GS-R-1 will take into account the many valuable lessons learned from the IRRS missions.

Several other important Safety Requirements relating to the management system, research reactors, decommissioning of facilities and geological disposal were also published in 2007. The September 2007 meeting of the Board of Governors approved the Safety Requirements publication on the Safety of Fuel Cycle Facilities.

In 2007, the revision of the International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources (the BSS) was started. In December 2007, the CSS also approved the revising of Safety Requirements No. GS-R-1: *Legal and Governmental*

Infrastructure for Nuclear, Radiation, Radioactive Waste and Transport Safety, No. NS-R-1: *Safety of Nuclear Power Plants: Design* and No. NS-R-2: *Safety of Nuclear Power Plants: Operation*, all first published in 2000.

Another important result of the 2004–2007 term is the progress achieved so far in the preparatory work being done by the CSS task force on the long term vision for the structure of the standards.

In terms of process, several significant improvements were observed, with, in particular, increased levels of openness, transparency and quality of the review process, with greater involvement of the users and interested parties, including collaborators in industry, and greater interaction between the Member States, the Committees and the CSS. This was facilitated by the use of modern information technologies and in particular the newly established interactive web site.

The IAEA Safety Glossary, which represents the international consensus on the terminology used in the safety standards, has been published in English, Arabic and Chinese. Editions in the other three official languages, French, Russian and Spanish, were being finalized. This work will assist in ensuring consistency in the six languages throughout all Safety Standards.

Since the establishment of the CSS and the Committees in 1995, 89 standards have been endorsed by the CSS for publication; of these, 79 (one Safety Fundamentals, 13 Safety Requirements and 65 Safety Guides) have been published; and 63 further standards (nine Safety Requirements publications and 54 Safety Guides) are being drafted or revised. A list of IAEA Safety Standards, indicating their status as of 31 December 2007, is attached as Annex I, and an up-to-date status report can be found on the Agency's website²⁵. The full texts of published IAEA Safety Standards are also available on the website²⁶.

B. Commission on Safety Standards (CSS)

The CSS, chaired by Mr. André-Claude Lacoste, President of the Nuclear Safety Authority in France, met twice in 2007, in June and in November. A CSS task force on the long-term structure for the safety standards was also created in 2007 and met in September and November 2007.

In 2007, the CSS endorsed the submission of the draft Safety Requirements publication on the Safety of Fuel Cycle Facilities to the Board of Governors for approval. The CSS also endorsed in 2007 for publication draft Safety Guides on: Management Systems for Technical Services in Radiation Safety (DS315), Management Systems for the Safe Transport of Radioactive Material (DS326), The Management System for the Processing, Handling and Storage of Radioactive Waste (DS336), The Management System for the Disposal of Radioactive Waste (DS337), Advisory Material for the IAEA Regulations for the Safe Transport of Radioactive Material (DS346), Core Management and Fuel Handling for Research Reactors (DS350), Operational Limits and Conditions and Operating Procedures for Research Reactors (DS261), The Operating Organization and the Recruitment, Training and Qualification of Personnel for Research Reactors (DS325), Management Systems for the

²⁵ <http://www-ns.iaea.org/downloads/standards/status.pdf>

²⁶ <http://www-ns.iaea.org/standards/>

Safe Transport of Radioactive Material (DS326), and Conduct of Operations at Nuclear Power Plants (DS347).

The CSS also approved in 2007 document preparation profiles (DPPs) for the revision of five existing Safety Guides and the preparation of eight additional new Safety Guides.

C. Nuclear Safety Standards Committee (NUSSC)

The Nuclear Safety Standards Committee (NUSSC), chaired by Mr. Lasse Reiman of the Radiation and Nuclear Safety Authority (STUK) of Finland, met twice in 2007.

In 2007, one Safety Guide was published: Maintenance, Periodic Testing and Inspection of Research Reactors: Safety Standards Series No. NS-G-4.2.

At its meetings in March and October 2007, NUSSC approved nine draft IAEA safety standards for submission to the CSS, namely three Safety Guides on Safety of Nuclear Fuel Cycle Facilities: Uranium Fuel Fabrication Facilities, Uranium and Plutonium Mixed Oxide Fuel Fabrication Facilities, and Conversion Facilities and Uranium Enrichment Facilities, and a Safety Requirements on Predisposal Management of Radioactive Waste, as well as five Safety Guides on the operation of nuclear power plants and research reactors.

In addition NUSSC reviewed and commented on various draft safety standards dealing with nuclear safety issues such as ageing, decommissioning, safety assessment and management systems. In 2007, NUSSC approved DPPs for eight new safety standards.

NUSSC also discussed a strategy for the future development and application of the IAEA Safety Standards, in particular the 'Roadmap on the Long Term Structure for Safety Standards' prepared by the CSS.

NUSSC had a joint meeting with RASSC and WASSC to enhance synergies and to avoid the duplication of work on the growing number of joint safety standards.

NUSSC was also involved in the revision of the BSS and commented on the different drafts prepared by the Secretariat.

As for the working tools, NUSSC introduced a new website where the members of the Committee could directly upload their comments on documents under review, as did all the other Committees.

A three year report²⁷ of the fourth term of NUSSC (2005–2007) has been drafted. The new term starts with the 25th NUSSC meeting in May 2008.

²⁷ http://www-ns.iaea.org/committees/files/draftcomments/547/FourththreeyearreportDraft3.1_301007_inclBelgcomments.pdf

D. Radiation Safety Standards Committee (RASSC)

The Radiation Safety Standards Committee (RASSC), chaired by Mr. Sigurdur Magnússon of the Icelandic Radiation Protection Institute, met in April and October 2007. The April meeting included a joint meeting with NUSSC and WASSC, and the October meeting included a joint meeting with WASSC, to discuss issues of common interest.

In 2007, RASSC approved a draft Safety Requirements publication on Predisposal Management of Radioactive Waste, and draft Safety Guides on: Advisory Material for the 2005 Edition of the IAEA Transport Regulations; Safety Assessment for the Decommissioning of Nuclear Facilities; Safety of Nuclear Fuel Cycle Facilities: Uranium Fuel Fabrication Facilities, Uranium and Plutonium Mixed Oxide Fuel Fabrication Facilities, and Conversion Facilities and Uranium Enrichment Facilities; and Radiation Protection and Radioactive Waste Management in the Design and Operation of Research Reactors.

RASSC received progress reports from the Secretariat on the revision of the International Basic Safety Standards (BSS). At both meetings, working groups were formed to discuss issues that had arisen during the revision of the BSS and to provide guidance to the Secretariat on resolving those issues.

In 2007, RASSC approved DPPs for the revision of three Safety Requirements publications and for the development of three new Safety Guides.

E. Transport Safety Standards Committee (TRANSSC)

The Transport Safety Standards Committee's (TRANSSC's) 14th and 15th meetings were chaired by Mr. Jarlath Duffy of the Radiological Protection Institute of Ireland. Meetings were convened in March and September 2007. On average there were 78 attendees, representing 35 Member States and six international organizations.

TRANSSC approved three draft safety standards relating to transport and three other standards for submission to CSS. The three standards relating to transport were on Management Systems; Compliance Assurance; and Schedules. In addition TRANSSC reviewed TS-R-1, 2005 Edition for harmonization with the UN Model Regulations on the Transport of Dangerous Goods. The other three were Safety Requirements on: Safety Assessment and Verification of Nuclear Facilities and Activities, and Predisposal Management of Radioactive Waste, and a Safety Guide on Radiation Safety in Industrial Radiography.

Four DPPs were approved on: Revision of NS-R-1: Safety of Nuclear Power Plants: Design; Revision of NS-R-2: Safety of Nuclear Power Plants: Operation; Revision of GS-R-1: Governmental and Regulatory Framework for Nuclear, Radiation, Radioactive Waste and Transport Safety; and the Licensing Process for Nuclear Installations.

In accordance with the new review and revision policy endorsed by the 49th regular session of the General Conference in 2005, a call for issues and any problems identified to be raised was initiated in June 2007 to address the possible publication of a new edition of TS-R-1 in 2011.

These proposals were discussed, more than 100 submissions were reviewed and the criteria developed by TRANSSC were applied. It was concluded that for none of the issues raised was there enough information available to be identified as significant in terms of safety, except with regard to the issue of harmonization with UN Model Regulations on the Transport of Dangerous Goods, which is already addressed in the draft 2009 Edition of TS-R-1.

F. Waste Safety Standards Committee (WASSC)

The Waste Safety Standards Committee (WASSC), chaired by Mr. Thiagan Pather of the National Nuclear Regulatory Body of South Africa, met in April and October 2007. The April meeting included a joint meeting with RASSC and NUSSC, and the October meeting included a joint meeting with RASSC, to discuss issues of common interest.

In 2007, WASSC approved three draft safety standards relating to waste management and four other draft standards for submission to the CSS. The waste management related drafts were: a draft Safety Requirements publication on Predisposal Management of Radioactive Waste; and draft Safety Guides on Safety Assessment for the Decommissioning of Nuclear Facilities and on Radiation Protection and Radioactive Waste Management in the Design and Operation of Research Reactors. Others drafts approved were for Safety Guides on Advisory Material for the 2005 Edition of the IAEA Transport Regulations; Safety of Nuclear Fuel Cycle Facilities: Uranium Fuel Fabrication Facilities, Uranium and Plutonium Mixed Oxide Fuel Fabrication Facilities, and Conversion Facilities and Uranium Enrichment Facilities.

At both meetings, WASSC received progress reports from the Secretariat on the revision of the BSS. In the April 2007 meeting, WASSC contributed to the RASSC working groups to discuss issues that had arisen during the revision of the BSS and to provide guidance to the Secretariat on resolving those issues.

In 2007, WASSC approved DPPs for the revision of three Safety Requirements publications and for the development of three new Safety Guides. The DPPs for the three Safety Requirements publications were for the revision of Safety of Nuclear Power Plants: Design (NS-R-1); Safety of Nuclear Power Plants: Operation (NS-R-2); and Legal and Governmental Infrastructure for Nuclear, Radiation, Radioactive Waste and Transport Safety (GS-R-1). The DPPs for the three new Safety Guides were those on: Licensing of Nuclear Facilities; Protection of the Public against Exposure to Natural Sources of Radiation including NORM Residues from Industrial Processes; and Arrangements for Dealing with Orphan Radioactive Sources and Radioactively Contaminated Material in the Metal Recycling Industry.

The IAEA Safety Standards as of 31 December 2007

Safety Fundamentals

- SF-1 Fundamental Safety Principles (2006) **Co-sponsorship:** EC, Euratom, FAO, ILO, IMO, OECD/NEA, PAHO, UNEP, WHO

Thematic Safety Standards

Legal and Governmental Infrastructure

- GS-R-1 Legal and Governmental Infrastructure for Nuclear, Radiation, Radioactive Waste and Transport Safety (2000) (under revision)
GS-G-1.1 Organization and Staffing of the Regulatory Body for Nuclear Facilities (2002)
GS-G-1.2 Review and Assessment of Nuclear Facilities by the Regulatory Body (2002)
GS-G-1.3 Regulatory Inspection of Nuclear Facilities and Enforcement by the Regulatory Body (2002)
GS-G-1.4 Documentation for Use in Regulating Nuclear Facilities (2002)
GS-G-1.5 Regulatory Control of Radiation Sources (2004) **Co-sponsorship:** FAO, ILO, PAHO, WHO

One other Safety Guide on licensing process for nuclear installations is being developed.

Emergency Preparedness and Response

- GS-R-2 Preparedness and Response for a Nuclear or Radiological Emergency (2002) **Co-sponsorship:** FAO, OCHA, OECD/NEA, ILO, PAHO, WHO
GS-G-2.1 Arrangements for Preparedness for a Nuclear or Radiological Emergency (2007) **Co-sponsorship:** FAO, OCHA, ILO, PAHO, WHO
109 Intervention Criteria in a Nuclear or Radiation Emergency (1994) (under revision)

One other Safety Guide on criteria for use in planning response to nuclear and radiological emergencies (replacing 109) is being developed.

Management System

- GS-R-3 The Management System for Facilities and Activities (2006)
GS-G-3.1 Application of the Management System for Facilities and Activities (2006)

Safety Guides in the Safety Series 50-SG

- Q8 Quality Assurance in Research and Development (under revision)
Q9 Quality Assurance in Siting (under revision)
Q10 Quality Assurance in Design (under revision)
Q11 Quality Assurance in Construction (under revision)
Q12 Quality Assurance in Commissioning (under revision)
Q13 Quality Assurance in Operation (under revision)

Q14 Quality Assurance in Decommissioning (under revision)

One Safety Guide is being developed on management system for nuclear installations to replace the above Q8 to Q14 guides and four other Safety Guides for: technical services in radiation safety; safe transport of radioactive material; waste treatment; and waste disposal are being developed.

Assessment and Verification

GS-G-4.1 Format and Content of the Safety Analysis report for Nuclear Power Plants (2004)

A Safety Requirement on safety assessment and verification and another Safety Guide on risk informed decision making are being developed. A Safety Guide on criticality safety is also being developed.

Site Evaluation

- NS-R-3 Site Evaluation for Nuclear Installations (2003)
- NS-G-3.1 External Human Induced Events in Site Evaluation for Nuclear Power Plants (2002)
- NS-G-3.2 Dispersion of Radioactive Material in Air and Water and Consideration of Population Distribution in Site Evaluation for Nuclear Power Plants (2002)
- NS-G-3.3 Evaluation of Seismic Hazard for Nuclear Power Plants (2003)
- NS-G-3.4 Meteorological Events in Site Evaluation for Nuclear Power Plants (2003) (under revision)
- NS-G-3.5 Flood hazard for Nuclear Power Plants on Coastal and River Sites (2004) (under revision)
- NS-G-3.6 Geotechnical Aspects of Site Evaluation and Foundations for Nuclear Power Plants (2005)

Radiation Protection

- 115 International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources (1996) **Co-sponsorship:** FAO, ILO, OECD/NEA, PAHO, WHO (under revision)
- RS-G-1.1 Occupational Radiation Protection (1999) **Co-sponsorship:** ILO
- RS-G-1.2 Assessment of Occupational Exposure Due to Intakes of Radionuclides (1999) **Co-sponsorship:** ILO
- RS-G-1.3 Assessment of Occupational Exposure Due to External Sources of Radiation (1999) **Co-sponsorship:** ILO
- RS-G-1.4 Building Competence in Radiation Protection and the Safe Use of Radiation Sources (2001) **Co-sponsorship:** ILO, PAHO, WHO
- RS-G-1.5 Radiological Protection for Medical Exposure to Ionizing Radiation (2002) **Co-sponsorship:** PAHO, WHO
- RS-G-1.7 Application of the Concepts of Exclusion, Exemption and Clearance (2004)
- RS-G-1.8 Environmental and Source Monitoring for Purposes of Radiation Protection (2005)
- RS-G-1.9 Categorization of Radioactive Sources (2005)
- RS-G-1.10 Safety of Radiation Generators and Sealed Radioactive Sources (2006) **Co-sponsorship:** ILO, PAHO, WHO

Two other Safety Guides on protection of the public against exposure to natural sources of radiation and on justification of practices are being developed.

Radioactive Waste Management

- WS-R-2 Predisposal Management of Radioactive Waste, including Decommissioning (2000) (under revision)

- WS-G-1.2 Management of Radioactive Waste from the Mining and Milling of Ores (2002) (under revision)
- WS-G-2.3 Regulatory Control of Radioactive Discharges to the Environment (2000)
- WS-G-2.5 Predisposal Management of Low and Intermediate Level Radioactive Waste (2003)
- WS-G-2.6 Predisposal Management of High Level Radioactive Waste (2003)
- WS-G-2.7 Management of Waste from the Use of Radioactive Materials in Medicine, Industry, Agriculture, Research and Education (2005)
- WS-G-6.1 Storage of Radioactive Waste (2006)
- 111-G-1.1 Classification of Radioactive Waste (1994) (under revision)

One other Safety Guide on safety assessment is being developed.

Decommissioning

- WS-R-5 Decommissioning of Facilities Using Radioactive Material (2006)
- WS-G-2.1 Decommissioning of Nuclear Power Plants and Research Reactors (1999) (under revision)
- WS-G-2.2 Decommissioning of Medical, Industrial and Research Facilities (1999) (under revision)
- WS-G-2.4 Decommissioning of Nuclear Fuel Cycle Facilities (2001) (under revision)
- WS-G-5.1 Release of Sites from Regulatory Control on Termination of Practices (2006)

One other Safety Guide on safety assessment for decommissioning of facilities using radioactive material is being developed.

Remediation

- WS-R-3 Remediation of Areas Contaminated by Past Activities and Accidents (2003)
- WS-G-3.1 Remediation Process for Areas Affected by Past Activities and Accidents (2007)

Transport Safety

- TS-R-1 Regulations for the Safe Transport of Radioactive Material 2005 Edition (2005) (under revision)
- TS-G-1.1 Advisory Material for the IAEA Regulations for the Safe Transport of Radioactive Material (2002) (under revision)
- TS-G-1.2 Planning and Preparing for Emergency Response to Transport Accidents Involving Radioactive Material (2002)
- TS-G-1.3 Radiation Protection Programmes for the Transport of Radioactive Material (2007)

Three other Safety Guides on management system for the safe transport of radioactive material (mentioned in section B.3), compliance assurance and schedule of provisions are being developed.

Facility Specific Safety Standards

Design of Nuclear Power Plants

- NS-R-1 Safety of Nuclear Power Plants: Design (2000) (under revision)
- NS-G-1.1 Software for Computer Based Systems Important to Safety in Nuclear Power Plants (2000)
- NS-G-1.2 Safety Assessment and Verification for Nuclear Power Plants (2002)

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| NS-G-1.3 | Instrumentation and Control Systems Important to Safety in Nuclear Power Plants (2002) |
| NS-G-1.4 | Design of Fuel Handling and Storage Systems for Nuclear Power Plants (2003) |
| NS-G-1.5 | External Events Excluding Earthquakes in the Design of Nuclear Power Plants (2004) |
| NS-G-1.6 | Seismic Design and Qualification for Nuclear Power Plants (2003) |
| NS-G-1.7 | Protection against Internal Fires and Explosions in the Design of Nuclear Power Plants (2004) |
| NS-G-1.8 | Design of Emergency Power Systems for Nuclear Power Plants (2004) |
| NS-G-1.9 | Design of the Reactor Coolant System and Associated Systems in Nuclear Power Plants (2004) |
| NS-G-1.10 | Design of Reactor Containment Systems for Nuclear Power Plants (2004) |
| NS-G-1.11 | Protection against Internal Hazards other than Fires and Explosions in the Design of Nuclear Power Plants (2004) |
| NS-G-1.12 | Design of the Reactor Core for Nuclear Power Plants (2005) |
| NS-G-1.13 | Radiation Protection Aspects of Design for Nuclear Power Plants (2005) |
| 79 | Design of Radioactive Waste Management Systems at Nuclear Power Plants (1986) |

Four other Safety Guides on safety classification of structures, systems and components, on development and application of level 1 and level 2 PSA and on deterministic safety analyses are being developed.

Operation of Nuclear Power Plants

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|-----------|---|
| NS-R-2 | Safety of Nuclear Power Plants: Operation (2000) (under revision) |
| NS-G-2.1 | Fire Safety in the Operation of Nuclear Power Plants (2000) |
| NS-G-2.2 | Operational limits and Conditions and Operating Procedures for Nuclear Power Plants (2000) |
| NS-G-2.3 | Modifications to Nuclear Power Plants (2001) |
| NS-G-2.4 | The Operating Organization for Nuclear Power Plants (2002) |
| NS-G-2.5 | Core Management and Fuel Handling for Nuclear Power Plants (2002) |
| NS-G-2.6 | Maintenance, Surveillance and In-Service Inspection in Nuclear Power Plants (2002) |
| NS-G-2.7 | Radiation Protection and Radioactive Waste Management in the Operation of Nuclear Power Plants (2002) |
| NS-G-2.8 | Recruitment, Qualification and Training of Personnel for Nuclear Power Plants (2003) |
| NS-G-2.9 | Commissioning for Nuclear Power Plants (2003) |
| NS-G-2.10 | Periodic Safety Review of Nuclear Power Plants (2003) |
| NS-G-2.11 | A System for the Feedback of Experience from Events in Nuclear Installations (2006) |

Five other Safety Guides on conduct of operations, ageing management, seismic evaluation of existing nuclear facilities, on severe accident management and on chemistry are being developed.

Research Reactors

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|----------|--|
| NS-R-4 | Safety of Research Reactors (2005) |
| NS-G-4.1 | Commissioning of Research Reactors (2006) |
| NS-G-4.2 | Maintenance, Periodic Testing and Inspection of Research Reactors (2006) |
| 35-G1 | Safety Assessment of Research Reactors and Preparation of the Safety Analysis Report (1994) (under revision) |
| 35-G2 | Safety in the Utilization and Modification of Research Reactors (1994) (under revision) |

Six other Safety Guides on operational limits and conditions; operating organization, recruitment, training and qualification; radiation protection and waste management; core management, use of graded approach and ageing management are being developed.

Fuel Cycle Facilities

- 116 Design of Spent Fuel Storage Facilities (1995) (under revision)
- 117 Operation of Spent Fuel Storage Facilities (1995) (under revision)

One Safety Requirements on safety of fuel cycle facilities, and six other Safety Guides on: safety of uranium fuel fabrication; MOX fuel fabrication; conversion facilities; reprocessing facilities; fuel cycle R&D and storage of spent fuel are being developed.

Radiation Related Facilities

- 107 Radiation Safety of Gamma and Electron Irradiation Facilities (1992) (under revision)
- RS-G-1.6 Occupational Radiation Protection in the Mining and Processing of Raw Materials (2004)

Four other Safety Guides on medical uses, on industrial radiography, on national strategy for regaining control over orphan sources and on orphan radioactive sources in the metal recycling industry are being developed.

Waste Treatment and Disposal Facilities

- WS-R-1 Near Surface Disposal of Radioactive Waste (1999) (under revision)
- WS-R-4 Geological Disposal of Radioactive Waste (2006) (under revision)
- WS-G-1.1 Safety Assessment for Near Surface Disposal of Radioactive Waste (1999) (under revision)
- 111-G-3.1 Siting of Near Surface Disposal Facilities (1994) (under revision)
- 111-G-4.1 Siting of Geological Disposal Facilities (1994) (under revision)

Two other Safety Guides on borehole disposal of radioactive waste and on monitoring and surveillance of disposal facilities are being developed.