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MEASURES TO STRENGTHEN INTERNATIONAL CO-OPERATION IN NUCLEAR, RADIATION AND WASTE SAFETY

including

Nuclear Safety Review for the Year 1999

1. This document presents an overview of measures to strengthen international co-operation in nuclear, radiation and waste safety, within the context of safety related developments worldwide. It is a successor to documents GC(43)/INF/4 and GC(43)/INF/8 (issued last August). However, in response to a proposal from the March 1999 session of the Board of Governors to produce a single document, the Secretariat merged the Nuclear Safety Review for the Year 1999 with the traditional General Conference report on the Agency's efforts to strengthen international co-operation in nuclear, radiation and waste safety. The document is also intended in part to provide information requested in GC(43)/RES/13 on developments in a number of safety related areas.

2. The document is in three parts:

- Part I describes briefly those events in 1999 that have, or may have, significance for nuclear, radiation and waste safety worldwide. It includes developments such as new initiatives in international co-operation, events of safety significance and events that may be indicative of trends in safety.
- Part II describes the Agency's efforts to strengthen international co-operation in nuclear, radiation and waste safety during 1999 and the first half of 2000. It covers legally binding international agreements, non-binding safety standards, and provision for the application of safety standards.
- Part III presents a brief look ahead to some issues that are likely to be prominent in the coming year(s).

For reasons of economy, this document has been printed in a limited number.
Delegates are kindly requested to bring their copies of documents to meetings.

3. A Draft Nuclear Safety Review for the Year 1999 was discussed at the March 2000 session of the Board of Governors (GOV/2000/5). Parts I and III of this document are the corresponding parts of that draft, modified on the basis of the discussion in the Board and other comments received from Member States. Part II is an updated and extended version of the corresponding part of the draft, and provides a more comprehensive account of the Agency's activities in nuclear, radiation and waste safety during 1999 and the first half of 2000.

4. Separate General Conference documents provide information on a number of specific safety related subjects, namely:

- the safety of radiation sources and the security of radioactive materials (GC(44)/7, relating to item 14(a) of the Provisional Agenda, in response to GC(43)/RES/10);
- the status of safety related conventions (GC(44)/INF/10);
- the International Conference on the Safety of Radioactive Waste Management, held in Córdoba, Spain, in March 2000 (GC(44)/INF/5);
- occupational exposure to radiation (GC(44)/INF/6);
- the safety of transport of radioactive materials (GC(44)/INF/7, in response to GC(43)/RES/11);
- the radiological protection of patients (GC(44)/INF/8, in response to GC(43)/RES/12); and
- international intercomparisons of radiation dose measurements (GC(44)/INF/9).

PART I

SAFETY RELATED EVENTS AND ISSUES WORLDWIDE

1. This section aims to identify those events or developments during 1999 that:

   (a) were of particular importance in their own right; and/or

   (b) provided lessons that may be more generally applicable; and/or

   (c) have potential long term consequences or could be indicative of developing trends that might be of longer term importance.

It is not intended to provide a comprehensive account of all events during the past year. It should be noted in particular that some events reported for reasons of the type indicated in (b) and (c) might not have been considered significant in their own right.

International Co-operation

Intergovernmental agreements

2. Legally binding agreements between States — ranging from bilateral treaties to international conventions — are increasingly recognized as an important element of the 'global safety culture' for improving nuclear, radiation and waste safety worldwide.

3. The Convention on Nuclear Safety entered into force in October 1996 and, as of the end of 1999, had 52 Contracting Parties. The first Review Meeting of Contracting Parties was held in Vienna in April 1999. Each Contracting Party was required to submit in advance a national report describing the measures it had taken to meet its obligations under the Convention. During the two-week Review Meeting, the Contracting Parties reviewed each national report, along with questions and comments that had been submitted. This detailed review was carried out in six parallel 'country groups', with a Rapporteur from each group reporting to the final plenary session on the results of the discussions. A consensus Summary Report was adopted by the Review Meeting, outlining the main conclusions from the discussions and the issues identified as being important for future progress in improving nuclear safety (see GC(43)/11).

4. The Contracting Parties agreed that the review process had been of great value to their national nuclear safety programmes, referring not only to the 'peer review' by other Contracting Parties and the very open discussions at the Review Meeting, but also to the self-assessment involved in producing the national reports. They concluded that the review process had demonstrated the strong commitment by all Contracting Parties to the safety objectives of the Convention. Although there were variations among Contracting Parties with regard to the levels from which they started implementation of Convention obligations and in the resources available for improvement programmes, it was noted that all Contracting Parties participating in the Meeting are taking steps in the right direction.

5. The Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management was opened for signature in September 1997. As of the end of 1999, 40 States had signed the Joint Convention, and 13 had ratified, accepted or approved it (the Joint Convention will enter into force after 25 States, at least 15 of which have an operational nuclear power plant, have ratified, approved or accepted). A third informal meeting of signatories and other interested States was held during 1999, following on from two meetings in 1998. The meeting reviewed and amended drafts of rules of procedure and financial rules, guidelines for the preparation of national reports and guidelines for the review process.

6. The Convention on Early Notification of a Nuclear Accident, which entered into force in October 1986, was formally invoked once during 1999, by Turkey in relation to a suspected missing source (see below). The Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency, which entered into force in February 1987, was formally invoked during 1999 by Turkey and Peru in relation to incidents involving overexposure to radiation sources (these events are described in more detail in the relevant section below), and in relation to an industrial radiography source stuck outside its housing in Ghana. The Agency also continued to provide assistance, in the framework of the Assistance Convention, to Georgia in relation to 'orphan' radiation sources.

Co-operation between national regulatory bodies

7. In recent years, several organizations have been established to provide forums in which regulators can exchange information and experiences on issues of common interest. Such groups have been established on the basis of reactor type (WWER and CANDU regulators), regional/linguistic considerations (the Western European Nuclear Regulators' Association (WENRA) and the Forum of Ibero-American Regulators), and size of nuclear power programme (the International Nuclear Regulators' Association (INRA) and the Network of Regulators of Countries with Small Nuclear Programmes (NERS)). Other forums for exchange between regulators on particular issues are also provided by international organizations, such as the IAEA's peer discussion groups on regulatory practices (which are held twice a year, and issue the results of their deliberations as IAEA publications) and the Meeting of Senior Regulators held annually during the IAEA's General Conference.

8. WENRA, made up of the heads of the nuclear regulatory authorities in the nine States of the European Union (EU) that have nuclear power plants — Belgium, Finland, France, Germany, Italy, the Netherlands, Spain, Sweden and the United Kingdom — and Switzerland, was established in 1999. Their first project was a report giving a collective opinion[1] on nuclear safety in those central and eastern European States that are currently seeking membership in the EU and have operating nuclear power plants (this is discussed further in the section on "Nuclear installations" below).

[1] Switzerland did not participate in the production of the report.

Activities of other international organizations

International Commission on Radiological Protection (ICRP)

9. ICRP's Main Commission approved two reports from Task Groups of Committee 4, on protection of the public in situations of prolonged radiation exposure and on radiation protection recommendations as applied to the disposal of long-lived solid radioactive waste. In addition to ICRP's standard peer review procedure, drafts of these two reports had been made available for comment on the Commission's web site. This was intended to achieve a broader degree of consultation on issues that are of particular interest to a wide range of people.

10. A more ambitious consultation exercise was undertaken to encourage wide discussion of proposals aimed at simplifying the Commission's basic radiological protection philosophy. A discussion paper on "controllable dose", outlining an approach giving more emphasis to individual dose from single sources of radiation, was circulated through the International Radiation Protection Association (IRPA) to its constituent societies for discussion at IRPA's Tenth International Congress in Hiroshima, Japan, in May 2000. The paper suggests that use of the proposed approach might remove the need for some of the distinctions currently made, for example, between practices and intervention or between occupational and public exposure.

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

11. The fourth and final part of the OECD/NEA's INEX 2 international emergency exercise was held in April 1999, based on a hypothetical accident at Darlington nuclear power plant in Canada. 30 countries and 4 international organizations (including the IAEA) participated in the exercise. The lessons learned from the four regional INEX 2 exercises — the others were in Switzerland in 1996, in Finland in 1997, in Hungary in 1998 — have been summarized.

12. The Radioactive Waste Management Committee published its future work orientation in a booklet addressing Strategic Areas in Radioactive Waste Management. A report entitled "Progress Towards Geologic Disposal of Radioactive Waste: Where Do We Stand?" presented an overview of recent developments and the current situation. A more detailed report addressed the increasingly important issue (both technically and with regard to public acceptance) of "Confidence in the Long-term Safety of Deep Geologic Repositories — Its Development and Communication". In response to a request from Japan, an international team organized by the NEA reviewed aspects of the Japanese waste disposal programme.

13. A report on The Role of the Nuclear Regulator in Promoting and Evaluating Safety Culture was produced, addressing early signs of declining safety performance that may stem from safety culture weaknesses. A second report, on Regulatory Response Strategies for Safety Culture Problems, has been completed but not yet published. To improve knowledge about regulatory effectiveness and to obtain a better understanding of how it can be measured a Workshop on Developing and Measuring Regulatory Effectiveness was held in June 1999.

14. The OECD/NEA's Y2K activities included a workshop in Ottawa, Canada, on the Impact of the Year 2000 on the Nuclear Industry, where the regulatory and industry strategies on Y2K problems were discussed. In addition, the Y2K Early Warning System (YEWS) — an Internet-based system to provide prompt information to authorities around the world during the year change period — was developed by the US Nuclear Regulatory Commission and the NEA, with wide participation of non-OECD countries.

World Association of Nuclear Operators (WANO)

15. Celebrating its tenth anniversary in 1999, the World Association of Nuclear Operators (WANO) continued to enhance its four major programmes: peer reviews; operating experience; technical support and exchange; and professional and technical development. WANO conducted 26 peer reviews and 2 follow-up reviews in 1999; a total of 110 peer reviews have now been conducted in 28 countries. The operating experience programme was enhanced with the development and distribution to members of reports of significant events. During 1999, WANO issued one Significant Operating Experience Report (SOER) and four Significant Event Reports (SERs) to members. This is in addition to the nearly 200 more routine event reports shared amongst members via an on-line event database, accessible to WANO members via the restricted WANO web site.

16. Nearly all WANO performance indicators continued to show a clear trend of improvement in plant performance, including safety performance.

17. WANO worked with its members and the IAEA to help co-ordinate efforts to address Y2K issues and to alert and educate members on the need to address this issue. A dedicated area of the WANO web site provided a forum for exchange of information on the Y2K topic.

Nuclear installations

Events at nuclear power plants

18. In July 1999, there was a leak of coolant from the primary circuit of the Tsuruga-2 nuclear power plant in Japan. More than 50 m^3 of coolant was estimated to have leaked, but none was released from the containment. The leak was attributed to cracks in a regenerative heat exchanger in the chemical and volume control system, caused by high cycle thermal fatigue. Although the direct consequences of the leak were not significant, in view of the nature of the event a detailed investigation programme was undertaken, and the operators of Tsuruga and other utilities took a number of measures to improve the monitoring and inspection of the heat exchangers and related piping and equipment.

19. A leak of coolant from the residual heat removal system at Civaux-1 nuclear power plant in France in 1998 led to it being shut down, and was subsequently attributed to a design fault in the N4 series of pressurized water reactors. The faulty systems have been replaced in all four reactors of the series; Units 1 and 2 at Chooz B were restarted in March and April 1999 respectively, and restart of Civaux-1 was authorized in August 1999. Initial fuel loading at Civaux-2 (which was not in

operation when the problem was identified) was authorized in July 1999, and the reactor went critical in December 1999.

20. On 1 October 1999 (the day after the Tokaimura accident — see below), a spill of heavy water occurred at Wolsong-3 nuclear power plant in the Republic of Korea, as a result of a seal failure. Two workers received unplanned radiation exposures, but these were below the dose limit and there was no release of radioactive material from the building. The Korean Government organized a "special review of the integrated nuclear safety in Korea", to investigate the root cause(s) of the Wolsong spill (which, along with some other issues relating to the Wolsong and Ulchin nuclear power plants, was to be addressed in Phase I), and also (in Phase II) to ascertain the safety level of nuclear power plants in the Republic of Korea and to establish a safety improvement programme. The review was conducted by an audit team which included representatives not only of the regulatory body and technical support organizations, but also of national and local government, universities, non-governmental organizations and residents of the areas near nuclear power plant sites.

21. In July 1998, Qinshan-1 nuclear power plant in China was shut down, following the discovery that some of the guide tubes for in-core instrumentation had moved from their original location, as a result of damage to the reactor internals. The damage was attributed to flow induced vibration, a problem encountered (and corrected) in the past in a number of PWRs. The operators contracted Westinghouse to carry out repairs and modifications to the internals, and the plant was restarted in August 1999 with the approval of the Chinese safety authority. Similar modifications were also carried out on the Chashma nuclear power plant in Pakistan, which is of the same design as Qinshan-1, before fuel loading began. An Agency TC project is supporting Chashma's management in the development of a special monitoring and surveillance programme focused on this damage mechanism.

22. Severe storms in France in late December 1999 caused (inter alia) the River Gironde to burst its banks. As a result, the Blayais nuclear power plant near Bordeaux suffered a partial loss of external electricity supply and flooding of the access route to the site, the basements of fuel storage buildings for units 1 and 2, and a pump in the essential service water system (part of the residual heat removal system) for unit 1. The flooding led to a number of backup safety systems becoming temporarily unavailable, and the three units that were operating at the time were shut down. The national emergency response organization was activated for 24 hours, their first activation in connection with a real incident: its prompt assembly and smooth functioning demonstrated the effectiveness of the programme of annual exercises. The preliminary conclusions of the French nuclear regulator DSIN were that the situation was handled correctly and that the safety of the plant was not threatened, but that flood prevention measures at the site were insufficient. Indeed, DSIN had previously requested the operators to undertake improvement work that was considered necessary, but that work had not yet been carried out. By the end of the year, unit 4 had restarted, but the restarting of unit 3 (which had not been operating at the time of the incident) had been made conditional by DSIN upon the establishment of a warning system based on meteorological forecasts. With regard to units 1 and 2, DSIN had required that the affected equipment and buildings be

repaired and that significant improvements be made in the flood protection measures before it would authorize their restart.

Nuclear power plants in central and eastern Europe

23. Bulgaria announced in November 1999 that the WWER-440/230 reactors in units 1 and 2 of Kozloduy nuclear power plant will be closed down by 2002, and that closure dates for units 3 and 4 would be decided, in agreement with the European Commission (EC), in 2002. Plans for closure of four other reactors were announced earlier in the year, by Slovakia in relation to Bohunice units 1 and 2 (also first generation WWERs), and by Lithuania in relation to the RBMK reactors at Ignalina. These eight reactors are considered by the EC to be "non-upgradeable" (meaning that they "cannot be upgraded to internationally acceptable safety standards at reasonable cost"), and agreement on their closure was a condition for launching negotiations with the countries concerned on accession to the European Union (EU). Confirming that these three States would be among a group of countries with which accession negotiations would begin early in 2000, the European Council in Helsinki, Finland, in December 1999 stated that it "recalls the importance of high standards of nuclear safety in Central and Eastern Europe" and "calls on the Council [of the European Union[2]] to consider how to address the issue of nuclear safety in the framework of the enlargement process in accordance with the relevant Council conclusions."

24. Earlier, in March 1999, the Western European Nuclear Regulators' Association (WENRA) had submitted to the EU a report giving a collective opinion on nuclear safety in those central and eastern European States that are currently seeking membership in the EU and have operating nuclear power plants, namely Bulgaria, the Czech Republic, Hungary, Lithuania, Romania, Slovakia and Slovenia. With regard to Ignalina, WENRA noted that, on the basis of the independent safety assessments conducted to date, "it appears that most of the deviations from Western European requirements could be reasonably addressed or compensated for by a continued safety improvement programme." However, they concluded — citing "the lack of an adequate reactor containment" — that "the existing and planned upgrading measures will not be sufficient to allow these units to achieve standards of safety which are comparable to those required for older reactors in Western Europe." In respect of Kozloduy units 1–4 and Bohunice V1 (units 1 and 2), the report was less categorical, indicating that further information was needed. Specific visits to Bohunice and Kozloduy were made later in the year. A fully updated version of the report is expected to be published by WENRA in late 2000.

25. A major international conference on the Strengthening of Nuclear Safety in Eastern Europe, organized by the IAEA in co-operation with the European Commission (EC) and the OECD/NEA, was held in Vienna in June 1999. All central and eastern European countries operating nuclear power plants with RBMK and WWER reactors — Armenia, Bulgaria, the Czech Republic, Hungary, Lithuania, the Russian Federation, Slovakia and Ukraine — participated in the Conference,

[2] The Council of the European Union (sometimes referred to simply as "the Council") is made up of one representative at ministerial level from each of the member countries (the representatives change from meeting to meeting, depending on the subject under discussion). The European Council is made up of the Heads of State or Government of the member countries.

along with representatives of 18 other countries and six international organizations. Each of the countries with RBMK and WWER reactors made presentations on their national status and plans, with particular reference to three main topics: regulatory aspects of nuclear safety; status of safety improvements; and status of safety analysis reports.

26. The Conference concluded that considerable progress on nuclear safety has been made in eastern Europe, particularly in areas such as the independence and technical competence of nuclear regulatory authorities, national legislative and regulatory frameworks and analysis of operating experience feedback. Areas identified as needing further attention in the future include ensuring that regulatory authorities have adequate financial resources and enforcement authority, transferring appropriate responsibilities for safety to the operators, maintaining and enhancing an effective safety culture, improving information exchange on engineering solutions and implementation of safety modifications among countries (to optimize the use of scarce resources), and improving the quality and consistency of safety analysis reports (to provide a sound basis for selecting and implementing design improvements). The conclusions from this conference, along with those from the Review Meeting of the Convention on Nuclear Safety, are major inputs in the planning of future programmes of international nuclear safety assistance to central and eastern Europe. The importance of the results of these two meetings was also explicitly recognized by the G-8 leaders in their communique from the Cologne Summit, in which they renewed their commitment made at the 1996 Moscow Summit "to safety first in the use of nuclear power and the achievement of high safety standards worldwide."

Chernobyl shelter

27. Previous Nuclear Safety Reviews have reported on the establishment of the Shelter Implementation Plan (SIP) to address the safety issues related to the shelter containing the remains of Chernobyl Unit 4, and of the Chernobyl Shelter Fund, administered by the European Bank for Reconstruction and Development. Work was carried out during 1999 to stablilize two beams supporting the shelter; this had to be achieved before other urgent tasks to stabilize and strengthen the overall structure can be carried out.

Management of safety

28. A number of events in recent years have raised concerns about the possible effects of management changes in operating organizations on safety at nuclear installations; examples include the developments at Ontario Hydro in Canada, reported in the Nuclear Safety Review for the Year 1997, and at the Dounreay nuclear licensed site in the United Kingdom, reported in the 1998 Review. Recognizing these concerns, the UK's Health and Safety Executive introduced a new licence condition on the control of organizational change. The new Licence Condition 36, which came into effect on 1 April 2000, requires all licensees to make and implement adequate arrangements to control any change to their organizational structure or resources that could affect safety, and gives the regulatory body the power to stop such changes if necessary.

The nuclear fuel cycle

29. On 30 September 1999, a criticality accident occurred at a uranium conversion facility operated by JCO Co. Ltd. in Tokaimura, Ibaraki Prefecture, Japan (120 km north-east of Tokyo).

A solution of enriched uranium (18.8% ^{235}U by mass) in an amount several times more than the specified mass limit had been poured directly into a precipitation tank, bypassing a dissolution tank and buffer column. When the volume of solution reached about 40 litres (equivalent to about 16 kg uranium), a self-sustaining nuclear fission chain reaction was established. Three JCO workers who were in the building at the time criticality was reached suffered acute radiation syndrome as a result of doses estimated at 16–20 GyEq[3], 6–10 GyEq and 1–4.5 GyEq respectively. The most exposed worker died on 21 December 1999 from multiple organ failure. The least exposed of the three was released from hospital in December but, as of the end of 1999, the other remained in hospital[4]. During the accident, 161 residents of households within 350 m of the building were evacuated, and people living within 10 km of the facility were advised, as a precaution, to stay indoors.

30. Criticality continued intermittently for about 20 hours, until it was stopped by draining water from the cooling jacket around the precipitation tank (the water had been reflecting neutrons back into the tank). Boron was then added to the solution to ensure that the nuclear reaction could not start again. 24 JCO workers involved in these operations received doses estimated to range from less than 0.1 mSv to about 120 mSv. In addition, 56 JCO employees (0.6–64 mSv), 3 Tokaimura emergency service workers (6.2–13 mSv) and 7 public workers who were just outside the JCO site (6.4–15 mSv) were confirmed to have been exposed as a result of the accident. Monitoring indicated that trace amounts of short-lived radioactive isotopes of noble gases and gaseous iodine were released to the atmosphere, but these were not radiologically significant and there was no residual contamination.

31. The Convention on Early Notification of a Nuclear Accident was not formally invoked because the nature of the accident was such that there was no likelihood of a release of radioactive material that could result in an international transboundary release that could be of safety significance for another State. Nevertheless, the IAEA established and maintained contact with the relevant competent authority in Japan to ascertain the facts in order to respond to the many requests for information. The Agency also offered assistance to the Japanese authorities in responding to the accident and, following discussions with representatives of the Government of Japan, the IAEA's Director General sent an expert team to Tokaimura to conduct a preliminary fact-finding mission. The report of the expert team was published shortly after their return.

32. A Criticality Accident Investigation Committee, established by the Nuclear Safety Commission of the Science and Technology Agency, issued its report on 24 December 1999. An underlying cause of the accident was a lack of awareness of the risk of criticality, which allowed the direct cause — violation of procedural regulations — to occur. The allocation of authority and responsibilities between the Nuclear Safety Commission, the regulatory authorities and the operator was a contributory factor. As well as specific recommendations concerning the details of the

[3] The unit GyEq (gray equivalent) is used to indicate that the doses quoted are the sum of those from neutrons — weighted to account for their relative biological effectiveness — and those from gamma radiation. The doses are not quoted in sieverts because the weighting factors used in these estimates are appropriate for acute exposures giving high doses, and differ from those recommended by ICRP for the calculation of equivalent dose.

[4] He died on 27 April 2000.

accident itself and the response to the accident, the Committee made wide-ranging recommendations focused on the need to improve the general level of risk awareness and safety culture in nuclear operations.

33. Following the accident, the Japanese authorities announced a thorough review of nuclear safety regulations and their application at all types of facility, both to ensure that there was no immediate possibility of any similar events occurring elsewhere and, looking further ahead, to strengthen the overall legal and regulatory framework for nuclear safety and emergency preparedness. New legislation was passed in December 1999 which, inter alia, extended the requirement for periodic regulatory inspections to cover nuclear fuel cycle facilities and modified the Government's role in responding to emergencies. The Federation of Electrical Power Companies, which represents nine Japanese utilities operating nuclear power plants, proposed the establishment of a national operators' association (modelled on the international World Association of Nuclear Operators) to promote a more safety-conscious corporate culture throughout the nuclear power industry, by the exchange of information and experience and through peer reviews. As well as nuclear power plant operators, all organizations involved in the handling or transport of nuclear fuel or radioactive waste management would be encouraged to join.

Radioactive waste management

34. The first shipment of transuranic waste was delivered to the Waste Isolation Pilot Plant (WIPP) near Carlsbad, New Mexico, USA, in March 1999, making it the world's first operational geologic repository for long-lived radioactive waste. The repository, which is operated by the US Department of Energy (DOE) is about 700 m deep, in a natural salt formation, and is intended for the disposal of defence related transuranic waste (operational wastes — mainly sludges, tools, rags, glassware and protective clothing — contaminated with radionuclides of transuranic elements).

35. Also in the USA, the DOE issued in July 1999 a Draft Environmental Impact Assessment for the proposed repository for spent fuel and high level waste (HLW) at Yucca Mountain in Nevada. Seventeen public hearings in different locations in Nevada and around the USA were scheduled between September 1999 and January 2000. Proposed Site Suitability Guidelines for Yucca Mountain were also published by the DOE, in November 1999.

36. In August 1999, the French Government authorized the construction of an underground laboratory to investigate the suitability of a site in a clay formation at Bure for a deep geological repository for high level waste. In addition, a commission has been set up to find a site for the establishment of a second underground laboratory, in a granite formation to be selected.

37. In May 1999, the company responsible for spent fuel management in Finland, Posiva, issued an Environmental Impact Assessment Report on four possible sites being investigated for a final disposal facility for spent fuel. The report concluded that all four sites were potentially suitable, and Posiva requested a "decision in principle" from the Finnish Parliament to allow them to proceed with a proposed facility at their preferred site, Olkiluoto. A preliminary safety assessment of the disposal concept by the regulatory body STUK and a "decision in principle" on the choice of site are expected during 2000.

38. Two examples from the United Kingdom illustrated a general trend internationally, of revisiting some of the basic elements of radioactive waste management policies, particularly in relation to deep geological disposal of high level and/or long lived waste. In March 1999, the House of Lords Select Committee on Science and Technology issued a report on the Management of Nuclear Waste[5], in which, while concluding generally that "phased disposal in a deep repository is feasible and desirable", they stressed "the need for widespread public consultation before a policy is settled", and recommended that: "The repository would be kept open while data are accumulated, and only closed when there is sufficient confidence to do so." In May 1999, a National Consensus Conference on Radioactive Waste Management was organized by the UK Centre for Economic and Environmental Development (an independent charitable foundation). The Conference consisted of a "Citizen's Panel" — 15 volunteer members of the public with no previous formal involvement in radioactive waste management issues — questioning a broad spectrum of expert witnesses and reporting on their conclusions. In their report[6], the Panel stated that they were "unanimous that the word 'disposal' should not be used, as it is misleading to the public", and concluded that: "Radioactive waste must be removed from the surface and stored underground, but must be monitorable and retrievable", in order to "leave options open for future solutions."

39. As reported in previous editions of the Nuclear Safety Review, a Contact Expert Group (CEG) for International Co-operation in Radioactive Waste Management with the Russian Federation has been in operation since 1996, with the aim of assessing and prioritizing waste management issues in the Russian Federation. The CEG met twice during 1999: in Fredrikstad, Norway, in May; and in Berlin, Germany, in November. The Fredrikstad meeting agreed on a communique, addressed to the Nuclear Safety Working Group of the G-8[7] Summit in Cologne, Germany, providing concise information on the safety problems with radioactive waste and spent nuclear fuel in Russia, and appealing for concerted assistance in solving them. The Berlin meeting of the CEG discussed a Strategy for Radwaste and Spent Fuel Management in the Russian Federation. A document will be finalized at the CEG's next meeting, and will set out the CEG's arguments to encourage substantially higher financial support for the highest priority projects.

Radiation sources

40. On 8 December 1998, two Type B(U) transport packages were bought as scrap metal in Istanbul, Turkey. One of the packages contained a cobalt-60 source, which had been used in a hospital until late 1993. However, although the packages were reportedly labelled with trefoil symbols, nobody appears to have been aware of the potential radiation hazard. During the next few days the packages and containers were dismantled. When some of the people present during the dismantling began to feel ill, they sought medical advice, but were released after a few hours when their nausea and vomiting ceased.

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[5] Available at www.parliament.the-stationery-office.co.uk/pa/ld199899/ldselect/ldsctech/41/4101.htm.

[6] Available at www.ukceed.org/conference/citizens_panel_report.htm.

[7] "G-8" refers to the G-7 group of seven industrialized countries — Canada, France, Germany, Italy, Japan, the United Kingdom and the United States of America — plus the Russian Federation.

41. On 8 January 1999, two of the people involved in the dismantling, still feeling ill, went to a private hospital in Istanbul. The doctor who examined them suspected that the symptoms were caused by radiation exposure, and reported the case to the Çekmece Nuclear Research and Training Centre (CNAEM) of the Turkish Atomic Energy Authority (TAEK). High radiation levels were subsequently found at the scrap yard, and a cobalt-60 source of about 3.3 TBq (89 curies) was recovered. At the request of the Turkish authorities under the terms of the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency, the Agency sent a mission to advise on the medical treatment of the patients. A total of 18 people suspected of having received significant exposure were hospitalized, of whom 10 were diagnosed as having suffered acute radiation syndrome. The highest doses were estimated to have been between 3 and 4 Gy (whole body), and one person also received a localized dose of 10–20 Gy to the fingers, apparently while trying to remove the source.

42. At the time of the incident, it was suspected that another, larger, cobalt-60 source might have been in the second transport package. As no such source had been found within a few days, the Turkish authorities, under the terms of the Convention on Early Notification of a Nuclear Accident, notified neighbouring States of the possibility that a source might have been lost, and requested the Agency to notify other Contact Points. Neither the subsequent Agency mission nor the Turkish authorities found any evidence of a second source, and it is now considered likely that there was no source in the second package.

43. On 20 February 1999, a welder at the Yanango Hydroelectric Power Plant in Peru picked up an industrial radiography source of approximately 1.3 TBq (36 Ci) ^{192}Ir, placed it in his trouser pocket and took it home. After a while, he experienced mild nausea and pain in his leg. Erythema on his thigh was initially diagnosed as an insect bite. Meanwhile, the radiographers at the hydroelectric plant had noticed that the source was missing, and began visiting the homes of workers. The source was recovered approximately ten hours after the victim had originally put it in his pocket. At the request of the Peruvian Nuclear Energy Institute, an IAEA mission visited Peru in March 1999 to provide expert medical consultation and to review the local authorities' dosimetry methodology and results. The victim was later transferred to France for specialized medical treatment, but his leg had to be amputated and he returned to Peru. As of the end of 1999, he remained in a very serious condition.

44. The Nuclear Safety Reviews for the Years 1997 and 1998 described a series of incidents involving orphan sources in Georgia. The IAEA continued to provide assistance throughout 1999, and meetings between Georgian authorities and the Agency were held both in Georgia and in Vienna to develop strategies to systematically locate and make safe other sources believed to be present in Georgia and not under proper control.

Rehabilitation of contaminated areas

45. As reported in the Nuclear Safety Review for the Year 1997, the Agency, at the request of the Government of Kazakhstan, carried out a preliminary assessment of the radiological conditions at the Semipalatinsk nuclear test site. The report on this assessment and recommendations for further

study were published in 1998. An international conference was held in Tokyo in September 1999, organized by the Government of Japan and the United Nations Development Programme (UNDP), and co-sponsored by the IAEA, the UN Office for the Coordination of Humanitarian Affairs (OCHA), the United Nations Children's Fund (UNICEF) and the United Nations Population Fund (UNFPA). The conference was one of the principal follow-up actions aimed at taking forward the recommendations made in a report from the UN Secretary-General to the 1998 General Assembly. The report and the conference addressed the whole range of issues related to the situation in the Semipalatinsk region and, inter alia, called for a comprehensive radiological assessment. The IAEA expressed a willingness in principle to organize such an assessment, if the necessary resources were made available.

46. The IAEA also started work during 1999 on the examination of the sites in Algeria at which nuclear weapons were tested in the 1960s.

47. Measures to rehabilitate areas of Belarus, the Russian Federation and Ukraine affected by the Chernobyl accident continue through a wide range of national programmes and bilateral and international assistance projects. Some examples of projects in which the IAEA is involved are discussed briefly in Annex 3.

Transport of radioactive materials

48. The Nuclear Safety Review for the Year 1998 reported on the suspension of irradiated nuclear fuel shipments in France, Germany and Switzerland following the discovery of transport flasks and rail wagons with non-fixed contamination exceeding 4 Bq/cm^2 beta–gamma regulatory activity limit. Transport of irradiated nuclear fuel was resumed in France in July 1998, and in Switzerland in September 1999. The resumption of transports in these two States required the introduction of improved technical procedures, monitoring, documentation and information flow. As of the end of 1999, transport of irradiated nuclear fuel in Germany remains suspended, although steps toward a solution have been taken.

49. International transport of radioactive waste and nuclear fuel continued to attract controversy, particularly shipments by sea of vitrified high level waste and mixed oxide fuel from Europe to Japan. A Resolution adopted by the IAEA's General Conference reminded Member States of the invitation in an earlier Resolution GC(42)/RES/13 to States shipping radioactive materials "to provide, as appropriate, assurances to potentially affected States upon their request that their national regulations take into account the Agency's Transport Regulations and to provide them with relevant information relating to shipments of radioactive materials. The information provided should in no case be contradictory to the measures of physical security and safety".

50. In September 1999, a container for the transport of radioactive reference materials was sent from a European Commission (EC) Joint Research Centre Institute in Geel, Belgium, via Luxembourg, to its manufacturer in Abingdon, UK, for maintenance. The container had been assumed to be empty, but was found on arrival at the manufacturer's premises to contain a reference material, comprising a diluted solution of 0.69 g plutonium in nitric acid. At no time was there any spillage or contamination, and the material was transferred to safe storage nearby. An audit was

conducted by the EC, which identified weaknesses in the operating instructions and control mechanisms at the Institute and made recommendations for correcting these.

Health effects of radiation exposure

51. An expert commission, set up in 1997 by the French Government to study the possibility of a connection between an observed increase in the incidence of leukaemia in young people in the Beaumont–Hague canton and discharges from nuclear installations on the North Cotentin peninsula, issued its report in July 1999. The commission concluded that, on the basis of the calculated doses, the probability of a connection appeared to be low. The number of leukaemia cases expected on the basis of the calculated doses was estimated to be less than 0.002, compared to the observed 2 cases. The uncertainty in this estimate was not quantified, and for this reason some members of the group did not consider it possible to support the overall conclusion favoured by other members of the group, that a connection was "very unlikely". On the basis of the report, the Government Ministers responsible for environment and health concluded in a statement issued in October 1999 that the installations do not appear to have a significant influence on the number of leukaemias among young people.

52. Many other studies on the risks of exposure to low doses of radiation were publicized during the year; each drew their own conclusions (usually with appropriate caveats) but, overall, the picture remained inconclusive. To quote just two examples, the second study of the UK's National Registry of Radiation Workers gave 'best estimate' risk factors consistent with those currently accepted internationally (although the uncertainty in these estimates was such that neither substantially higher risk factors nor a threshold effect could be ruled out as possibilities), whereas a study of residents in the Kerala region of India, where natural background doses are many times higher than elsewhere, found no excess of cancers. A conference on "Bridging Radiation Policy and Science" was held in Warrenton, USA, in December 1999 to debate the scientific evidence and how that evidence should be translated into policies for regulating uses of radiation and radioactive materials. The participants included a broad range of scientists, policy-makers, regulators and interested individuals. A list of conclusions and recommendations "that received the broadest support" at the Conference was issued[8]. These included the observations that: "Fundamental questions about the shape of the dose–response curve and mechanisms of effects of radiation at low doses are unlikely to be answered in the near future", and that: "No radiation dose is below regulatory concern but certain levels should be below regulatory action, and appropriate dose levels should be established." The conclusions noted that: "The conference supports the evolving global framework of the IAEA for the safe use of radiation."

Y2K

53. As indicated in some specific instances elsewhere in this report, much effort was devoted during 1999, at both national and international levels, to prepare computer systems for the year change to 2000. One concern was the possible effects of Y2K-related computer failures on the safety of nuclear installations or of other facilities handling radiation sources and/or radioactive

[8] Available at www1.misinc.net/burkinc/.

material. However, no events of safety significance related to the year change have occurred at any such facilities, either during the rollover to 2000 or in the subsequent few months.

PART II

AGENCY ACTIVITIES IN NUCLEAR, RADIATION AND RADIOACTIVE WASTE SAFETY

1. The Agency's activities can be addressed in the context of the three main elements of the global safety culture:

(1) Legally binding international instruments, such as safety related conventions;

(2) Internationally accepted safety standards; and

(3) Application of those safety standards.

2. More detailed (and updated) information on the Agency's work in these areas is given in Annexes 1 to 7.

International instruments

3. The major safety related agreements currently in force are the Convention on the Physical Protection of Nuclear Material, the Convention on Early Notification of a Nuclear Accident, the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency and the Convention on Nuclear Safety. The Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management has been opened for signature, but has not yet entered into force. Lists of the Contracting Parties and signatories to these Conventions as of mid-2000 can be found in Annex 1, and more detail is given in GC(44)/INF/10: up-to-date lists are also available on the Agency's WorldAtom web site at www.iaea.org/worldatom/glance/legal/.

4. One part of the Agency's work in relation to these Conventions is administrative, typically including a secretariat role and, in the person of the Director General, the function of depositary. Important developments during 1999 are outlined in Part I. The Agency also has specific, more active roles in relation to the Notification and Assistance Conventions when incidents occur; examples of such activities are indicated in the relevant sections of Part I.

Safety standards

5. A major programme of work to update and expand the Agency's suite of nuclear, radiation, radioactive waste and transport safety standards has been under way in recent years. The number of new and revised safety standards reaching publication increased significantly in 1999, and is expected to peak in the next two years.

6. The safety standards preparation and review process involves five standing advisory bodies of senior experts nominated by Member States: an Advisory Commission on Safety Standards (ACSS)

and four Advisory Committees, on nuclear, radiation, transport and waste safety. The members of the ACSS were appointed for a four-year term which finished at the end of 1999; the Commission is being reconstituted with revised membership for the period 2000–2003.

7. During 1999, Safety Requirements on the near surface disposal of radioactive waste and six Safety Guides — three on occupational radiation protection, two on decommissioning and one on near surface disposal — were published. A further three Safety Requirements publications — on legal and governmental infrastructure, on the safety of nuclear power plant operations, and on predisposal management of radioactive waste, including decommissioning — were approved by the September 1999 session of the Board of Governors. A Safety Guide on the regulatory control of discharges to the environment was also endorsed by the ACSS for publication.

8. More than 50 other new or revised safety standards are at earlier stages of the preparation and review process. A summary of the current status of all of the Agency's safety standards is available from the Secretariat or through the Coordinet pages of the WorldAtom web site (www.iaea.org/ns/coordinet/). Further details on developments in the safety standards programme are given in Annex 2.

International Nuclear Safety Advisory Group (INSAG)

9. INSAG is an independent expert group established to advise the Director General of IAEA on nuclear safety issues. In August 1999, a report by the Group entitled "The Safe Management of Sources of Radiation: Principles and Strategies" was published as INSAG-11. This report was prepared in response to a specific request from the Director General, and aims at drawing together the common principles underlying the Agency's three current Safety Fundamentals publications[1]. INSAG reports are advisory in nature and are not Agency safety standards, but it is intended that INSAG-11 will be an important input in reviewing the existing Safety Fundamentals publications, with a view to producing a single set of consensus Safety Fundamentals applicable to all areas of safety.

10. Three other reports from INSAG were published in late 1999, namely:

- "Basic Safety Principles for Nuclear Power Plants", an update of INSAG-3 issued as INSAG-12;
- "Management of Operational Safety in Nuclear Power Plants" (INSAG-13); and
- "Safe Management of the Operating Lifetimes of Nuclear Power Plants" (INSAG - 14).

11. Members of INSAG are appointed by the Agency's Director General, on the basis of nominations from Member States, for a three-year term. The term of the group appointed in 1996 ended in 1999, and INSAG has been reconstituted with a new membership, under the chairmanship

[1] The Safety of Nuclear Installations, Safety Series No. 110 (1993); The Principles of Radioactive Waste Management, Safety Series No. 111-F (1995); Radiation Protection and the Safety of Radiation Sources, Safety Series No. 120 (1996).

of Mr. A. Baer (Switzerland), for the period 1999–2002. Approximately one-third of the members who served from 1996–1999 were reappointed for the new term.

Application of the standards

12. Application of safety standards in Member States is primarily a national matter, but the Agency undertakes many activities to assist Member States in this endeavour, many of which are supported through the technical co-operation (TC) programme:

(1) Providing direct safety related assistance to Member States;

(2) Fostering the exchange of safety related information;

(3) Encouraging education and training;

(4) Rendering a wide range of safety review services; and

(5) Co-ordinating and supporting safety related research and development.

Safety related assistance

13. In addition to the IAEA's Regular Budget, there are two major sources of direct safety related assistance from the Agency to Member States: the technical co-operation (TC) programme and extrabudgetary programmes (EBPs). Further details on this work are given in Annex 3.

14. By far the larger of the two is the safety related TC programme, financed by the TC Fund and delivered with technical support from the Departments of Nuclear Safety and Nuclear Energy and the Legal Division. This work in 1999 involved an annual budget of approximately $16 million, with about 140 national, regional and interregional projects in operation.

15. Substantial work in recent years has been carried out under the Model Project 'Upgrading of Radiation Protection Infrastructure' in more than 50 Member States, where the Agency is providing technical support and assisting in the implementation of Action Plans aimed at establishing effective radiation safety programmes. In order to quantify the progress achieved so far under the Model Project, a representative group of 14 participating States were visited by Peer Review Teams during the second half of 1999. The Peer Review Teams evaluated the adequacy of the legal and regulatory framework, the empowerment of the regulatory authority to enforce legislation and regulations, the system of notification and authorization for control of radiation sources, compliance monitoring, enforcement, the existing financial and human resources, and the number of adequately trained personnel. The Peer Reviews, the monitoring of project activities and appraisal meetings indicate that about 30% of participating countries have achieved the first milestone — a system of notification, authorization, inspection and enforcement including the relevant legislation and regulatory infrastructure — a further 40% are in the process of implementing such a system, but the remaining 30% are late in their implementation. Significant progress has also been made towards the second milestone — a system for control of occupational exposure — with 60% of participating States having individual monitoring systems for external exposure and about 40% having workplace monitoring established and operational. The Peer Reviews also concluded that the Model Project is having a positive impact on the radiation protection infrastructure in the participating countries. This

result will determine the way forward with respect to the future of the Model Project. Further information on the Model Project is given in Annex 3.

16. A programme of assistance on the conditioning of spent radium sources has been completed or is close to completion in 12 countries of Latin America. Similar programmes are under way in Africa — where operations have been completed in Ghana and the United Republic of Tanzania — and in Asia, where operations have so far been carried out in China and Pakistan. The Agency also reviewed a report by the Atomic Energy Commission of South Africa on a concept for the disposal of spent sealed sources in specially designed boreholes.

17. The Nuclear Safety Review for the Year 1998 reported on the issue of intergranular stress corrosion cracking (IGSCC) of stainless steel piping in RBMK reactors. A new extrabudgetary programme was established in 1999 to co-ordinate and assist with actions to address the issue at potentially affected facilities. The programme will focus on improving in-service inspection and qualification; comprehensive assessment techniques; qualification of repair techniques; and decontamination techniques.

18. The existing Extrabudgetary Programme on the Safety of Nuclear Installations in South East Asia, Pacific and Far East Countries continued to provide assistance to China, Indonesia, Malaysia, the Philippines, Thailand and Viet Nam. The Programme places particular emphasis on enhancing the technical capabilities of regulatory bodies and technical support organizations. Activities during 1999 included a review of the Malaysian regulatory organization, pre-IRRT[2] missions to Indonesia and Viet Nam and a workshop on the regulatory function in Thailand; four design safety missions and two PSA workshops in China; three expert review missions and a Regional Training Course on research reactor safety; and an expert mission to Indonesia on emergency preparedness. Further information on this and other extrabudgetary programmes is given in Annex 3.

Information exchange

19. In addition to producing a wide range of safety related publications, the Agency organized four major international conferences with relevance to safety in 1999:

(1) the International Conference on the Strengthening of Nuclear Safety in Eastern Europe; held in Vienna in June 1999, and discussed in Part I;

(2) an International Symposium on Technologies for the Management of Radioactive Waste from Nuclear Power Plants and Back End Nuclear Fuel Cycle Activities, held in Taejon, Republic of Korea, from 30 August to 3 September 1999;

(3) an International Symposium on Research Reactor Utilization, Safety and Management, held in Lisbon, Portugal, in September 1999; and

(4) an International Symposium on Restoration of Environments with Radioactive Residues, held in Arlington, USA from 29 November to 3 December 1999.

[2] International Regulatory Review Team.

20. Another major international conference, on the Safety of Radioactive Waste Management, was held in Córdoba, Spain, in March 2000. The findings and conclusions of this conference are summarized in GC(44)/INF/5.

21. Further information on the Agency's recent activities in this area is given in Annex 4.

Education and training

22. Safety related training courses, workshops and seminars are supported by the Agency, mostly under the TC programme, but also through the EBPs and regular budget activities. In addition, a number of TC projects are dedicated to establishing/strengthening infrastructure for plant personnel training. Further information is given in Annex 5.

23. More than 80 national, regional and interregional safety related training events were held during 1999 under the TC programme. Nine-week Basic Professional Training Courses in Radiation Protection were held in the Syrian Arab Republic (in Arabic) and the Russian Federation (in Russian), and Regional Post-Graduate Educational Training Courses of longer duration were held on radiation protection in South Africa (in English) and on radiation protection and nuclear safety in Argentina (in Spanish). The first nine-week Basic Professional Training Course in Nuclear Safety was held at Saclay, France (in English).

24. Standard 'packages' of materials for Agency-supported training courses — syllabuses, manuals, visual aids, etc. — are increasingly being used, both to improve the consistency of the courses supported by the Agency and to allow Member States to conduct their own courses using the Agency materials.

25. An international Working Group established by the Agency provides a forum for exchange of information concerning the training and qualification of nuclear power plant personnel. The group's members are nominated by the governments of Member States with operating nuclear power plants. A key issue that the group has asked the Agency to focus on is that, in a number of Member States, a large fraction of the nuclear industry workforce is nearing retirement age. At the same time, nuclear power is facing greater competition from other industries in recruiting personnel, particularly from technology oriented companies. The situation is further compounded by the fact that the educational infrastructure that supported the initial implementation of nuclear power is in many cases being dismantled or significantly reduced.

Research and development

26. Twenty-five Co-ordinated Research Projects (CRPs) were active during 1999: eight on nuclear safety, ten on radiation safety, three on transport safety and four on waste safety. These CRPs involved a total of over 250 individual contracts and agreements. CRPs are typically of 3–5 years duration, and cover a wide range of topics in nuclear, radiation and waste safety. Five CRPs (one nuclear safety — on validation of accident and safety analysis methodology — and four radiation safety — two on radiation protection in diagnostic radiology and two dosimetry intercomparison studies) were completed during the year, and the results will be disseminated by the

Agency, typically in the form of TECDOCs. Five new CRPs started in 1999, on indicators to monitor operational safety performance at nuclear power plants, on reliability data for research reactor PSAs, on image quality and patient dose optimization in mammography, on application of PSA to radiation sources, and on safety indicators (such as concentrations and fluxes) for radioactive waste disposal assessments.

27. Further information on the CRPs is given in Annex 6.

Safety services

28. During 1999, the Agency conducted:

- 3 OSART[3] missions, 4 OSART follow-up missions and 5 pre-OSART visits;
- 1 safety culture enhancement mission, 1 peer review of a self-assessment of safety culture, and a workshop on management of safety culture. The mission and peer review were both conducted for Electronuclear, Brazil (the operators of Angra nuclear power plant), and represented a new comprehensive approach to the safety culture enhancement process. Work with Electronuclear will continue as the programme of recommended improvements is implemented;
- 1 ASSET[4] peer review of self-assessments of operational events, 1 ASSET seminar on plant self-assessment and 2 ASSET workshops on root cause analysis;
- 18 ESRS[5] missions: 5 on design safety, 12 on internal/external events (e.g. seismic safety, fire safety), and 1 software safety review;
- 1 full IRRT review, 2 pre-IRRT missions and 4 preparatory visits;
- 2 INSARR[6] missions, to Belgium and Finland, and 13 other missions to research reactors. These included one, carried out with extrabudgetary funds, to assist in dealing with spent fuel elements at the Vinča research reactor in Belgrade; and
- 4 IPERS-PSA[7] missions.

29. More detailed information on safety review services is given in Annex 7.

30. At the request of the 1998 General Conference, a new service, the Transport Safety Appraisal Service (TranSAS), was introduced by the Agency to provide reviews, on request, of national implementation of the IAEA Regulations for the Safe Transport of Radioactive Material. The first mission visited Slovenia in June 1999 and carried out an appraisal of the legislative framework for

[3] Operational Safety Review Team.

[4] Assessment of Safety Significant Events Team.

[5] Engineering Safety Review Service.

[6] Integrated Safety of Research Reactors.

[7] International Peer Review Service on Probabilistic Safety Analysis.

transport of radioactive materials and the associated division of responsibilities, approval procedures, and inspection and emergency preparedness arrangements. With the agreement of Slovenia, the report of the review was presented to the 1999 General Conference, and in Resolution GC(43)/RES/11 the General Conference encouraged Member States "to make use where appropriate of the Transport Safety Appraisal Service with a view to achieving the highest possible levels of safety during the transport of radioactive materials".

Y2K

31. The Agency undertook a substantial special project to assist Member States in addressing the year 2000 computer problem. With the assistance of experts from Member States, the Agency prepared guidance documents, aimed at operators of nuclear installations and associated electricity grids, radioactive waste management facilities and medical facilities using radiation generators or radioactive materials. Workshops were held on Y2K preparedness for nuclear power plants, waste management and medical facilities, and on the interface between electricity grid performance and nuclear power plant operations, and a workshop was held in November 1999 specifically to address contingency planning for nuclear power plants and the associated electricity grids. The full text of the guidance documents, along with detailed reports from all four workshops, were made available through the Agency's Y2K web pages (www.iaea.org/worldatom/program/y2k/), which also provided access to information provided by Member States in response to a Y2K questionnaire and to a newsgroup for the direct exchange of Y2K information, as well as links to useful information on other web sites. The Agency also sent, on request, 20 missions to nuclear power plants in nine Member States, to review and advise upon their Y2K preparations.

32. The IAEA's Emergency Response Centre was in operation throughout the year change period, to monitor developments in each of its Member States having nuclear power plants as local time passed through midnight from 31 December 1999 to 1 January 2000. By 10:30 UTC on 1 January 2000 (two and a half hours after the last nuclear power plants in the USA passed local midnight), all countries operating nuclear power plants had confirmed to the Agency that no incident with implications for safety had occurred at any nuclear power plant as a result of the immediate transition to the year 2000.

Safety of radiation sources and security of radioactive materials

33. The Action Plan for the Safety of Radiation Sources and the Security of Radioactive Materials was developed at the request of the March 1999 session of the Board of Governors, approved by the Board of Governors in September 1999 and endorsed by the General Conference in resolution GC(43)/RES/10. The Action Plan covers seven areas:

- Regulatory infrastructures;
- Management of disused sources;
- Categorization of sources;
- Response to abnormal events;
- Information exchange;

- Education and training; and
- International undertakings.

These areas are discussed briefly in turn in the following paragraphs: a more detailed account is given in GC(44)/7.

34. **Regulatory infrastructures**: the Secretariat has established a Radiation Safety Regulatory Infrastructure (RSRI) service to, at the request of a State, assess the effectiveness of regulatory infrastructures, recommend improvements and, where appropriate, assist in the implementation of improvements.

35. **Management of disused sources**: The Secretariat is preparing three TECDOCs, on the management of high activity disused sources, on procedures for conditioning and storing long lived disused sources, and on disused sealed source management involving storage/disposal in boreholes. A Technical Committee, with representatives from major source manufacturers, Member States and other international organizations, is being planned.

36. **Categorization of sources**: A categorization scheme has been developed and endorsed by a Technical Committee (with representatives from 15 Member States). The categorization ranks sources, according to the harm they could cause, as higher risk (industrial radiography sources, teletherapy sources, irradiators), medium risk (brachytherapy sources, well logging sources and some fixed industrial gauges) and lower risk (fixed industrial gauges with lower activity sources). This general categorization provides an indication of the priority that a regulatory authority should assign to the control of such sources.

37. **Response to abnormal events**: A TECDOC is to be prepared defining a model national strategy for the detection and location of orphan sources. The key elements and issues to be addressed in this model strategy have been identified. The Secretariat has begun formulating criteria for radiation detection and monitoring equipment for use at border crossings, etc., with priority on the detection of higher risk sources. The Agency's technical guidance for response organizations is being updated and expanded in relation to radiological emergencies. A leaflet for doctors on recognizing and responding to radiation injuries has been produced. Existing training materials are being provided to identified trainers in Member States on CD-ROM, and further materials are being prepared. Regional workshops have been held to increase awareness of the need to strengthen national response capabilities. The Secretariat's own capabilities in this area, along with arrangements for co-operation with other relevant international organizations, are being strengthened and updated, for example by establishing an international network of qualified emergency response teams, available to assist the Agency in responding to requests for assistance.

38. **Information exchange**: An international conference for national regulatory authorities will be held in Buenos Aires, Argentina, in December 2000 to provide a forum for an exchange of information and experience. Six regional workshops are being organized for users and manufacturers of sources as well as regulators. A database of missing and found orphan sources is planned, and a database of of unusual radiation events (RADEV) has been developed and is

currently being tested. An international catalogue of sources and devices containing sources is also under development: data for the catalogue are currently being collected from Member States.

39. **Education and training**: The Agency's standard syllabus for post-graduate educational courses in radiation protection has been revised and updated, and the frequency of such courses is planned to increase. Shorter specialized courses and workshops are organized to provide further training. Emphasis is being placed on developing standard training materials and on "training the trainers" to help strengthen Member States' own training capabilities.

40. **International undertakings**: An open-ended meeting of technical and legal experts in March 2000 held exploratory discussions on a possible Code of Conduct on the Safety of Radiation Sources and produced a first draft of such a Code. A second open-ended meeting in July 2000 revised and finalized the draft Code and submitted it to the Director General, with the request that it be submitted to the Board of Governors for consideration.

PART III

LOOKING AHEAD

1. This section provides a brief discussion of some forthcoming events, and of some safety related issues that are likely to be prominent in the coming years. (The order in which items appear is not intended to imply anything about their relative importance.)

Safety related conventions

2. As noted in Part I, the first Review Meeting of Contracting Parties to the Convention on Nuclear Safety took place in April 1999. The Convention on Nuclear Safety is an 'incentive Convention', which depends for its effectiveness on a process of peer review and, by extension, peer pressure. Each Contracting Party is required to report to the other Contracting Parties on the measures it has taken and is taking to meet the nuclear safety obligations set out in the Convention. The Contracting Parties review and comment on these measures in the context of the Convention obligations, and thereby provide an indication of the improvements that might be needed, as well as applying peer pressure to encourage the implementation of such improvements.

3. The Review Meeting was the first major test of this process for a safety related convention. Overall, the Contracting Parties concluded that the review process had proven to be of great value to their national nuclear safety programmes, providing learning through international co-operation. Although the review process thus was considered to have been very successful, especially considering that it was the first of its kind, the Contracting Parties decided on certain improvements and amendments to the procedures. These experiences, and the changes adopted, were of particularly interest in the planning work for the entry into force of the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management.

Regulatory independence

4. The independence of national regulatory bodies was discussed at some length during the first Review Meeting of Contracting Parties to the Convention on Nuclear Safety. In their Summary Report, the Contracting Parties stated that the effective independence of regulatory bodies is considered an essential element in nuclear safety. A distinction was drawn, however, between "de jure" independence — the formal, legal separation of the regulatory body from organizations or government departments involved in the promotion of nuclear technology — and "de facto" independence — meaning that, in practice, the regulatory body acts in an independent way. The Report noted that, generally, the regulatory bodies of Contracting Parties appeared to act in a clearly independent way in a "de facto" sense, but that in several cases, it would be desirable, and in some cases even necessary, to improve the "de jure" independence of the regulatory body.

Effects of external factors on nuclear safety

5. In their Summary Report of the first Review Meeting, the Contracting Parties to the Convention on Nuclear Safety noted trends in several countries with regard to factors and circumstances external to the nuclear safety programme as such, but which could have a significant impact on nuclear safety if not counteracted by appropriate actions. Such factors included:

- economic deregulation of electricity markets, associated ownership changes and increased competition;
- maintaining competence in industry, regulators and research institutions, especially in countries with small nuclear programmes, or where phasing out nuclear power is part of the national energy policy, or where the use of nuclear power is reduced for other reasons; and
- lack of sufficient economic resources in some countries.

6. In response to economic deregulation and the resulting pressures of competition, nuclear utilities worldwide increasingly need to adopt an integrated approach to the management of nuclear safety, production and economics, based on the understanding that production and safety are not contradictory objectives. In many cases measures being implemented to improve the reliability and economics of electricity generation also lead to increased safety.

7. One consequence of the stagnation or decline of nuclear power programmes in a number of Member States is that, while a large fraction of the nuclear industry's workforce is nearing retirement age, the recruitment of suitable replacement personnel is hindered by significantly reduced educational opportunities in the relevant subjects, and by increased competition from other industries perceived as having a brighter future.

Safety standards for nuclear fuel cycle facilities

8. The development of the IAEA's safety standards has concentrated mainly on particular types of facility: the nuclear safety standards primarily address nuclear power plants and research reactors; the waste safety standards address facilities involved in the various stages of waste management (including decommissioning), but particularly repositories; and the radiation safety standards are either independent of the type of facility (e.g. radiation protection measures) or focused mainly on facilities outside the 'nuclear industry'. It had already been recognized that some types of facility are not expressly addressed by the existing international safety standards, and a programme of work was proposed to identify new standards that might be necessary. The Tokaimura accident at a fuel processing facility (see Part I) highlighted this issue, particularly in relation to criticality safety at non-reactor facilities. At its meeting in November 1999, the Advisory Commission on Safety Standards requested the Secretariat to prepare detailed plans for safety standards to cover those facilities or issues not already addressed.

Radiation protection of patients

9. Although medical applications were among the earliest deliberate uses of ionizing radiation, the protection of patients undergoing diagnostic and therapeutic procedures involving radiation has tended to receive somewhat less attention than the radiation protection of workers and members of the public. However, this situation is changing, stimulated in part by a wish to prevent accidents such as those in Zaragoza, Spain, in 1990 and San José, Costa Rica, in 1996, but also by a growing recognition of the need to control doses from normal procedures — particularly high dose ones, such as interventional radiology. In the member countries of the European Union, this general trend has been given additional impetus by the need to implement the 1997 Council Directive on Health Protection of Individuals against the Dangers of Ionising Radiation in relation to Medical Exposures (97/43/EURATOM) (see the Nuclear Safety Review for the Year 1997).

10. A number of events during 1999 were indicative of the greater emphasis being given to this subject, for example:

- the IAEA's first guidelines on radiation protection in interventional radiology were finalized. These provide more specific guidance on implementing the requirements for the radiation protection of patients established in the International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources in 1996;
- an International Seminar on Radiological Protection in Diagnostic Radiology was held at the University of Málaga, Spain, in April 1999; and
- an Advisory Group established by the UK's National Radiological Protection Board issued advice on optimizing radiation doses in medical diagnostic procedures (Documents of the NRPB, Vol. 10, No. 1).

11. A resolution adopted by the IAEA General Conference (GC(43)/RES/12) requested the IAEA Secretariat to "organize as soon as feasible, in close collaboration with the World Health Organization, … an international meeting on the radiological protection of patients for the purpose of an exchange of information and the development of recommendations, as appropriate".

The safety of radiation sources and the security of radioactive material

12. Previous editions of the Nuclear Safety Review have detailed many instances of serious — sometimes fatal — consequences resulting from radiation exposures due to radiation sources and radioactive materials that, for one reason or another, were not under proper control. Part I of the current edition describes incidents during the past year.

13. In response to the continuing occurrence of such events, the IAEA's Board of Governors and General Conference endorsed in September 1999 an action plan on the safety of radiation sources and the security of radioactive material. This sets out a programme of Agency activities in the coming years, maximizing the use of existing initiatives such as the Model Project on strengthening radiation and waste safety infrastructure, and work with the World Customs Organization and Interpol on the prevention, detection and response to illicit trafficking. The main, regulatory

components of the action plan comprise Agency activities aimed at: (1) strengthening national regulatory programmes covering notification and authorization, the safety of radiation sources and the security of radioactive materials, and the storage or disposal of disused sources; (2) detection and emergency response; and (3) recovery and remediation. Training is an essential part of all these activities. The action plan also calls for a meeting of technical and legal experts, to take place within a year of the adoption of the plan, for exploratory discussions relating to an international undertaking in the area of the safety of radiation sources and the security of radioactive materials. Supporting components of the action plan are aimed at persons or organizations having an interest in seeing that the orphan source problem is addressed. These include metal recyclers, metallurgical plants and non-radioactive waste disposal facilities. Manufacturers and suppliers of monitoring or detection systems are also part of this group.

Quality assurance within regulatory bodies

14. Increasing attention is being given to the formal application of quality assurance practices to the performance of regulatory functions. This is necessary due to the variety and complexity of activities performed by the nuclear regulator in the various licensing areas, and the increasing scrutiny under which regulators work (both with regard to the accuracy and consistency of their work and the effectiveness and efficiency with which they carry it out). Effective quality assurance systems also provide a sound basis from which regulators can respond to new regulatory challenges as the need arises. Such changes could have a profound effect on, for example, work planning, resources, training, regulations, regulatory policies and priorities. The Agency published in 1999 a technical document summarizing available experience on the application of quality assurance principles and methods by regulatory bodies to their activities. The aim is to continue exchanging experience on quality systems in regulatory bodies and integrate this experience as appropriate in further development of the safety standards.

Safety of research reactors

15. The Nuclear Safety Review for the Year 1998 highlighted increasing concern about the safety of research reactors. The International Symposium on Research Reactor Utilization, Safety and Management, held in Lisbon, Portugal, in September 1999, highlighted the important issues. Many of these issues — such as the need for rigorous and effective in-service inspection programmes, the safe management of spent fuel, the updating of safety documentation and the maintenance of safety expertise — are particularly associated with ageing reactors. These issues need to be addressed to make sure that old reactors — whether they continue in operation or are decommissioned — are managed in a way that is consistent with modern safety standards. The Agency will enhance exchange of information among research reactor regulators and operators through the Incident Reporting System for Research Reactors and a new Co-ordinated Research Project. Furthermore, the methodology of the Integrated Safety Assessment of Research Reactors (INSARR) service has been improved and the number of missions is increasing.

16. The Agency has project and supply agreements in place for some 25 research reactors, and these agreements require, inter alia, that the States concerned apply the Agency's safety standards in connection with these reactors. The agreements also call for the Agency to determine that the safety

measures are adequate. The Secretariat is reviewing these agreements with a view to enhancing its knowledge about the current safety operations and practices of these research reactors. Where necessary, the Secretariat will, in accordance with the terms of the relevant agreement, arrange safety missions to assist and advise on safety measures.

Radioactive waste management

17. On the basis of the current rate of ratification, it is likely that the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management will enter into force in 2000 or 2001. This will impose on the Contracting States a range of obligations concerning the safety of existing and proposed facilities. With this in mind, the IAEA, in co-operation with the EC and the OECD/NEA, sponsored an International Conference on the Safety of Radioactive Waste Management, hosted in Córdoba by the Government of Spain, from 13 to 17 March 2000. The Agency is also organizing, during the 44th session of the General Conference in September 2000, a Scientific Forum entitled "Radioactive Waste Management: Turning Options into Solutions", to bring to the attention of senior governmental representatives present at the General Conference some of the important scientific and technical issues in the field of radioactive waste management and to promote awareness of the international dimension of current developments.

18. At the same time, as reported in the "Looking Ahead" section of the Nuclear Safety Review for the Year 1998, many States are re-examining national policies, particularly in relation to geological disposal of higher level wastes, in an effort to find solutions that are both technically safe and broadly acceptable to the public. The examples from the UK quoted in Part I are indicative of the attention being given to the idea of waste being kept in a retrievable form. It is clear that new approaches are needed to build consensus on waste management solutions that are both safe and publicly acceptable, and to build confidence in those solutions. As a contribution to this process, the IAEA is promoting the concept of an international, multidisciplinary 'forum' on high level waste management.

Uranium mining and milling

19. The impact of uranium mining and milling has become a more prominent issue in recent years, particularly in relation to the environmental impact of developing new operations and the management of the wastes produced by the processes. Recognizing the increasing interest in this issue worldwide, a joint report by the OECD/NEA and the IAEA was published in 1999, providing an overview of the environmental and safety activities being undertaken at existing and disused sites in 29 countries. The activities covered in the report range from the planning of facilities and operations, through the control of emissions and the working environment (including radiation protection of workers) during operations, to the restoration of sites affected by the residual wastes after operation. The management of mining and milling wastes was also highlighted by IAEA Member States reviewing the Agency's safety programme as a priority issue for future work. A number of safety standards covering various aspects of this topic are already being prepared, and an IAEA International Symposium on the Uranium Production Cycle and the Environment, in co-operation with the OECD/NEA, the Nuclear Energy Institute and the Uranium Institute, is scheduled for 2–6 October 2000 in Vienna.

NORM waste

20. Other types of waste containing naturally occurring radioactive materials (NORM), in which the concentration of one or more of the radionuclides is naturally higher than average or has been enhanced by industrial processes unrelated to the nuclear fuel cycle, are being recognized — often for the first time — as a safety issue. This is a potential issue in a wide range of countries and the wastes typically occur in large amounts, and the lack of internationally agreed criteria for managing these wastes has led to a wide range of approaches. Workshops are being held and action teams are being formed to address the subject.

Innovative reactor designs

21. High temperature gas-cooled reactor (HTGR) designs currently being developed are predicted to achieve a high degree of safety through reliance on inherent safety features. Such features include ceramic-coated fuel particles that can retain fission products under both normal and accident conditions, stabilizing neutron physics characteristics, and the ability to dissipate decay heat by natural heat transport mechanisms, preventing excessive temperatures from being reached. Such design features should allow the technical demonstration of a very high level of public protection with significantly reduced active safety systems and emergency planning requirements.

22. For example, a scale model criticality test mock-up of a Pebble Bed Modular Reactor (PBMR) — an HTGR design being developed by the South African utility Eskom — achieved criticality at a test facility in Moscow in June 1999, and a decision on whether to build a prototype is expected during 2000. An IAEA review of technical, economic and safety aspects of the PBMR design was initiated in 1999. The safety part of this review will draw upon the results of three recently completed Co-ordinated Research Projects (CRPs) on HTGRs, which addressed, respectively, the validation of safety related physics calculations, heat transport and afterheat removal under accident conditions, and the validation of predictive methods for fuel and fission product behaviour. Reports on these three CRPs are also being made available on the Agency's web site as they are completed.

23. An overview of other innovative gas, water and liquid metal cooled reactors is given in the Nuclear Technology Review 2000 (GC(44)/9).

Reactors for cogeneration and non-electricity applications

24. A number of Member States are considering the use of nuclear reactors either for applications that combine the generation of electricity with other uses of the heat, such as for district heating, or desalination of sea water, or for applications that use the heat solely for non-electric purposes. The overall safety and licensing issues associated with an integrated facility consisting of a nuclear energy system coupled to a heat utilization unit, such as a desalination or district heating system, are primarily those associated with the nuclear plant itself. Nevertheless, the safety and licensing of the integrated system must be addressed and some specific characteristics, such as siting and the coupling of the reactor with the heat utilization unit, require particular consideration from a safety point of view.

ANNEX 1

STATUS OF SAFETY RELATED CONVENTIONS

1. In the table below:

- a date in bold type indicates, for a Contracting Party, the year of the deposit of an expression of consent to be bound (i.e. an instrument of ratification, accession, acceptance, etc.) with the depositary;
- a date in parentheses indicates, for a signatory which is not a Contracting Party, the year of signature; and
- (ocp) indicates, for a State or organization which is not a signatory or a Contracting Party, that an official contact point for the purposes of the relevant convention has been made known to the Secretariat. Unless otherwise indicated, signatories of and Contracting Parties to the Early Notification Convention and the Assistance Convention have notified the Agency of an official contact point.

STATUS OF SAFETY RELATED CONVENTIONS, 31 JULY 2000

	Early Notification	Assistance	Nuclear Safety	Joint Convention
IAEA Member States				
Afghanistan	(1986)[a]	(1986)[a]		
Albania				
Algeria	(1987)	(1987)	(1994)	
Angola				
Argentina	**1990**	**1990**	**1997**	(1997)
Armenia	**1993**	**1993**	**1998**	
Australia	**1987**	**1987**	**1996**	(1998)
Austria	**1988**	**1989**	**1997**	(1998)
Bangladesh	**1988**	**1988**	**1995**	
Belarus	**1987**	**1987**	**1998**	(1999)
Belgium	**1999**	**1999**	**1997**	(1997)
Benin				
Bolivia	(ocp)	(ocp)		
Bosnia and Herzegovina	**1998**	**1998**[a]		
Brazil	**1990**	**1990**	**1997**	(1997)
Bulgaria	**1988**	**1988**	**1995**	**2000**
Burkina Faso				
Cambodia				
Cameroon	(1987)	(1987)[a]		
Canada	**1990**	(1986)	**1995**	**1998**
Chile	(1986)	(1986)[a]	**1996**	
China	**1987**	**1987**	**1996**	

STATUS OF SAFETY RELATED CONVENTIONS, 31 JULY 2000

	Early Notification	Assistance	Nuclear Safety	Joint Convention
Colombia	(ocp)			
Costa Rica	**1991**	**1991**		
Côte d'Ivoire	(1986)	(1986)[a]		
Croatia	**1992**	**1992**	**1996**	**1999**
Cuba	**1991**	**1991**	(1994)	
Cyprus	**1989**	**1989**	**1999**	
Czech Republic	**1993**	**1993**	**1995**	**1999**
Democratic Republic of the Congo	(1986)	(1986)[a]		
Denmark	**1986**	(1986)	**1998**	**1999**
Dominican Republic				
Ecuador	(ocp)	(ocp)		
Egypt	**1988**	**1988**	(1994)	
El Salvador				
Estonia	**1994**	**1994**		
Ethiopia	(ocp)			
Finland	**1986**	**1990**	**1996**	**2000**
France	**1989**	**1989**	**1995**	**2000**
Gabon	(ocp)			
Georgia	(ocp)	(ocp)		
Germany	**1989**	**1989**	**1997**	**1998**
Ghana	(ocp)	(ocp)	(1995)	
Greece	**1991**	**1991**	**1997**	**2000**
Guatemala	**1988**	**1988**[a]		
Haiti	(ocp)			
Holy See	(1986)	(1986)[a]		
Hungary	**1987**	**1987**	**1996**	**1998**
Iceland	**1989**	(1986)[a]	(1995)	
India	**1988**	**1988**	(1994)	
Indonesia	**1993**	**1993**	(1994)	(1997)
Iran, Islamic Republic of	(1986)	(1986)		
Iraq	**1988**	**1988**		
Ireland	**1991**	**1991**	**1996**	(1997)
Israel	**1989**	**1989**	(1994)	
Italy	**1990**	**1990**	**1998**	(1998)
Jamaica				
Japan	**1987**	**1987**	**1995**	
Jordan	**1987**	**1987**	(1994)	
Kazakhstan	(ocp)	(ocp)	(1996)	(1997)
Kenya	(ocp)	(ocp)		
Korea, Republic of	**1990**	**1990**	**1995**	(1997)
Kuwait	(ocp)			
Latvia	**1992**	**1992**	**1996**	**2000**
Lebanon	**1997**	**1997**	**1996**	(1997)
Liberia				
Libyan Arab Jamahiriya	(ocp)	**1990**[a]		
Liechtenstein	**1994**	**1994**[a]		

STATUS OF SAFETY RELATED CONVENTIONS, 31 JULY 2000

	Early Notification	Assistance	Nuclear Safety	Joint Convention
Lithuania	**1994**	(ocp)	**1996**	(1997)
Luxembourg	(1986)	(ocp)	**1997**	(1997)
Madagascar	(ocp)	(ocp)		
Malaysia	**1987**	**1987**		
Mali	(1986)[a]	(1986)[a]	**1996**	
Malta	(ocp)	(ocp)		
Marshall Islands				
Mauritius	**1992**	**1992**		
Mexico	**1988**	**1988**	**1996**	
Monaco	**1989**	**1989**	(1996)	
Mongolia	**1987**	**1987**[a]		
Morocco	**1993**	**1993**	(1994)	**1999**
Myanmar	**1997**	(ocp)		
Namibia				
Netherlands	**1991**	**1991**	**1996**	**2000**
New Zealand	**1987**	**1987**		
Nicaragua	**1993**	**1993**[a]	(1994)	
Niger	(1986)	(1986)		
Nigeria	**1990**	**1990**[a]	(1994)	
Norway	**1986**	**1986**	**1994**	**1998**
Pakistan	**1989**	**1989**	**1997**	
Panama	**1999**[a]	**1999**[a]		
Paraguay	(1986)	(1986)		
Peru	**1995**	**1995**	**1997**	(1998)
Philippines	**1997**	**1997**	(1994)	(1998)
Poland	**1988**	**1988**	**1995**	**2000**
Portugal	**1993**	(1986)	**1998**	
Qatar	(ocp)			
Republic of Moldova	**1998**	**1998**	**1998**	
Romania	**1990**	**1990**	**1995**	**1999**
Russian Federation	**1986**	**1986**	**1996**	(1999)
Saudi Arabia	**1989**	**1989**		
Senegal	(1987)	(1987)[a]		
Sierra Leone	(1987)[a]	(1987)[a]		
Singapore	**1997**	**1997**	**1997**	
Slovakia	**1993**	**1993**	**1995**	**1998**
Slovenia	**1992**	**1992**	**1996**	**1999**
South Africa	**1987**	**1987**	**1996**	
Spain	**1989**	**1989**	**1995**	**1999**
Sri Lanka	**1991**[a]	**1991**[a]	**1999**	
Sudan	(1986)	(1986)	(1994)	
Sweden	**1987**	**1992**	**1995**	**1999**
Switzerland	**1988**	**1988**	**1996**	**2000**
Syrian Arab Republic	(1987)	(1987)	(1994)	
Thailand	**1989**	**1989**		

STATUS OF SAFETY RELATED CONVENTIONS, 31 JULY 2000

	Early Notification	Assistance	Nuclear Safety	Joint Convention
The former Yugoslav Republic of Macedonia	**1996**	**1996**[a]		
Tunisia	**1989**	**1989**[a]	(1994)	
Turkey	**1991**	**1991**	**1995**	
Uganda				
Ukraine	**1987**	**1987**	**1998**	**2000**
United Arab Emirates	**1987**	**1987**[a]		
United Kingdom of Great Britain and Northern Ireland	**1990**	**1990**	**1996**	(1997)
United Republic of Tanzania	(ocp)	(ocp)		
United States of America	**1988**	**1988**	**1999**	(1997)
Uruguay	**1989**	**1989**	(1996)	
Uzbekistan				
Venezuela				
Viet Nam	**1987**	**1987**		
Yemen	(ocp)	(ocp)		
Yugoslavia	**1989**	**1991**[a]		
Zambia	(ocp)			
Zimbabwe	(1986)[a]	(1986)[a]		
Non-Member States[b]				
Belize	(ocp)			
Brunei Darussalam	(ocp)	(ocp)		
Cape Verde	(ocp)			
Chad	(ocp)			
Democratic People's Republic of Korea	(1986)	(1986)		
Dominica	(ocp)	(ocp)		
Grenada	(ocp)	(ocp)		
Guinea	(ocp)			
Guinea–Bissau	(ocp)			
Kiribati	(ocp)			
Kyrgyzstan	(ocp)	(ocp)		
Malawi	(ocp)	(ocp)		
Maldives	(ocp)			
Papua New Guinea	(ocp)			
Saint Lucia	(ocp)	(ocp)		
Samoa	(ocp)	(ocp)		
Tonga	(ocp)	(ocp)		
Turkmenistan	(ocp)			
International Organizations[b]				
Arab Atomic Energy Agency	(ocp)	(ocp)		
European Atomic Energy Community	(ocp)		**2000**	
Food and Agriculture Organization	**1990**	**1990**		
International Labour Organization	(ocp)	(ocp)		
United Nations Educational, Scientific and Cultural Organization	(ocp)	(ocp)		

STATUS OF SAFETY RELATED CONVENTIONS, 31 JULY 2000

	Early Notification	Assistance	Nuclear Safety	Joint Convention
United Nations Environment Programme	(ocp)			
United Nations Office for the Coordination of Humanitarian Affairs	(ocp)			
World Health Organization	**1988**	**1988**[a]		
World Meteorological Organization	**1990**	**1990**[a]		

[a] Signatories and Contracting Parties which have not notified the Agency of an official contact point in relation to the relevant convention.

[b] Non-Member States and international organizations are listed only if they are signatories of or Contracting Parties to at least one convention or if they have notified the Agency of an official contact point in relation to at least one convention.

ANNEX 2

STATUS OF THE AGENCY'S SAFETY STANDARDS

Background

1. Under Article III.A.6 of its Statute, the Agency is authorized "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". Since soon after the Agency's inception the Secretariat has been involved in developing and establishing such standards.

2. In 1996, the Secretariat introduced a uniform preparation and review process for safety standards. To this end, it created a set of advisory bodies with harmonized terms of reference to assist it in preparing and reviewing all documents, namely the Advisory Commission for Safety Standards (ACSS), the Nuclear Safety Standards Advisory Committee (NUSSAC), the Radiation Safety Standards Advisory Committee (RASSAC), the Waste Safety Standards Advisory Committee (WASSAC) and the Transport Safety Standards Advisory Committee (TRANSSAC). It assigned to each of these bodies a Scientific Secretary, who co-ordinates the work of the body with the relevant Agency policies and programmes, and appoints a Technical Officer for the preparation of each document in accordance with recommendations made.

International basis for the Agency's safety standards

3. The Agency establishes its safety standards on the basis of advice provided by its International Nuclear Safety Advisory Group (INSAG), of studies by the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) and of recommendations made by a number of international bodies, principally the International Commission on Radiological Protection (ICRP).[1]

4. At its annual meeting in June 2000, UNSCEAR approved its latest report to the UN General Assembly on sources and effects of ionizing radiation. UNSCEAR's latest estimates of the average risk of fatal cancer from acute exposure to 1 Sv (9% and 13% for males and females) and of the worldwide average annual individual dose from all sources (2.4 mSv) are not significantly different

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[1] In *The Agency's Health and Safety Measures*, INFCIRC/18, it was stated that "The Agency's basic safety standards will be based, to the extent possible, on the recommendations of the International Commission on Radiological Protection (ICRP)".

from previous estimates. These estimates are important reference figures in the establishment of the Agency's safety standards.

5. New ICRP recommendations on the radiological protection of the public following the disposal of long-lived solid radioactive waste have recently been published as ICRP Publication 81. Recommendations on the protection of the public in situations of prolonged exposure (ICRP Publication 82) are in press. Publications on risk estimation for multifactorial diseases and dose coefficients for the embryo and foetus are also due to be published in the near future.

The hierarchy of Agency safety standards documents

6. The Agency's safety standards fall into three categories:

- **Safety Fundamentals**, which state the basic objectives, concepts and principles involved in ensuring protection and safety;
- **Safety Requirements**, which specify requirements that must be satisfied in order to ensure safety for particular activities or application areas, these requirements being governed by the basic objectives, concepts and principles stated in Safety Fundamentals; and
- **Safety Guides,** which supplement Safety Requirements by presenting recommendations, based on international experience, regarding measures to ensure the observance of safety requirements.

7. **Safety Reports** give examples and descriptions of methods which can be applied in implementing both Safety Requirements and Safety Guides. These are not safety standards, but are documents for fostering information exchange.

Activities of the advisory bodies

8. A brief summary is given below of the main activities of the ACSS and the four Safety Standards Committees since the last session of the General Conference. A document outlining the current status of all of the Agency's safety standards is available from the Secretariat, or through the Agency's web site at www.iaea.org/ns/coordinet/.

9. Four Safety Requirements have been approved by the Board of Governors and will be published in the second half of 2000:

- one in the General Safety area, on legal and governmental infrastructure for safety;
- two on the safety of nuclear installations: design and operation; and
- one on the predisposal management of radioactive waste, including decommissioning.

10. Six Safety Guides have been approved by the relevant committees, and will be published in the second half of 2000:

- one in the nuclear safety design area, on software for computer based systems important to safety;
- two in the nuclear safety operation area, on fire safety in operation and on operational limits and conditions and operating procedures;
- one on regulatory control of discharges to the environment; and
- two on transport safety: advisory material for the 1996 Edition of the Transport Regulations; and guidance on emergency response planning and preparedness for transport accidents involving radioactive material.

11. A glossary of terms and definitions used in Agency safety standards has been developed, with the aim of promoting harmonization of terminology and usage in nuclear, radiation, radioactive waste and transport safety. Version 1.0 of the glossary has been issued as working material, for use by drafters and reviewers of safety standards. The glossary is also available for information purposes, on request from the Secretariat or, in the near future, through the Coordinet pages of the Worldatom web site.

Advisory Commission on Safety Standards (ACSS)

12. The Advisory Commission on Safety Standards (ACSS) is a standing body of senior government officials holding national responsibilities for establishing standards and other documents relevant to nuclear, radiation, waste and transport safety. The Commission has a special overview role with regard to the Agency's safety standards and provides advice to the Director General on the overall safety-standards-related programme.

13. The members of the Commission were appointed by the Director General for a four-year term which was completed at the end of 1999. On the basis of nominations from Member States, the Director General appointed members of the Commission for the 2000–2003 term. The old Commission met for the last time in November 1999, and the first meeting of the reconstituted Commission was held in June 2000, under the chairmanship of Mr. L. Williams (Health and Safety Executive, United Kingdom).

14. A summary report on the Commission's first four-year term (1996–1999) was submitted to the Director General in February 2000. The report outlined the major decisions taken by the Commission and identified several recommendations for the future, mainly on the role and functioning of the Commission (and its relations with other bodies) but also on some technical issues. A particular issue was that the Commission should take a more strategic 'oversight' role in the development of safety standards.

15. The Agency has developed safety standards covering the most common types of facility; in particular, nuclear power plants, research reactors, repositories and other waste management facilities, and industrial and medical facilities using radiation sources and/or radioactive materials.

There has been growing recognition that some fuel cycle facilities do not fit into any of these groups and that, although many of the basic safety principles would be applicable, there are some safety issues relevant to fuel cycle facilities that are not adequately addressed by the existing safety standards. A particularly topical example is criticality safety in the processing of fuel. At its June 2000 meeting, the Commission endorsed the development of a new suite of safety standards specifically covering the safety of fuel cycle facilities. They decided that NUSSAC should act as lead committee for the review of these standards, with review also by RASSAC and WASSAC as appropriate.

Nuclear Safety Standards Advisory Committee (NUSSAC),
Radiation Safety Standards Advisory Committee (RASSAC),
Waste Safety Standards Advisory Committee (WASSAC) and
Transport Safety Standards Advisory Committee (TRANSSAC)

16. Each of the four committees is a standing body of senior regulatory officials with technical expertise in the relevant area of safety. They provide advice to the Secretariat on the overall safety programme in their respective areas of expertise, and have the primary role in the development and revision of the Agency's safety standards in that area.

17. All four of the committees have been involved in reviewing safety standards on **legal and governmental infrastructure for safety**. The Safety Requirements have been approved by the Board of Governors and five supporting Safety Guides are in preparation. Four of these relate to particular aspects of the regulation of nuclear facilities: NUSSAC has been designated as the lead committee for these documents. The fifth, for which RASSAC is the lead committee, addresses regulatory infrastructure for the safety of smaller scale uses of radiation sources and radioactive materials.

18. All four of the committees are also involved in reviewing draft Safety Requirements on **emergency preparedness and response**. The Nuclear Energy Agency of the Organisation for Economic Cooperation and Development, the Food and Agriculture Organization of the United Nations and the World Health Organization have each indicated an intention to co-sponsor these Safety Requirements on emergency preparedness and response.

19. In April 2000, RASSAC and WASSAC for the first time held a joint meeting to discuss issues of common interest to the two committees, including regulatory infrastructure for radiation safety, the application of the principles of exclusion, exemption and clearance and the cleanup of areas contaminated by past activities and accidents. The joint meeting was considered to have been successful, and a number of topics were identified for future joint discussions between the two committees.

20. **NUSSAC**, under the chairmanship of Mr. P. Govaerts (Association Vinçotte Nuclear, Belgium), met twice during the past year, and provided advice on the revision and updating of the

existing NUSS documents in the areas of nuclear power plant operation, design and site evaluation[2] and on research reactors. About three-quarters of the nuclear safety standards currently in preparation have now reached at least the stage of initial review by NUSSAC.

21. As the lead committee for the Safety Guides on legal and governmental infrastructure for nuclear facilities, NUSSAC considered drafts of the four documents: organization and staffing of the regulatory body; documentation for the regulatory process; regulatory review and assessment; and regulatory inspection and enforcement. These drafts have been circulated to Member States for comment, and the comments received are being incorporated.

22. Safety Requirements on the design of nuclear installations were approved by NUSSAC and forwarded to the ACSS (and subsequently endorsed by the ACSS and approved by the Board of Governors — see above).

23. **RASSAC**, chaired by Mr. G.C. Mason (Australian Radiation Protection and Nuclear Safety Agency) met in October 1999 and April 2000 (the latter meeting included the joint RASSAC–WASSAC session).

24. At its meeting in April 2000, RASSAC reviewed the draft Safety Guide on preventing, detecting and responding to illicit trafficking in radioactive materials. The RASSAC members considered that the term "illicit trafficking" should include only those actions falling within the common understanding of the expression, i.e. intentional illegal trading in radioactive materials. It was also agreed that the parts of the Safety Guide on prevention could be incorporated into the Safety Guide on regulatory infrastructure for radiation safety, whereas the parts on detection and response, which contain technical information primarily aimed at customs and police officers, should be published as a Safety Report or TECDOC rather than a Safety Guide.

25. The April 2000 meeting also considered the guidelines on iodine prophylaxis following nuclear accidents that had been published by a WHO regional office in 1999, and which give advice on reference levels for iodine prophylaxis that are not consistent with the Agency's Basic Safety Standards. RASSAC expressed concern at the confusion that had been caused, and recommended that the Agency consult with the other co-sponsors of the BSS, including WHO, and prepare a joint statement to clarify the existing international guidance on iodine prophylaxis. They also recommended that a scientific forum be held to review the science related to iodine prophylaxis and that, if consensus is reached, new guidance be prepared.

26. With regard to plans for the review and eventual revision of the Basic Safety Standards, RASSAC felt that consideration of a major revision could be deferred for the time being, but that it was appropriate to proceed with plans for any necessary revisions to the existing document on a time scale of 2–3 years. It was agreed that the review process should provide opportunity for comment from a broad spectrum of interested parties.

[2] The Committee decided that the term "site evaluation" reflects more accurately the approach being adopted in the safety standards in preparation than the term "siting" used previously.

27. **WASSAC**, chaired by Mr. P. Metcalf (Council for Nuclear Safety, South Africa) has met twice since the last session of the General Conference: in December 1999 and April 2000 (the latter meeting included the joint RASSAC–WASSAC session).

28. WASSAC endorsed a Safety Guide on decommissioning of nuclear fuel cycle facilities for submission to the ACSS for approval. Drafts of two Safety Guides on predisposal management — of low and intermediate level waste, and of high level waste — were approved for circulation to Member States for comment.

29. The revision of safety standards on geological disposal had been delayed for some time because of an apparent lack of consensus on some issues among Member States. Over the past year or two, however, there appeared to have been some convergence, and the Committee considered that progress should now be possible. The April 2000 meeting approved proposals for the development of a Safety Requirements publication on geological disposal, and proposals for supporting guidance documents will be developed in due course.

30. **TRANSSAC** met in April 2000 under the chairmanship of Mr. C. Young (Department of Transport, Environment and the Regions, United Kingdom).

31. Last year, the Committee approved a new two-year review cycle for revisions to the Transport Regulations, intended to be more compatible with the review cycles of other international organizations responsible for promulgating regulations in the transport field. At its April 2000 meeting, the Committee approved a proposal to begin work on the next revision of the Transport Regulations. A revision panel is scheduled to meet in September 2000. Further information is given in GC(44)/INF/7.

ANNEX 3

PROVISION OF SAFETY RELATED ASSISTANCE TO MEMBER STATES

Background

1. In addition to its Regular Budget activities the Agency, pursuant to its Statute, helps Member States to comply with its safety standards through technical co-operation (TC) programmes and extrabudgetary programmes (EBPs). In doing so, it attaches high priority to the establishment and strengthening of nuclear, radiation and waste safety infrastructures in Member States. Assistance is provided in the form of experts' services, equipment and training.

2. The current safety related TC programme includes about 140 national, regional and interregional projects (representing total resources of about US $16 million), of which about 35% are devoted to nuclear safety and 65% to radiation and waste safety. The projects cover a very wide range of nuclear, radiation and waste safety issues, from the establishment of basic technical, legislative and regulatory infrastructure for the use of radiation and radioactive materials in medicine, research and industry to assistance in further strengthening the much more complex and sophisticated safety infrastructure needed for the development and operation of nuclear reactors. In addition, in the past year more than 70 national, regional and interregional workshops and training courses have been organized and more than 300 applications for fellowships and scientific visits have been evaluated (see also Annex 5 and GC(44)/INF/3).

3. Extrabudgetary programmes are currently under way on the safety of nuclear power plants (NPPs) in south-east Asia, the Pacific and the Far East, on RBMK accident analysis, and on intergranular stress corrosion cracking in stainless steel piping of RBMK reactors.

Technical Co-operation in Nuclear Safety

4. Following the completion of the extrabudgetary programme on the safety of WWER and RBMK NPPs at the end of 1998, three regional TC projects continue to provide assistance in important areas of safety to the States in central and eastern Europe and the former Soviet Union operating these reactors. This assistance includes training courses, workshops, safety review missions and expert advice. The three projects cover:

- support for safety assessment of NPPs, aimed at strengthening the capabilities of operating and technical support organizations;
- capability for assessment of operational safety of NPPs, aimed at assisting operating organizations in reviewing their own operational safety performance; and

- nuclear safety regulatory infrastructure, aimed at strengthening nuclear safety regulatory bodies.

5. All three regional projects will continue in the next TC cycle, being refocused on current issues with specific consideration given to the results of the International Conference on Strengthening Nuclear Safety in Eastern Europe held in June 1999.

6. The Agency continues to participate in the G-24 Nuclear Safety Co-ordination (NUSAC) mechanism, which aims to co-ordinate domestic and international programmes for improving the safety of WWER and RBMK reactors in central and eastern Europe and the former Soviet Union and to enhance the effectiveness of bilateral and multilateral assistance and co-operation programmes. The annual meeting of NUSAC in March 2000, inter alia, adopted consensus conclusions on the evaluation and benchmarking of technical assistance, but the main topic of the meeting was the NUSAC mechanism itself. A number of participants considered that the key functions of the NUSAC mechanism could be fulfilled by other forums or organizations and that NUSAC could therefore be phased out. However, there was no consensus on this matter. The matter will be discussed further with the aim of presenting a definitive proposal to the next NUSAC meeting.

7. Among other regional TC projects in the nuclear safety area are the following:

- A project on the safety of research reactors in the Latin American region, aimed at improving national capabilities in ageing management and in applying Agency safety standards in backfitting and upgrading of operating research reactors and designing new reactors (with particular emphasis on improving capabilities in core parameter evaluation);
- A project to support and strengthen existing safety management systems at NPPs and utilities in the Asian region. Activities in this project are being closely co-ordinated with those in the extrabudgetary programme on nuclear safety in the region (see below); and
- A project to enhance the safety of ageing research reactors and associated spent fuel stores in the European region, by developing generic long term measures for improving safety and security at all research reactors in the region, and by providing guidance and training to correct shortcomings in those identified as needing priority attention.

8. The Integrated Strategy for Assisting Member States in Establishing/Strengthening their Nuclear Safety Infrastructure aims to make the IAEA's nuclear safety related assistance more focused, solution oriented and cost effective. To this end, a systematic approach to the TC assistance programmes is being followed by the Departments of Nuclear Safety and Technical Co-operation.

9. The systematic approach involves the development — jointly by the Agency and the Member State — of a Country Nuclear Safety Profile (CNSP), describing the actual nuclear safety situation in the Member State. The actual situation in the Member State (as described in the CNSP) is then compared with a predefined 'reference situation' based on the Agency's Safety Requirements, to

identify the areas where Agency assistance could most effectively be applied. A Country Nuclear Safety Action Plan (CNSAP) is then prepared, based on the findings from the comparison between the CNSP and the reference situation, the Member State's priorities and the Agency's ability to provide suitable and effective assistance to the Member State.

10. Country Nuclear Safety Profiles (CNSPs) have now been completed for all of those Member States receiving Agency assistance that have NPPs in operation, and questionnaires have been used as a basis for evaluating the current safety status against the 'reference situation'.

Extrabudgetary Programmes on Nuclear Safety

11. An extrabudgetary programme on **the Safety of Nuclear Installations in South East Asia, the Pacific and the Far East** was initiated in 1997. The objective of the programme is to strengthen nuclear safety in countries of the region, and in particular to enhance the technical capabilities of regulatory authorities and supporting technical organizations, the nuclear safety infrastructure and human resources development. The participating countries are China, Indonesia, Malaysia, the Philippines, Thailand and Viet Nam, and extrabudgetary contributions towards the Programme, in cash and/or in kind, have been made by Canada, France, Germany, Japan, the Republic of Korea, Spain and the United States of America.

12. The programme focuses on providing assistance for:

- training in nuclear safety;
- strengthening national regulatory frameworks and technical and management capabilities, including nuclear legislation, regulations, safety assessment, licensing, inspection and enforcement;
- emergency planning and preparedness;
- safe storage of research reactor spent fuel;
- promotion of safety culture concepts;
- preparation of information for decision makers and the public to build understanding of and confidence in nuclear safety; and
- establishing a regional forum to exchange information to harmonize the implementation of nuclear safety concepts.

13. The activities in Phase I (1997–1998) of the programme were focused on the development of Country Nuclear Safety Profiles, the provision of regional assistance in areas of common interest, and the provision of specific national assistance in high priority areas of safety. Phase II (1999–2000) has been aimed at providing continuing assistance, at both regional and national levels, on the basis of the needs identified from the Country Profiles. Over the past year or so, technical visits have been made to each of the participating countries to review the Country Profiles.

14. An Advisory Group met in October 1999 to review the implementation of the programme to date, to advise on activities and priorities for 2000 and to discuss plans for Phase III (2001–2002) of the programme.

15. A regional workshop on nuclear safety information for decision makers was held in Kuala Lumpur, Malaysia, in March 2000. The workshop aimed to provide decision makers with basic knowledge about nuclear safety, and to exchange experience and identify issues in communicating with the public on nuclear safety. A regional training workshop covering all aspects of NPP siting was held in Indonesia in April 2000.

16. Activities over the past year at the national level have focused on the provision of the following workshops and safety review services:

- in China, reviews of several aspects of the design of the Tianwan NPP, a seminar on living PSA and PSA applications and a review of the PSA for Tianwan, a design review mission on verification and tests for an experimental fast reactor, and workshops on periodic safety review and fire safety (at Qinshan) and on severe accident policy and safety goals;
- in Indonesia, assistance to the national atomic energy agency (BATAN) in improving the safety analysis report for the G.A. Siwabessy multipurpose research reactor at Serpong, reviews of emergency preparedness and of the inspection and enforcement programme, and a workshop on nuclear safety and risk assessment;
- in Malaysia, a review of the organization of the regulatory body, and provision of guidance for the preparation of safety analysis reports;
- in the Philippines, a 'pre-mission' to evaluate the condition of the PRR-1 research reactor;
- in Thailand, a pre-IRRT mission to the regulatory body, and a seminar on the regulatory function; and
- in Viet Nam, a training course on nuclear safety analysis for research reactors.

17. An extrabudgetary programme on **RBMK accident analysis** was established in 1998, based on the Kursk-1 NPP in the Russian Federation. The primary objective of the programme is to verify the applicability of the IAEA's accident analysis guidelines to RBMK reactors. The tasks involved include:

(a) assessing, verifying and validating the codes and models;

(b) applying the accident analysis methodology, with special attention being paid to beyond design basis accidents;

(c) transferring relevant technology and experience; and

(d) recommending a training programme.

These tasks, along with a technical report describing the work done, are scheduled for completion by the end of 2000.

18. Further work to develop and verify graphite heat transfer and hydrodynamic loop models, to review and verify existing critical heat flux correlations, to benchmark relevant codes, and to establish RBMK accident analysis training capabilities in the Russian Federation are planned for 2001 (subject to the availability of funding).

19. An extrabudgetary programme has been initiated to assist countries operating RBMK reactors in establishing an effective programme to assess the impact of and mitigate **intergranular stress corrosion cracking** (IGSCC) in the austenitic stainless steel piping. The first meeting of the Steering Committee in Vienna in May 2000 marked the start of the programme, which is scheduled to be completed in two years. The meeting was attended by representatives of the participating countries (Japan, Lithuania, Russian Federation, Sweden, Ukraine, United States of America and United Kingdom), including representatives of the RBMK designers, operating organizations, and regulators from each country with RBMK reactors.

20. The programme includes activities being undertaken by four working groups — WG 1 on improvements in in-service inspection performance and qualification, WG 2 on comprehensive assessment techniques, WG 3 on repair and mitigation, and WG 4 on water chemistry and decontamination — co-ordinated and integrated by the Steering Committee. The first Steering Committee meeting was structured to provide technical background information related to each of these activities, including summary presentations on related national and international activities, and preliminary programme plans for each working group were discussed and finalized. It was agreed that the first meetings of the working groups would be held at RBMK plants, starting with WG 1 at Kursk NPP in July 2000. The second meeting of the Steering Committee is scheduled for 5–7 December 2000 in Vienna.

Technical Co-operation in Radiation and Waste Safety

21. A large part of the TC work related to radiation and waste safety is carried out within the Model Project "Upgrading of Radiation Protection Infrastructure" (originally a single interregional project, now a set of regional projects, but still commonly referred to as "the Model Project"). The aim of the Model Project is to establish effective national radiation protection and waste safety infrastructures complying with the International Basic Safety Standards. Fifty-two Member States are participating in the project, as listed in the following table.

MEMBER STATES PARTICIPATING IN THE MODEL PROJECT "UPGRADING RADIATION PROTECTION INFRASTRUCTURE"

Africa	West Asia/East Asia	Latin America	Europe
Cameroon	Bangladesh	Bolivia	Albania
Côte d'Ivoire	Jordan	Colombia	Armenia
Democratic Republic of the Congo	Kazakhstan	Costa Rica	Belarus
Ethiopia	Lebanon	Dominican Republic	Bosnia and Herzegovina
Gabon	Mongolia	El Salvador	Cyprus
Ghana	Myanmar	Guatemala	Estonia
Madagascar	Qatar	Jamaica	Georgia

MEMBER STATES PARTICIPATING IN THE MODEL PROJECT "UPGRADING RADIATION PROTECTION INFRASTRUCTURE"

Africa	West Asia/East Asia	Latin America	Europe
Mali	Saudi Arabia	Nicaragua	Latvia
Mauritius	Sri Lanka	Panama	Lithuania
Namibia	Syrian Arab Republic	Paraguay	Moldova
Niger	United Arab Emirates		The former Yugoslav Republic of Macedonia
Nigeria	Uzbekistan		
Senegal	Viet Nam		
Sierra Leone	Yemen		
Sudan			
Uganda			
Zimbabwe			

22. The Model Project established a systematic approach to assessing and improving safety status in Member States lacking adequate radiation and waste safety infrastructure, which was subsequently used in the Integrated Strategy as described in para. 8 of this Annex. This systematic approach is also now being used in other regional TC projects on radiation and waste safety.

23. For all participating States in the Model Project, the implementation of 'Action Plans' is well under way. The 'Action Plans' cover five milestones including: legislation and regulations; the Regulatory Authority; regulatory control; control of occupational exposure; control of medical exposure; control of public exposure; emergency response; waste management; human resources development; and technical support services. The first milestone was the establishment of a system of notification, authorization, inspection and enforcement for radiation sources and the transport of radioactive material (including the necessary laws and regulations and the establishing of inventories of sources). To this end, the Secretariat developed a generic 'model' system — adaptable to the conditions in different States — for the notification, registration and licensing of radiation sources and for their inspection and control.

24. In order to quantify the progress achieved so far under the Model Project, a representative group of 14 participating States[1] were visited by Peer Review Teams during the second half of 1999. The Peer Review Teams evaluated the adequacy of the legal and regulatory framework, the empowerment of the regulatory authority to enforce legislation and regulations, the system of notification, authorization and control of radiation sources, existing financial and human resources, and the number of adequately trained personnel. The Peer Reviews, the monitoring of project activities and annual appraisal meetings indicate that about 30% of participating countries have achieved the first milestone — a system of notification, authorization, inspection and enforcement, including the relevant legislation and regulatory infrastructure — a further 40% are in the process of

[1] Bangladesh, Belarus, Bolivia, Costa Rica, Cyprus, Ethiopia, Lebanon, Madagascar, Paraguay, Republic of Moldova, Senegal, Syrian Arab Republic, Viet Nam and Zimbabwe.

implementing such a system, and the remaining 30% are late in their implementation. Significant progress has also been made towards the second milestone — a system for control of occupational exposure — with 60% of participating States having individual monitoring systems for external exposure and about 40% having workplace monitoring established and operational. The Peer Reviews also concluded that the Model Project is having a positive impact on the radiation protection infrastructure in the participating countries. This result will determine the way forward with respect to the future of the Model Project. Peer Reviews for a further 15 participating Member States are planned for the second half of 2000.

25. The Regulatory Authority Information System (RAIS) is a personal computer application with five modules, for use in:

- compiling and maintaining inventories of radiation sources and installations;
- tracking the administrative status of sources and installations through the authorization process;
- maintaining lists of inspections carried out and planned, and of follow-up or enforcement actions (including deadlines);
- maintaining records of occupational exposure, for an installation or for a worker; and
- tracking performance indicators, both for installations (trends in doses, incidents, etc.) and for the Regulatory Authority itself (time to process authorizations, inspections, etc.).

The system is being used successfully in more than 40 of the Member States participating in the Model Project, and a number of Member States (developing and developed) have also requested copies for their own use. To promote wider use, RAIS has been translated into Arabic, French, Russian and Spanish.

26. Other regional TC projects in the radiation and waste safety areas include:

- A project on improving occupational radiation protection in nuclear power plants in the European region. The project aims to improve the implementation of the optimization (ALARA) principle through, inter alia, information exchange meetings of health physicists from WWER and RBMK reactors and training courses on optimization;
- Projects on harmonizing radiation protection in Asia and Africa, including workshops, training courses, intercomparison studies covering topics such as standards and regulations, accident management and emergency response, radiation protection in medicine, occupational radiation protection and control of radiation sources;
- A project on harmonization of nuclear emergency preparedness in central and eastern Europe, aimed at developing a common understanding of the appropriate response to a severe reactor accident. This includes the development of a system of early warning based on reactor conditions, and co-ordinating technical and public information responses;
- A Latin American regional project to provide guidance on the organization of medical response and treatment in cases of accidental overexposure;

- A new project aimed at improving radiation protection in medicine in Latin America, through the implementation of the Basic Safety Standards in selected hospitals. A related model project in Cuba aims to establish a national system of radiation protection in diagnostic radiology. A national model project on radiation protection in medicine has also been started in Israel;
- A project on reducing external exposures doses in Chernobyl-affected villages in Belarus, the Russian Federation and Ukraine, aimed at demonstrating the potential for significant dose reduction in contaminated settlements and providing the necessary procedures and tools to implement these measures. Related national TC projects include model projects in Belarus — on rehabilitation of Chernobyl-affected territories to create favourable conditions for the sustainable development of the area — and in Ukraine, on reducing radionuclides in human food and the environment; and
- A new project on upgrading the safety of near surface waste disposal facilities in the European region, with particular emphasis on operational safety, waste acceptance criteria, post-closure safety and establishing/upgrading safety assessment capabilities.

Legislative and Regulatory Assistance

27. In order to foster the establishment of basic legislation as part of safety infrastructure, legislative and regulatory assistance has been provided to Member States within the framework of various projects under the TC Programme, particularly the Model Project on Upgrading Radiation Protection Infrastructure, a European regional project on legislative assistance for the utilization of nuclear energy and a new Asian regional model project on legislation for safe and peaceful nuclear applications.

28. This assistance is co-ordinated by the Agency's Legal Division, and provided by teams of lawyers and safety Technical Officers, interacting with the recipient States to match legal and safety requirements. In particular, joint working sessions have been held, involving legal and technical specialists from the Agency and their counterparts from the recipient States, to review draft laws and regulations in the light of Agency safety standards and other requirements.

ANNEX 4

FOSTERING OF SAFETY RELATED INFORMATION EXCHANGE

Background

1. Fostering the exchange of information on nuclear, radiation and waste safety is an integral part of the activities aimed at providing for the application of the Agency's safety standards. Moreover, Article III.A.3 of the Agency's Statute authorizes the Agency to "foster the exchange of scientific and technical information on peaceful uses of atomic energy".

Publications

2. All Agency publications issued in 1999 are listed in the Annual Report (GC(44)/4); a list of safety related publications issued so far in 2000 is provided below.

AGENCY PUBLICATIONS ON NUCLEAR, RADIATION AND WASTE SAFETY JANUARY–JUNE 2000

Safety of Nuclear Installations	
Primary to secondary leaks in WWER nuclear power plants	EBP-WWER-13
Use of operational experience in fire safety assessment of nuclear power plants	TECDOC-1134
Regulatory review of probabilistic safety assessment (PSA) Level 1	TECDOC-1135
Advances in safety related maintenance	TECDOC-1138
Radiation and Waste Safety	
Calibration of radiation protection monitoring instruments	Safety Reports Series No. 16
Lessons Learned From Accidental Exposures in Radiotherapy	Safety Reports Series No. 17
Indirect methods for assessing intakes of radionuclides causing occupational exposure	Safety Reports Series No. 18
Restoration of environments affected by residues from radiological accidents: Approaches to decision making	TECDOC-1131
Modelling of the transfer of radiocaesium from deposition to lake ecosystems	TECDOC-1143
National competent authorities responsible for approvals and authorizations in respect of the transport of radioactive material: List no. 31 (2000 edition)	NCAL-31

Electronic information systems

3. Increasing the scope and effectiveness of its use of electronic media in information exchange activities is a priority for the Agency, to improve both the accessibility and ease of use of the information. A new area, CoordiNet (www.iaea.org/ns/coordinet/), has been added to the existing safety related pages of the Agency's web site (NUSAFE, on the safety of nuclear installations, at www.iaea.org/ns/nusafe/ and RasaNet, on radiation and waste safety, at www.iaea.org/ns/rasanet/), providing information on co-ordination of the Agency's safety related activities. This includes information on the status of the Agency's safety standards (see also Annex 2) and on other safety related publications issued by the Agency, on the Agency's interfaces with other international organizations, and on Co-ordinated Research Projects (CRPs; see also Annex 6).

4. A database of generic safety issues for nuclear power plants (NPPs) with light water reactors (LWRs) and the measures that have been taken to resolve them is available to Member States, along with a TECDOC describing the main issues and measures taken. In order that the database can be kept up-to-date, Member States are encouraged to continue to provide the Secretariat with information on their national experiences with the identified safety issues, particularly with respect to the measures used in resolving them.

5. Work has begun on the development of a database of generic safety issues for NPPs with pressurized heavy water reactors (PHWRs). A first draft document has been prepared with a structure similar to that of the TECDOC for LWRs. A Technical Committee meeting is scheduled for December 2000.

6. Results from OSART missions (see Annex 7) have been incorporated into the OSMIR (OSART Mission Results) database. The database covers all missions since January 1991 for which the official report has been published, as well as the results of follow-up visits. As of mid-2000, the database contains results from 43 OSART missions and 24 follow-up visits. A CD-ROM of the OSMIR database has been offered to nuclear power plants, utilities, regulators, research institutes and organizations directly involved in the fuel cycle, as a source of information that can help them strengthen nuclear safety performance.

7. The IAEA's database of safety issues and plant status of NPPs with WWER and RBMK reactors is updated periodically on the basis of information from Agency safety missions. A set of updated CD-ROMs was distributed in the first half of 2000 to the relevant national contact points in Member States.

8. The Agency is the lead organization in relation to radioactive substances in developing an information clearing house mechanism for the UN's Global Programme of Action for the Protection of the Marine Environment from Land-based Activities. One of the activities under way which will provide input to this programme is the development of an Information System on Radioactive Discharges and Disposals (SIRDD). A prototype system has been completed and a final version of the system, including data from the Agency's existing databases of accidents and disposals at sea, is

expected to be ready by the end of 2000. Data on radioactive discharges to the environment will be added to the database by the Secretariat.

Conferences, seminars and meetings

9. An important means of fostering the exchange of safety related information is the organization of scientific and technical meetings, ranging from large meetings (such as conferences, symposia and seminars) with broad participation to smaller, specialized meetings (such as Technical Committee meetings) with the participation of selected experts. Information exchanged at such meetings is subsequently made available by the Agency in priced publications such as conference proceedings, or in unpriced ones such as technical documents (the IAEA TECDOC series). Some of these meetings are discussed in other Annexes of this document; a number of other important meetings are described below.

10. An Agency-sponsored International Symposium on Research Reactor Utilization, Safety and Management was held in Lisbon, Portugal, in September 1999, with more than 140 participants from 42 countries. Although some papers described work on new research reactors, the dominant issues in the safety related parts of the symposium were those relating to older reactors, such as management of ageing, safety review and reassessment, preserving knowledge, and decommissioning and spent fuel management issues.

11. An International Symposium on Restoration of Environments with Radioactive Residues was held in Arlington, Virginia, USA, from 29 November to 3 December 1999, sponsored by the IAEA and hosted jointly by the United States Department of Energy, Environmental Protection Agency and Nuclear Regulatory Commission. The Symposium was attended by approximately 250 people from 34 countries and four international organizations. Sessions addressed the nature and magnitude of the problem of contaminated environments worldwide, the criteria being used in different countries for cleanup operations, experience from actual cleanup operations and radiological assessments, and involvement of the public on the decision making process.

12. An International Conference on the Safety of Radioactive Waste Management was convened by the Agency, in co-operation with the European Commission and OECD/NEA, and hosted by the Government of Spain in Córdoba in March 2000. More than 300 senior officials and scientists from 55 Member States and six international organizations attended. Topical sessions were devoted to the siting of facilities, legislative and general safety issues, predisposal management, near surface disposal, geological disposal, the management of disused sources and the transboundary movement of waste, and several other issues were addressed in panel discussions. A detailed report on the Conference is given in GC(44)/INF/5, including the observations, conclusions and recommendations of the session chairpersons and the conference President.

13. Three important safety related conferences will be held in the coming months:

- an International Conference on Radiation Legacy of the 20th Century: Environmental Restoration, organized by the Ministry of the Russian Federation for Atomic Energy in

co-operation with the IAEA, in Moscow, Russian Federation, from 30 October to 3 November 2000;

- an International Conference of National Regulatory Authorities with Competence in the Safety of Radiation Sources and the Security of Radioactive Materials, to be hosted by the Government of Argentina in Buenos Aires, 11–15 December 2000. The conference is being organized within the framework of the Agency's Action Plan on the Safety of Radiation Sources and the Security of Radioactive Materials (see Part II of the main text and GC(44)/12), and is intended to provide a forum for an exchange of information and experience regarding the development of regulatory systems for ensuring the safety of radiation sources and the security of radioactive materials; and
- an International Conference on the Radiological Protection of Patients in Diagnostic and Interventional Radiology, Nuclear Medicine and Radiotherapy, co-sponsored by the IAEA, the European Commission, the Pan American Health Organization and the World Health Organization, to be hosted by the Government of Spain in Torremolinos (Málaga), 26–30 March 2001. The organization of such a conference was requested in GC(43)/RES/12, for the purpose of an exchange of information and the development of recommendations, as appropriate, regarding the radiological protection of patients. The conference programme addresses protection in the various applications of radiation in different branches of medicine: further details are given in GC(44)/INF/8.

14. Preparations have begun for a major international conference on Topical Safety Issues, to be held in Vienna on 3–7 September 2001.

Incident Reporting System (IRS)

15. The Incident Reporting System (IRS) is an international system operated jointly by the IAEA and the Nuclear Energy Agency of the Organisation for Economic Co-operation and Development (OECD/NEA). The IRS was established as a worldwide system to complement national schemes by ensuring proper reporting and feedback on events in nuclear power plants of safety significance for the international community, so that the causes and lessons learned are disseminated widely and can help to prevent the occurrence or recurrence of serious incidents or accidents. The IRS is also a response to the obligation under Article 19 of the Convention on Nuclear Safety that Contracting Parties take the appropriate steps to ensure that "programmes to collect and analyse operating experience are established, the results obtained and the conclusions drawn are acted upon and that existing mechanisms are used to share important experience with international bodies and with other operating organizations and regulatory bodies".

16. All 31 of the States with operating nuclear power plants participate in the IRS, and almost 2900 event reports are now in the database, which is distributed to participants as a CD-ROM on a quarterly basis. The annual number of IRS reports in recent years has varied from just under 100 to more than 140, and the number received so far this year suggests that the total for 2000 is likely to be within this range.

Review and analysis of reported events

17. The IAEA and OECD/NEA conducted reviews of the quality of reports received by the IRS during 1999, concluding that the overall quality was good. It was recommended that greater use could be made of the database's annotation system to provide additional information or explanation to the basic IRS report.

18. The annual meeting of national IRS co-ordinators, which was held in Paris, France, in May 2000, included in-depth discussion of recent events at NPPs. Issues highlighted in relation to these events included design deficiencies, work practices, use of contractors, teamwork, clarity of technical specifications and organizational factors. The role played by unexpected human behaviour in a number of events was also noted.

19. Two new topics were identified for future IRS topical studies: organizational challenges; and training/retraining issues (including retraining of managers). The meeting participants also strongly recommended continued study of two subjects, namely: (a) events indicating non-compliance with operational limits and conditions; and (b) events caused or aggravated by loss of corporate knowledge or memory.

20. In relation to the operation of the IRS, the co-ordinators recommended adjusting the system to take account of developments in nuclear safety in recent years, and to obtain a broader range of information. For example, contributors would be encouraged to provide additional comments from regulators, designers, contractors and others, and to compile national summaries of low level events and near misses for inclusion in the database.

Incident Reporting System for Research Reactors (IRSRR)

21. A Consultants' Meeting and Technical Committee Meeting were held, in September and November 1999 respectively, to evaluate the results of the initial trial period of the Incident Reporting System for Research Reactors (IRSRR) and advise the Agency on future actions. All States having or planning to build research reactors were invited to participate in the Technical Committee and representatives of 24 States attended. The participants in the meetings stressed the importance of the IRSRR to the research reactor community and made a number of recommendations, including:

- development of new guidelines for the system, including clear reporting criteria;
- 'relaunching' of the system, by inviting Member States not already participating to join the system and encouraging participating Member States to report incidents in accordance with the new guidelines;
- development of a Safety Guide on operational feedback for research reactors;
- regular (annual or biennial) meetings, starting in November 2000, for national and local co-ordinators to exchange information on events, to review and assess progress with the IRSRR and identify future development needs, and to identify items of generic interest for more detailed consideration; and

- training workshops on the IRSRR and event investigation techniques.

22. Work has begun to implement these recommendations: in particular, preparation of the new guidelines is under way, procedures for receiving, verifying and distributing reports have been prepared and tested, and the Agency's existing information on incidents in research reactors has been compiled into a single reference document. In the first half of 2000, two incident reports have been received and distributed to national co-ordinators.

International Nuclear Event Scale (INES)

23. INES is now used by 60 countries for facilitating rapid communication to the media and the public regarding the significance of events at all nuclear installations associated with the civil nuclear industry, including events involving the use of radiation sources and the transport of radioactive materials.

24. The Agency received and disseminated information relating to 20 events during the period July 1999 to June 2000 — ten at NPPs and ten others (including events involving radiation sources). Of these events, nine were Level 2, none was Level 3 and two were Level 4: these were the criticality accident at Tokaimura, Japan, in September 1999 and the accident involving an iridium-192 radiography source in Egypt in June 2000 (the rating of the latter event is provisional). Each case led to two fatalities due to radiation exposure. In addition, there was a fatal accident in Thailand in February 2000 involving a cobalt-60 radiotherapy source (three fatalities), but Thailand does not participate in the INES service.

25. In March 2000, a national seminar on the use of INES and the rating of events was held in Ottawa, Canada, at the request of the Atomic Energy Control Board[1] (AECB), for staff of the AECB and Canadian nuclear facilities. In June 2000, an INES seminar was conducted at the Australian Nuclear Science and Technology Organisation (ANSTO) near Sydney, at the request of the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA).

26. A revised version of the INES User's Manual has been agreed and will be published in the near future.

Information System on Occupational Exposure (ISOE)

27. The Information System on Occupational Exposure (ISOE) database is the world's largest database on occupational exposure to ionizing radiation. It contains occupational exposure data from 88% of the world's operating commercial nuclear power reactors: participation in ISOE as of May 2000 is shown in the tables below. The IAEA co-sponsors ISOE under an agreement with OECD/NEA pursuant to which the IAEA invites those countries with operating nuclear power plants which are Member States of the IAEA but not of OECD to participate in ISOE cost-free (through the IAEA's ISOE Technical Centre). As indicated in more detail in GC(44)/INF/6, the Joint NEA–

[1] Now the Canadian Nuclear Safety Commission.

IAEA Secretariat has prepared revised terms and conditions for the operation of ISOE, which entered into force on 1 November 1999 and will remain in force until 31 December 2003.

UTILITIES PARTICIPATING IN ISOE, MAY 2000

Country	Utility	Number of plants
Operating reactors		
Armenia	Armenian (Medzamor) NPP	1
Belgium	Electrabel	7
Brazil	Eletronuclear A/S	1
Canada	Three utilities	22
China	Two utilities	3
Czech Republic	CEZ	4
Finland	Two utilities	4
France	Electricité de France	57
Germany	13 utilities	20
Hungary	Magyar Vilamos Muvek Rt	4
Japan	11 utilities	52
Korea, Republic of	Korean Electric Power Corp.	12
Lithuania	Ignalina State Nuclear Power Plant	2
Mexico	Comisión Federal de Electricidad	2
Netherlands	N.V. EPZ	1
Romania	National Electricity Company	1
Slovakia	Jaslovské Bohunice NPP	4
Slovenia	Krško Nuclear Power Plant	1
South Africa	ESKOM	2
Spain	UNESA	9
Sweden	Four utilities	12
Switzerland	Four utilities	5
Ukraine	Department of Nuclear Energy of the Ministry of Energy	16
United Kingdom	Nuclear Electric	1
United States	17 utilities	41
Definitively shutdown reactors		
France	Electricité de France	7
Germany	Two utilities	2
Italy	Ente Nazionale per l'Energia Elettrica	4
Japan	Japan Atomic Power Co.	1
Netherlands	GKN	1
Spain	UNESA	1
United States	Six utilities	6

REGULATORY AUTHORITIES PARTICIPATING IN ISOE, MAY 2000

Country	Authority
Armenia	Armenian Nuclear Regulatory Authority (ANRA)
Belgium	Service de la sécurité technique des installations nucléaires
Bulgaria	Committee on the Use of Atomic Energy for Peaceful Purposes
Canada	Atomic Energy Control Board (AECB)
China	China National Nuclear Corporation (CNNC)
Czech Republic	State Office for Nuclear Safety
Finland	Säteilyturvakeskus (STUK)
France	Ministère du travail, et des affaires sociales, represented by the Office de Protection contre les Rayonnements Ionisants (OPRI)
Germany	Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit
Italy	Agenzia Nazionale per la Protezione dell'Ambiente (ANPA)
Japan	Science and Technology Agency (STA), and Agency of Natural Resources and Energy of the Ministry of International Trade and Industry (MITI)
Korea, Republic of	Ministry of Science and Technology (MOST) Korea Institute of Nuclear Safety (KINS)
Lithuania	Radiation Protection Centre (RSC)
Mexico	Comisión Nacional de Seguridad Nuclear y Salvaguardias
Netherlands	Ministerie van Sociale Zaken en Werkgelegenheld
Pakistan	Pakistan Atomic Energy Commission
Romania	National Commission for Nuclear Activities Control
Slovakia	State Health Institute
Slovenia	Slovenian Nuclear Safety Administration (SNSA)
South Africa	Council for Nuclear Safety
Spain	Consejo de Seguridad Nuclear
Sweden	Statens strålskyddsinstitut (SSI)
Switzerland	Office Fédéral de l'Énergie, Division principale de la Sécurité des Installations Nucléaires, DSN
United Kingdom	Nuclear Installations Inspectorate
United States	Nuclear Regulatory Commission (NRC)

ANNEX 5

PROMOTION OF SAFETY RELATED EDUCATION AND TRAINING

Background

1. Education and training are essential in providing for the application of the Agency's safety standards. The Agency's policy in education and training in this field was developed in response to the 1991 General Conference Resolution GC(XXXV)/RES/552. The Agency, through its Technical Co-operation and Nuclear Safety Departments and the Legal Division, promotes education and training by organizing, in collaboration with organizations in host countries, courses of an 'educational' nature covering a broad range of nuclear, radiation and waste safety issues, and more specialized training courses and workshops covering specific subject areas. The Agency also promotes education and training through other mechanisms, such as sponsoring fellowships and scientific visits and publishing educational and training materials.

2. A substantial amount of training is also carried out by the Agency at the national level in the course of providing safety related assistance (e.g. through TC and extrabudgetary projects) and safety related services (e.g. training aspects of OSART missions, seminars on safety culture or self-assessment methodologies). Such training is discussed in the relevant parts of Annex 3 and Annex 7 respectively.

Educational courses

3. A Basic Professional Training Course on radiation protection was held in South Africa (in English) in the second half of 1999: another such course, again in South Africa, began in July 2000 and continues until November. The first Basic Professional Training Course in Nuclear Safety was held (in English) in Saclay, France, in late 1999: the second such course, in Spanish, will be held in November–December 2000 in Brazil, for Latin American countries operating or constructing NPPs.

4. A Post-Graduate Regional Training Course on radiation protection and nuclear safety (in Spanish), continues to be held annually in Buenos Aires, Argentina. This year's course, which runs from April–October 2000, is the 23rd: in total, more than 500 professionals from 16 Member States have attended the course.

Specialized training courses and workshops

5. All of the training courses held in 1999 are listed in the Agency's Annual Report (GC(44)/4); safety related regional and interregional training courses in the first half of 2000 are listed in the following table:

REGIONAL AND INTERREGIONAL TRAINING COURSES AND WORKSHOPS
JANUARY–JUNE 2000

Title	Host Country	Date
Interregional Courses and Seminars		
Regulatory aspects and safety documentation of research reactors	USA	May 2000
Management for excellence in nuclear power plants	France	June 2000
Regional Courses and Workshops		
Public information and dealing with the media	Slovenia	February 2000
Safety in the operation and utilization of research reactors	Indonesia	February 2000
Effluent monitoring and environmental assessment	Japan	March 2000
Radiation protection in medicine, for regulators and radiation safety officers	Singapore	March 2000
Regulatory experience with commissioning	Austria	March 2000
Optimization of radiation protection in nuclear power plants, for regulatory staff	Sweden	March 2000
Response and preparedness for radiological emergencies	Cuba	March 2000
Post-graduate educational course on radiation protection and nuclear safety (in Spanish)	Argentina	April–October 2000
Regulatory Authority Information System (RAIS)	South Africa	April 2000
Development and validation of emergency operating procedures	Czech Republic	April 2000
Nuclear power plant siting	Indonesia	April 2000
Application of a common basis for judging the safety of nuclear power plants built to earlier standards	India	April 2000
Application of a common basis for judging the safety of nuclear power plants built to earlier standards	Pakistan	April 2000
Planning, organization and implementation of a regulatory programme for radiation protection	South Africa	May 2000
Characterization, management and storage of spent fuel elements from research and test reactors	Poland	May 2000
Regulatory requirements and practices for ageing management	Slovakia	May 2000
Design, evaluation and licensing of nuclear power plant modifications	Slovenia	May 2000
Operational and safety issues of nuclear power plants, with special focus on operation organizations and management of operational safety	Republic of Korea	May 2000
Radiation protection principles applied to waste management	Republic of Korea	May 2000
Regulatory control of radiation sources	Slovakia	May–June 2000

REGIONAL AND INTERREGIONAL TRAINING COURSES AND WORKSHOPS JANUARY–JUNE 2000

Title	Host Country	Date
Nuclear power plant safety assessment to assist decision makers	Finland	June 2000
Radiation safety in industrial irradiators	Canada	June 2000
Regulatory control of nuclear power plants	Germany	June–July 2000

6. An interregional training course on Regulatory Aspects and Safety Documentation of Research Reactors was held in Argonne, USA, in May 2000, and attended by 24 participants from 18 Member States. Compared to a similar course held in 1998, more emphasis was placed on the licensing process and regulatory inspection (almost half of the participants were from regulatory bodies).

7. Three interregional training courses on safety related topics, or with safety related elements, are scheduled to be held in the second half of 2000 in Argonne, USA:

- on the safety of spent fuel storage, 11–22 September 2000;
- on advances in the monitoring, assessment and enhancement of operational safety of NPPs, 2–20 October 2000; and
- on the decommissioning of research reactors, 30 October–17 November 2000.

8. As part of a regional TC project on strengthening radiation protection infrastructure, a distance learning course on radiation protection is being developed in co-operation with, and co-ordinated by, the Australian Nuclear Science and Technology Organization (ANSTO). A workshop for country supervisors was held in Sydney, Australia, in November 1999 to evaluate the results so far of the 'phase 2' trial, which involves more than 50 students in seven countries (Australia, Indonesia, the Republic of Korea, Malaysia, New Zealand, the Philippines and Thailand) and to recommend improvements. The phase 2 trial is continuing with the development of additional modules and increased use of electronic course materials.

9. Educational and training activities have also been carried out in the context of legislative assistance, in order to transfer knowledge and know-how on legal issues that are of importance in the law-making process and the establishment of a legal infrastructure as a basis for the implementation of safety requirements. These activities, co-ordinated by the Agency's Legal Division, have included workshops and fellowships (according to the requests from recipient States), involving multidisciplinary teams of lawyers and safety Technical Officers to ensure adequate acquisition of knowledge by the participants.

Other mechanisms for education and training

10. In addition to providing courses, seminars and workshops, the Agency promotes education and training by arranging fellowships and scientific visits for scientists and engineers from Member States and by producing educational and training materials.

Fellowships and scientific visits

11. During the period July 1999–June 2000, the Agency received and evaluated almost 300 applications for fellowships and scientific visits related to nuclear, radiation and waste safety, from about 50 countries. After evaluation, placement of applicants can take up to several months, and therefore the exact number of successful applications is not known at the time of writing, but past experience suggests that approximately 70% of applications result in placements.

Educational and training material

12. The Secretariat continues to prepare of standard packages of training materials — syllabuses, lecture notes, visual aids, etc. — for its educational and training courses. This approach not only helps to ensure consistency and quality in the Agency's courses, but also provides Member States with tools that they can use in their own national training activities.

13. Efforts are under way to develop standard materials for training courses on safety culture. As a first step, material on safety culture was included in the set of lecture notes for Agency training courses on Regulatory Control of Nuclear Power Plants (most recently used at a course in Liverpool, United Kingdom, in September 1999), which has been compiled as working material.

14. Following the incorporation of comments from Member States, a Safety Guide entitled "Building Competence in Radiation Protection and the Safe Use of Radiation Sources" was approved by the Radiation Safety Standards Advisory Committee (RASSAC) for submission to the Advisory Commission on Safety Standards (ACSS). The Safety Guide covers training on radiation safety and on the radiation protection aspects of transport and waste safety, and addresses responsibilities for training, qualifications and competencies, strategy for building competence and the establishment of training programmes.

ANNEX 6

SUPPORT FOR SAFETY RELATED RESEARCH AND DEVELOPMENT

Background

1. The Agency supports research and development related to nuclear, radiation and waste safety mainly through Co-ordinated Research Projects (CRPs). The CRPs are intended to optimize the use of research and development resources by bringing together researchers working in common areas. Each CRP includes a number of contracts and agreements (typically about 7–20) with individual institutions in Member States, and typically runs for 3–5 years. Research Co-ordination Meetings (RCMs) between the participating institutions are held at the beginning of, during, and at the end of the CRP to plan the work, discuss progress and report on results achieved.

2. At the time of writing (mid-2000), there were 15 CRPs active, involving more than 150 individual contracts and agreements. The following table lists the CRPs in progress, indicating the planned completion dates, and the number of countries participating.

CO-ORDINATED RESEARCH PROJECTS IN PROGRESS (as of 2000-06-30)

Project title	Start–End	Countries participating
Radiation and Waste Safety		
Limitations of radioepidemiological assessments for stochastic radiation effects in relation to radiation protection	1994–2001	2
Biosphere modelling and assessment methods (BIOMASS)	1996–2000	12
Improvement of safety assessment methodologies for near surface disposal facilities for radioactive waste (ISAM)	1997–2000	23
Formulation of approaches to compare the potential impacts of wastes from electricity general technologies (FACTS)	1997–2000	11
Development of radiological basis for the transport safety requirements for low specific activity material and surface contaminated objects	1997–2001	7
Accident severity during air transport of radioactive material	1998–2001	7
Cytogenetic biodosimetry	1998–2001	19
Use of selected safety indicators (concentrations, fluxes) in the assessment of radioactive waste disposal	1999–2003	
Image quality and patient dose optimization in mammography in eastern European countries	1999–2003	8

CO-ORDINATED RESEARCH PROJECTS IN PROGRESS (as of 2000-06-30)		
Project title	Start–End	Countries participating
Appropriate methods and procedures to apply probabilistic safety assessment (PSA) techniques in the safety of large radiation sources	2000–2001	
Safety of Nuclear Installations		
Round-robin exercise on WWER-440 reactor pressure vessel weld metal irradiation embrittlement and annealing	1996–2004	8
Investigation of methodologies for incident analysis	1997–2001	14
Safety of RBMK nuclear power plants in relation to external events	1997–2002	7
Development and application of indicators to monitor operational safety performance at nuclear power plants	1999–2003	9
Updating and expansion of reliability data for research reactor PSAs	2000–2004	

3. Five CRPs have ended since the last session of the General Conference:

- Development of relevant accident data for quantifying risks associated with the transport of radioactive material;
- Regional personal dosimetry intercomparison;
- Intercomparison of in vivo counting systems using a reference Asian phantom;
- Management of ageing of in-containment instrumentation and control cables; and
- Development of methodologies for optimization of surveillance testing and maintenance of safety related equipment at nuclear power plants

The results of CRPs are disseminated to Member States by the Agency, usually in the form of TECDOCs. Researchers also prepare scientific papers for publication in a variety of technical journals and for presentation at meetings and conferences.

4. A number of new CRPs have started since the last session of the General Conference:

- Use of selected safety indicators (concentrations, fluxes) in the assessment of radioactive waste disposal;
- Image quality and patient dose optimization in mammography in eastern European countries;
- Appropriate methods and procedures to apply probabilistic safety assessment (PSA) techniques in the safety of large radiation sources;
- Development and application of indicators to monitor operational safety performance at nuclear power plants; and
- Updating and expansion of reliability data for research reactor PSAs.

ANNEX 7

RENDERING OF SAFETY RELATED SERVICES

Background

1. In response to a request from a Member State, the Agency will render safety related services to address any safety topic. Each service can be tailored to meet the specific needs of the Member State. Some of the services have been rendered many times, and these are discussed in this Annex. The services related to nuclear installation safety are:

- operational safety review services, namely the Operational Safety Review Team (OSART) service, the Peer Review of Operational Safety Performance Experience (PROSPER) service[1] and the Safety Culture Enhancement Programme (SCEP) service[2];
- the Engineering Safety Review Services (ESRS), including the Fire Safety Review Service (FSRS), the Ageing Management Advisory Team (AMAT) service, the Design Safety Review Service (DSRS), the Seismic Safety Review Service (SSRS) and the Software Safety Review Service (SWSRS);
- the International Probabilistic Safety Assessments Review Team (IPSART) service[3];
- the Review of Accident Management Programmes (RAMP) service;
- the Integrated Safety of Research Reactors (INSARR) service; and
- the International Regulatory Review Team (IRRT) service.

2. The provision of such services to developing countries is supported by the Agency's technical co-operation and extrabudgetary programmes; for services to developed countries, the costs are borne by the countries themselves.

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[1] This service is derived from, and replaces, the former ASSET (Assessment of Safety Significant Events Team) service.

[2] This service represents a development and extension of, and replaces, the former ASCOT (Assessment of Safety Culture in Organizations Team) service.

[3] This service was formerly called the IPERS (International Peer Review Service) for probabilistic safety assessments.

3. In addition to the increasingly common inclusion of radiation, waste and transport safety in the scope of IRRT reviews, a number of safety review services in these areas of safety are offered, on request, to Member States, including:

- a range of review services relating to radioactive waste management (either dealing exclusively with safety issues or as part of broader advisory services on waste management);
- the Emergency Preparedness Review (EPREV) service, in which an international team of experts reviews a Member State's emergency preparedness programme. A pilot review was conducted in December 1999 in Indonesia, as part of the extrabudgetary programme on nuclear safety in Asia;
- the Transport Safety Appraisal Service (TranSAS) to appraise national implementation of the IAEA Regulations for the Safe Transport of Radioactive Material (for further information, see GC(44)/INF/7); and
- an International Review of Irradiator Safety (IRIS) service.

4. The Agency also carries out, as a service to its Member States on request, radiological assessments of sites where residual radioactive material is present, e.g. as a result of an accident, past waste management practices or nuclear explosions.

5. The Agency organizes international intercomparisons of radiation dose measurements for radiation protection purposes, to contribute towards harmonizing the use of dosimetric quantities and techniques in Member States. An international intercomparison of measurements of the quantity personal dose equivalent, $H_p(10)$, which involved monitoring services in 34 Member States, was completed in February 2000: nearly 80% of the participating services satisfied the evaluation criteria. An intercomparison of measurements of activity in simulated human urine samples is under way, with monitoring services from 39 Member States participating, and an intercomparison of measurements of activity in simulated human organs is due to start in September 2000. Three regional intercomparison exercises are also planned to begin in the second half of 2000, and the Secretariat is discussing with relevant national and international organizations the possibility of co-sponsorship of future intercomparisons. Further information is given in GC(44)/INF/9.

Operational Safety Review Services

6. The trend over the last year has been for more requests from utilities and regulatory organizations to provide capability in methodologies for self-assessment of management processes and safety culture, and increased demand for assistance in areas identified by assessments as needing improvement.

7. The Agency's operational safety review services are being enhanced to better meet current and future challenges identified by the Member States using the services. An Advisory Group meeting in December 1999 characterized the challenges as the need to balance safety and competitiveness during times of financial stress, increased competition from economic deregulation of electricity markets, early plant closures from social and political pressures and economic

liberalization. The Advisory Group endorsed the Agency's existing initiatives and made a number of recommendations, including:

- all operational safety services should provide for the review of management effectiveness (at all levels) in developing and maintaining a strong safety culture in the face of organizational and economic pressures, and for assistance in making improvements. This would include assisting with self-assessment and/or performing safety culture assessments for plants or for whole organizations;
- more emphasis should be placed on measures to compensate for plant ageing and also a diminishing nuclear workforce and the consequent loss of institutional memory;
- more guidance is needed to assist Member States with decisions involving modernization of safety related hardware, software and procedures, application of new safety standards, use of risk based decision making processes and new and more sophisticated safety performance indicators; and
- operational safety services should be provided for non-reactor installations, particularly fuel cycle facilities.

8. The Advisory Group also endorsed the evolution in review services related to operating experience feedback, from peer reviewing an organization's ability to learn from events and identify corrective actions, to a new process which would include factors such as low level events and conditions, improved human performance analysis capability and measures of the effectiveness of corrective action processes.

Operational Safety Review Team (OSART) Service

9. In the past 12 months, two OSART missions, five follow-up missions, and two preparatory missions have been carried out. Increased emphasis has been placed on the promotion of effective self-assessment by operating organizations and, as part of the OSART service, seminars on the OSART methodology are held to assist plant staff or regulatory personnel in implementing and/or enhancing operational self-assessment. During the last year, seminars were held at Tricastin and Paluel (both in France) and at Dukovany in the Czech Republic. In addition, a workshop on the results of the January 1999 OSART mission to Kozloduy and the OSART methodology was conducted in Bulgaria in October 1999.

10. At the request of the Temelin NPP in the Czech Republic, the Agency conducted a mission in February 2000 to review operational preparedness and the status of plant commissioning regarding operational safety. Although this was not an OSART review, the OSART methodology using international experts was employed in selected areas appropriate for the state of commissioning of the plant.

11. Subsequent to an OSART mission, the Agency can assist the Member State in developing activities to enhance the plant's operational safety capabilities. In the past year, the Agency has provided, through the TC programme, technical assistance in improving operational safety at plants following OSART missions. One such project provides support for senior management personnel of

the Qinshan NPP in China, aiming to further improve the management systems of the operating organization and to develop future managers. Project activities included visits to NPPs in the USA, France and the Republic of Korea and a familiarization workshop for senior managers. The second project involved a number missions to facilitate enhancements in the management of operational safety at the Chashma NPP in Pakistan. Support was also provided to the regulatory body to strengthen their capabilities for inspecting operational safety. Activities also included a workshop on good safety management practices, which was also attended by representatives from the Karachi NPP.

OSART missions

12. The two OSART missions referred to in para. 8 were to the NPPs at Goesgen in Switzerland and North Anna in the United States of America. A common feature from these missions was the commitment of managers to improving the operational safety and reliability of their plant. Several examples of good practice were identified, together with recommendations and suggestions to improve operational safety. These will be made available to the nuclear industry through the OSMIR database and OSART highlight reports.

13. Particular areas where the OSART missions identified a need for improvement in one or more of the plants visited in the past year were as follows:

- plant procedures warranted improvements;
- each plant exhibited some lapses in safety management/safety culture, such as a lack of attention to detail for one plant in some areas, and evidence of a lack of questioning attitude and conservative decision-making with respect to safety for the other plant;
- for one plant, the quality assurance programme has not been developed and implemented in a consistent and effective way, and no internal assessment programme has been developed; and
- in one plant, efforts to expose some key functions to good international practices and performance could raise standards and stimulate further improvement.

OSART follow-up missions

14. Follow-up missions are conducted as an integral part of the OSART process, normally approximately 18 months after the OSART mission. The five OSART follow-up visits in the past year — to Golfech (France), Ascó (Spain), Khmelnitsky (Ukraine), Bugey (France) and Yonggwang (Republic of Korea) — demonstrated the effectiveness of the OSART service and the commitment of the plants to implement improvements recommended by the mission teams. The review of actions taken by the plants to correct issues identified revealed that, at most plants, 93% of the issues were either totally resolved or satisfactory progress had been made, whereas for 7% of the issues the progress was considered insufficient. In some cases it was noticed that the corrective measures implemented went beyond the recommendations made by the OSART mission and addressed a more comprehensive set of issues.

Development of the OSART programme

15. Apart from the international review programmes — IAEA's OSART missions and WANO's peer reviews — various countries have national or utility review programmes. The Agency has developed guidelines for assessment of national/corporate review systems, with the aim not only of guiding Agency review teams, but also of supporting countries/utilities setting up national peer review systems. One pilot assessment using these guidelines has been performed in the United Kingdom and a second pilot was carried out during April and May 2000 in France.

16. As part of the enhancement efforts for the operational safety services, the agency continues to review the adequacy of the information contained in the OSART guidance, with particular emphasis on the management of operational safety and safety culture. Also, to further the benefits to the Member States, the OSART service is continuing its efforts to integrate capabilities from the different operational safety services. For example, increased attention to reviewing the safety culture of an organization is facilitated by providing initial team training on the subject and by holding daily team review meetings during the mission to maintain focus on this important aspect of facility safety.

Peer Review of Operational Safety Performance Experience (PROSPER) Service

17. A new service — Peer Review of Operational Safety Performance Experience (PROSPER) — has been developed, taking account of the 1996 PPAS recommendation to include experience feedback in future developments of operational safety services and the results of an internal assessment of the effectiveness of the Assessment of Safety Significant Events Team (ASSET) process. The new service is aimed at assessing the effectiveness of a plant's total operating experience and corrective action programme. The core principles of ASSET event analysis and self-assessment methodology are maintained in the new service, but the scope has been expanded to include the use of all operational performance data that are part of the complete operating experience programmes now being used by most utilities and NPPs. The PROSPER service will continue to be based on an international peer review of a plant's self-assessment, and will be complemented by plant walkdowns and field observations to verify the effectiveness of the corrective action process.

18. Guidelines for the PROSPER service have been developed: these are currently in draft form and will be used in a pilot peer review mission to a nuclear power plant in the United Kingdom in September 2000.

PROSPER/ASSET missions

19. The first training seminar on the PROSPER process was conducted at Khmelnitsky, Ukraine, in June 2000. A workshop was held at KANUPP, Pakistan, during July 2000 on the PROSPER service, with special emphasis on the collection, trending and analysis of low level events and near misses.

PROSPER/ASSET-related Activities

20. Working Material on experience with analysis of precursors to operational events has been in development since 1997, and provides information on trending and analysis of low level operational

events considered as precursors to degraded safety performance. Further work in this area included a meeting on precursor case studies, to obtain available information, experiences, and good practices in studies of event precursors and to show the direct relation between prevention of low level events and prevention of significant events or severe accidents.

Management of Safety and Safety Culture

21. The management of safety and safety culture is an important focus area in the programme to develop the operational safety services. The development programme reflects an initiative launched as a result of requests by Member States for processes that corporate and plant management, as well as government and regulatory executives, could use in overseeing operational safety aspects of NPP management within the suite of all management process indicators.

22. At a Technical Committee Meeting in Quebec, Canada, in August 1999, 23 nuclear executives from 13 Member States gave their input as to what is necessary to successfully integrate and maintain the safety aspects of nuclear management within the suite of nuclear business processes. Material from this meeting and others described below is being compiled into guidance documents for corporate and senior governmental and regulatory management of the nuclear business.

23. Reflecting the interest of nuclear industry and governmental organizations in self-assessment processes, the IAEA has published a report (TECDOC-1125) that helps organizations provide a stronger focus on operational safety. This safety assessment enhancement also recognizes that the advocated processes and practices could be applied to the overall operating performance of nuclear power plants. This information is being used in Agency sponsored training, seminars and workshops, such as the workshop on self-assessment and peer review held in October 1999 at the Daya Bay NPP in China.

24. Further documents are being developed to provide guidance and/or information on a number of specific issues, including:

- management of organizational changes in nuclear utilities;
- techniques, processes and practices to build and maintain an outstanding operational safety management system;
- experiences and good practices in strengthening safety culture in maintenance, and their contribution to the development of safety culture in the NPP organization;
- the role of governments and regulatory bodies in promoting a sound safety culture in nuclear installations; and
- a compilation of safety culture self-assessment highlights and good national practices.

Safety Culture Services

25. The Agency's new programme of services, the Safety Culture Enhancement Programme (SCEP), has been developed to support Member States in their efforts to develop a sound safety culture of their organizations. The SCEP support to Eletronuclear, Brazil, has served as a basis for

the continued development of these services and, based on the experiences gained, guidance is being developed on how to implement a safety culture enhancement programme. A full scope SCEP includes a review of safety culture by an external Safety Culture Assessment Review Team (SCART). A Consultants' Meeting was held in November 1999 to review the strategies and methods to be used in SCART missions and to be presented in guidelines.

26. In May 2000, Mexico hosted a safety culture assistance visit that further developed their understanding of the Agency's ability to assist their NPP's corporate and operating organizations in improving safety culture.

Safety Culture Missions

27. In the last twelve months, seminars and workshops have been held in seven Member States — Bulgaria, China, Finland, Hungary, Mexico, Slovakia and Sweden — for representatives of nuclear power plants, regulators, regional co-operative organizations and research reactors.

Engineering Safety Review Services (ESRS)

28. The various services formerly rendered under the generic heading of Engineering Safety Review Services (ESRS) are now referred to by more specific titles, namely:

- the Design Safety Review Service (DSRS);
- the Seismic Safety Review Service (SSRS);
- the Fire Safety Review Service (FSRS);
- the Ageing Management Advisory Team (AMAT) service; and
- the Software Safety Review Service (SWSRS).

Documents on the organization and conduct of the seismic and software services have now been published in the IAEA Safety Services Series, completing the set of five documents covering all of the ESRS services.

Design Safety Review Service (DSRS)

29. Design Safety Review Services have gained momentum recently, both in relation to new designs and existing nuclear power plants. A number of projects are under way within which such reviews have been conducted: the following provides some highlights of this activity.

30. Under a TC project, the Preliminary Safety Analysis Report (PSAR) for the Bushehr NPP in Iran is being reviewed. This plant was originally designed by Siemens and partly constructed, but then suffered considerable damage as a result of an air raid during the Iran–Iraq war in the 1980s. A Russian contractor is now finishing the construction and installing a WWER-1000 reactor. The safety review of this design and construction is especially challenging because of these unique features. The part of the review related to seismic input and foundations was completed in late 1999. The review of the primary coolant system design was initiated in the beginning of this year. In

September 2000, a review team of fifteen international experts and Agency staff members is scheduled to visit Tehran and the NPP site to review several chapters of the PSAR.

31. Another major review effort (also through the TC programme) relates to the Korean Next Generation Reactor (KNGR). The design requirements for the next generation reactor developed by the Korean Institute for Nuclear Safety (KINS) were reviewed by a team of Agency staff members and international experts in April and May 2000. The first meeting (in Vienna) was preparatory and developed the review procedures. The main review (in Taejon, Republic of Korea) was conducted by a team of 15 specialists. A review of the KNGR design itself is currently scheduled for May 2001.

32. At the recent request of the Bulgarian regulatory body, the IAEA conducted a review of the design upgrades performed at units 5 and 6 of the Kozloduy NPP. The review team visited Kozloduy in July 2000.

33. At the request of the South African Ministry of Minerals and Energy, the Agency organized a review of the economic feasibility and the safety of the new Pebble Bed Modular Reactor (PBMR) developed by the South African utility ESKOM. The safety review took place in February 2000 in Centurion, South Africa. The review of this innovative design was made by a panel of six external experts with the participation of three staff members. The main issue was that the IAEA's safety standards do not explicitly address High Temperature Gas Reactor designs such as the PBMR, and so an approach to safe design was advocated. This approach was also discussed with the regulatory body.

34. As part of the extrabudgetary programme on nuclear safety in Asia (see Annex 3), review missions visited the Tianwan NPP in China in November 1999 to review four aspects of the design: safety systems; component integrity (including application of the leak before break concept); containment and accident management; and fuel safety. Also under this extrabudgetary programme, a mission visited China in November–December 1999 to review the design verification testing for the China Experimental Fast Reactor.

Seismic Safety Review Service (SSRS)

35. Seismic Safety Review Services have in recent years extended fom the traditional field of application of the seismic re-evaluation of existing NPPs to more general siting projects and to facilities other than NPPs. Moreover, such services have often been combined with general reviews of NPP siting in relation to all external events, where the correlation between seismic action and the other potential events had to be carefully reviewed in a global context of risk evaluation.

36. An extensive review of the seismic re-evaluation programme being implemented at Bohunice V1 NPP (Slovakia) was recently conducted. In addition to the review of the plant itself, this was also a 'model project' for similar WWER plants with similar requirements. A number of recommendations were made on the management of the programme (particularly the interfaces between tasks), and on the design and implementation of the upgrading of structures, mechanical components and electrical equipment according to the general safety criteria. A walkdown to review

the implemented tasks provided an opportunity for analysis of the general feasibility of such actions and for recommendations on the selection of technological solutions to seismic issues.

37. The seismic siting and design for a new research reactor at Maamora in Morocco were reviewed in two missions, which also addressed seismic classification, project QA and component testing. This project has also provided demonstrations of how Agency documents can be used as a basis for contracts, and of how the Agency's documents compare with national standards.

38. Another seismic safety mission visited Istanbul, Turkey, to conduct a follow-up of an earlier review mission to the TR-2 research reactor. A detailed review of the seismic classification of safety systems was carried out and the methodology for the evaluation of the seismic capacity was assessed.

39. A general review of siting issues, including the seismic issue, was carried out in Indonesia for the Muria site, as a follow-up to several task-oriented missions in the past. This more global review identified the areas in which additional investigations are needed and the approach to be used for data homogenization to guarantee consistent and reliable conclusions from the siting phase.

40. Under a TC project for the European region, a technical meeting was organized to study the details of the seismic qualification of systems and components in existing plants, based on the many reviews that have been carried out in eastern European plants. The participants analysed the main findings from such review missions and highlighted the key issues, providing guidelines for generic improvements to such techniques for future applications.

Fire Safety Review Service (FSRS)

41. An IAEA fire safety review mission visited the Chashma NPP (CNPP) at the request of the Pakistan Atomic Energy Commission (PAEC) in November 1999. The plant is a PWR designed by China and supplied under a turnkey contract between PAEC and the China Zhongyuan Engineering Corporation (CZEC). At the time of the review mission, the plant was in the commissioning phase and was awaiting initial core loading. An urgent request for further training was made in April 2000 following a fire at the plant in December 1999. The mission to provide this additional training was combined with a partial fire protection review of the plant, which found that the fire protection practices at the plant had improved significantly since the November 1999 mission.

Ageing Management Advisory Team (AMAT) Service

42. A mission to South Ukraine NPP in October 1999 addressed safety issues relating to WWER-1000 containments, including the loss of prestressing forces in the tendons which occurs with time.

43. An AMAT mission visited Karachi NPP, Pakistan, in November 1999, reviewed the current situation with regard to the management of physical ageing of the plant and provided advice on the establishment of a systematic ageing management programme.

44. A national workshop on periodic safety review (PSR) and ageing management on NPPs was held in the Republic of Korea in November 1999, to assist in a pilot project to apply PSR to the life extension/licence renewal for unit 1 of the Kori NPP. A regional workshop on regulatory requirements and practices for ageing management was held in Bratislava, Slovakia, in May 2000. The workshop included presentations and discussions on regulatory guidelines and related inspection and assessment practices in 13 Member States.

International Probabilistic Safety Assessments Review Team (IPSART) Service

45. The former IPERS (International Peer Review Service) for probabilistic safety assessments (PSAs) was renamed the International Probabilistic Safety Assessments Review Team (IPSART) service at the beginning of 2000 in order to include the primary subject matter of the service (PSA) more clearly in the name of the service.

Missions

46. Six IPERS/IPSART missions have been conducted in the past year. Reviews were conducted in September and October 1999 of the Level 1 shutdown PSAs for Paks NPP, Hungary, and Bohunice V2, Slovakia. Level 1 PSAs for South Ukraine NPP, Ukraine, and Ignalina NPP, Lithuania, were reviewed by IPSART missions in April and June 2000 respectively, and reviews of Level 1/2 PSAs for Krško NPP, Slovenia, and José Cabrera NPP, Spain, were made in March and April 2000.

47. A review of the preliminary Level 1 PSA for internal events was conducted during the expert missions to China in November 1999 to review selected solutions adopted for the AES-91 design with WWER-1000/428 reactors for the Tianwan NPP (carried out under the extrabudgetary programme on nuclear safety in Asia — see Annex 3).

48. General positive observations from the missions listed above included:

- The issues and questions raised by the IPERS/IPSART teams during the missions were generally effectively addressed by the PSA teams in the host countries, which indicates that the PSA teams have a thorough knowledge of PSA methods and techniques and have developed a detailed knowledge and understanding of the studies;
- Significant progress has been made in recent years in respect of the computer codes and scenarios used in the development of 'success criteria' (which describe the requirements for plant systems needed to respond to the transients and LOCAs considered in the PSA);
- The use of plant specific data base is increasing in most PSA studies. Considerable efforts have been devoted to identifying plant specific failure rates based on both the plant operating history and generic data; and
- For the PSAs for low power and shutdown operations, the development of detailed plant operational states represents the state-of-the-art methodology.

49. With regard to areas identified for improvement, the quality of the documentation continues to be an area of concern for a number of PSAs. Often, there is very little backup information, and no cross-referencing between the detailed plant information used in the model development and the PSA computer models. Also, for a number of the PSAs reviewed, the human reliability analyses were overly simplified, poorly documented, and contained many sources of potentially significant optimism, including no systematic examination and quantification of pre-initiator human errors (deficiencies in testing, maintenance, calibration, etc.). In a number of studies there was also insufficient treatment of possible dependencies between post-initiator operator actions. The review teams considered that the combined effect of these deficiencies may be a significant source of numerical optimism in the current PSA results.

Related Activities

50. A TECDOC on regulatory review of PSA Level 1, prepared jointly by the IAEA and OECD/NEA, was published in February 2000. The document is intended to provide guidance to regulatory bodies on how to review the PSA for a nuclear power plant to gain confidence that it has been carried out to an acceptable standard so that it can be used as a basis for risk informed decisions.

51. A European regional training course on advanced PSA modelling techniques was held in Madrid, Spain, in October–November 1999, with 25 participants from utilities, NPPs, regulatory bodies and support organizations in nine countries. The course laid special emphasis on those issues related to the more common deficiencies identified in IPERS/IPSART reviews, as well as issues of particular interest for PSA developments in the European region. Another European regional training course, on nuclear power plant safety assessment to assist decision makers, was held in Helsinki, Finland, in June 2000. As indicated in Annex 3, workshops on PSA-related issues were also held in China and Indonesia under the extrabudgetary programme on nuclear safety in Asia.

Integrated Safety Assessment of Research Reactors (INSARR) Service

52. As part of the Agency's continuing efforts to improve the integration and consistency of its safety review services, the methodology for INSARR missions has been modified to follow more closely the OSART methodology applied to NPPs. Increased emphasis is also being placed, both in review missions and in the safety standards and guidance for research reactors, on the adequacy of regulatory supervision of research reactors and associated facilities.

53. An INSARR mission visited the HOR research reactor at the University of Delft in the Netherlands in May 2000, following a pre-INSARR visit in February. The mission was conducted according to the new INSARR methodology derived from the OSART methodology. Other pre-INSARR missions visited the PRR-1 Triga reactor in the Philippines in January 2000 and the Maria research reactor in Poland in April 2000 (the INSARR mission to Poland is scheduled to begin in late September 2000).

Other Missions to Research Reactors

54. A mission visited Vinča, near Belgrade, Yugoslavia, in October 1999 to assist with the management of spent fuel from the research reactor on that site (this mission was funded by an extrabudgetary contribution from Italy). A fact-finding mission visited the research reactor at Kinshasa, Democratic Republic of the Congo, in November 1999. In each case, follow-up missions are planned to assist in addressing identified safety issues. Two expert missions visited the site at which a research reactor is under construction in Morocco: see para. 36 above. Two expert missions (April and August 2000), also visited the site at Dalat, Viet Nam, to conduct a seminar on research reactor safety and to assess the preparation of the safety analysis report. A safety mission and inspection was conducted at the IAN-R1 reactor in Colombia in May 2000. An expert mission visited the Puspati Triga Mark II reactor in Malaysia in June 2000 to advise on improvements to the safety analysis report.

55. The Agency has project and supply agreements in place for some 25 research reactors, and these agreements require, inter alia, that the States concerned apply the Agency's safety standards in connection with these reactors. The agreements also call for the Agency to determine that the safety measures are adequate. The Secretariat is reviewing these agreements with a view to enhancing its knowledge about the current safety operations and practices of these research reactors. Where necessary, the Secretariat will, in accordance with the terms of the relevant agreement, arrange safety missions to assist and advise on safety measures.

56. As indicated in Annex 3, a number of training events relating to various aspects of the safety of research reactors in Asia have been organized as part of the extrabudgetary programme on nuclear safety in the region.

International Regulatory Review Team (IRRT) Service

57. The purpose of the IRRT service is to review the effectiveness of the relevant regulatory bodies and to exchange information and experience in predetermined areas, such as: legislative and governmental responsibilities; authority, responsibilities and functions of the regulatory body; organization of the regulatory body; the authorization process; review and assessment; inspection and enforcement; development of regulations and guides; emergency preparedness; radioactive waste management and decommissioning; radiation protection; and transport safety. The report prepared by the team contains specific recommendations to the Government or the regulatory body which will enhance regulatory effectiveness.

58. Since the last session of the General Conference, IRRT missions have visited the Slovenian Nuclear Safety Administration (November–December 1999), the State Office for Nuclear Safety of the Czech Republic (February 2000), the Finnish Radiation and Nuclear Safety Authority (March 2000) and the Hungarian Atomic Energy Authority (May–June 2000). An expert mission, using the IRRT guidelines, visited Malaysia in November 1999 to review the legal and governmental infrastructure for nuclear safety. A preparatory meeting has held in November 1999 for an IRRT mission to China, which is scheduled for October 2000. There has been increasing demand for

services in this area in recent years, and several IRRT missions have been requested by Member States for 2001.

59. Many of the recommendations for improvement made during the IRRT missions are specific to the particular national circumstances. However, some issues of more general interest were raised, such as:

- the need for legislation to provide clear definition of the roles and responsibilities of all governmental bodies involved in the regulatory process, and to give the bodies the appropriate authority to meet these responsibilities;
- the need to ensure that the resources allocated to the regulatory body are adequate for it to function effectively;
- the importance of effective co-ordination between different regulatory bodies responsible for different aspects of a facility or activity.

Related activities

60. As part of the extrabudgetary programme on nuclear safety in Asia (see Annex 3), a training workshop was held in Indonesia in June 2000 on regulatory inspection and enforcement.

61. A training video has been prepared, intended for the technical staff of national regulatory bodies, outlining the new Safety Requirements on legal and governmental infrastructure for safety, including the role and responsibilities of the regulatory body within that infrastructure.

Safety Review Services on Radioactive Waste Management

62. Two expert review teams visited the Angra NPP site in Brazil to provide advice: the first in November–December 1999, on the licensing of a bituminzation plant at Angra-2; and the second, in May 2000, on the safety of the cementation and storage of waste from Angra-1.

63. A WATRP (Waste Management Assessment and Technical Review Programme) mission to Budapest, Hungary, in November 1999 included an international peer review of safety issues in the selection and investigation of a site at Üveghuta for the disposal of low and intermediate level waste.

Radiological Assessments

64. In recent years, the Agency has carried out several radiological assessments of sites affected by residual radioactive material from accidents, from past waste management practices and from past nuclear explosions.

65. One of these was a preliminary assessment, carried out at the request of the Government of Kazakhstan, of radiological conditions at the Semipalatinsk test site. Recent developments in relation to Semipalatinsk are described in Part I of the main text. As indicated in Part I, the Agency has developed a proposal for a comprehensive radiological assessment of the Semipalatinsk test site but, to date, no source of funding for conducting such an assessment has been found.

66. At the request of the Government of Gabon, an Agency mission in September 1999 carried out a preliminary environmental assessment of the Mounana uranium mining area. The mission team made recommendations on the remediation of areas containing tailings and of water supplies that could be affected by these tailings, and on programmes to monitor radioactive and chemical pollutants in the environment, especially in potential sources of drinking water.

67. In November 1998, the Board of Governors approved, as part of the Agency's TC Programme, a project entitled "Radiological assessment of nuclear test sites in Algeria". In November 1999, an international team of experts convened by the Agency carried out a preliminary radiological assessment of the test sites near Reggane and In-Ekker and an experimental test site in the Adrar Tikertine area. A preliminary assessment report is being prepared and will be submitted to the Government of Algeria for consideration.

68. An IAEA fact-finding mission visited Tajikistan in December 1999 to make a preliminary assessment of the radiological situation in the country. The mission focused particularly on evaluating the situation in relation to the safety and security of radiation sources, the existing regulatory system of control, and the radioactive residues from the extensive uranium ore mining and processing activities that took place in the country.